A daily perspective on work interruptions

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Abstract

This dissertation is based on one theoretical paper and two empirical studies.

The theoretical paper: A theoretical framework is proposed that explores the accumulation of work interruptions and their effects. Most research studies have dealt with interruptions as isolated phenomena, leaving the simultaneous or sequential occurrence of interruptions common to everyday life unaccounted for. This gap will be filled by this thesis and insight into the process of the accumulation of interruptions will be provided by mapping deep-level regulations onto the observable sequence of actions. Further, it will be explained how the accumulation of interruptions leads to qualitatively different effects because of the interaction and joint development of isolated effects, identifying some mediating and moderating factors. In doing so, the relationships between the effects of single interruptions found in laboratory studies and the impacts on health and well-being of multiple interruptions found in applied research will be disclosed.

Study 1: This study investigates how interruptions affect perceptions of performance and irritation by employing a within-person approach. It is proposed that the occurrence of interruptions is negatively related to satisfaction with one's own performance and positively related to forgetting of intentions and the experience of irritation. Mental demands and time pressure are proposed as mediators. Data were gathered from 133 nurses in German hospitals by means of a 5-day diary study. Multilevel analyses supported the proposed main effects. The proposed mediation effects of mental demands and time pressure were found for irritation and (partially) for satisfaction with performance. They were not supported for the forgetting of intentions. These findings demonstrate the importance of reducing the time and mental demands associated with interruptions.

Study 2: In this study, the within-person relationships between workday "cognitive" stressors (multitasking demands and workflow interruptions) and strain (mood throughout the day and irritation in the evening) was examined. It was hypothesized that chronological age and indicators of functional age (working memory capacity and alertness) would moderate these relationships, in that older employees with low alertness and working memory abilities would suffer most from the stressors. A 5-day diary study (cf. study 1) and one survey (age) and computer-based cognitive performance test before the diary survey were conducted. Multilevel analyses showed that multitasking and workflow interruptions have detrimental effects on mood (valence and calmness) and irritation. No main effect was found on energetic arousal. The three-way interactions did not show the predicted pattern. Basic cognitive abilities (working memory ability and alertness) do make a difference to coping with stressors for younger employees but not for their older colleagues. According to the findings older employees seem to have abilities to deal with the stressors that outweigh possible cognitive losses.

Overall, it can be concluded that there is general support for those parts of the theoretical framework that were tested. It is possible to generalise and transfer results of laboratory research to the field, but specifics of the field need to be considered. The proposed mediation effect (study 1) was (partially) found, but the results show that the whole working day needs to be examined and that specific outcomes (forgetting of intentions) need more specific mediators. Further, the results of study 2 support the proposition that cognitive capacity is an important resource to deal with interruptions, although in the field setting other resources also play a role.

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I appreciate that XXX and XXX have agreed to review this thesis.

Table of contents

List of tables

List of figures

Chapter 1:

Introduction

How many time were you interrupted today, by a call, someone knocking on the door or an incoming e-mail? How many interruptions do you expect within a day? What effect will they have on your well-being, your performance and the strain you feel? And why? Which resources might help to deal with the demands posed by interruptions? Questions like these shall be answered in this dissertation.

Work interruptions are a typical stressor of modern working life. According to a representative German survey among employees, work interruptions are the fourth most common and second most demanding stressor at work, with 44 % of participants reporting a frequent occurrence of this stressor and 26% reporting feeling strained by interruptions (BAuA, 2012). In a representative European survey across 34 countries, 33% of the respondents reported that work interruptions happen 'very' or 'fairly' often and that 52% find them disruptive (Eurofound, 2012).

Thus, reducing interruptions at work as well as learning more about successful coping strategies for this type of demand is important for improving working conditions and preventing stress. In order to establish practical guidelines, an in-depth knowledge of the effects and processes of interruptions is needed. Previous research has provided good insights into the process of isolated interruptions in laboratory settings (e.g. Altmann & Trafton, 2002; Bailey & Konstan, 2006; Carton & Aiello, 2009; Eyrolle & Cellier, 2000) and about the general long term effects of the task characteristic work interruptions (in cross sectional field studies; e.g. Grebner et al., 2003; Lühring & Seibel, 1981; Wülser, 2006). Further, action regulation theory is able to explain why work interruptions act as a stressor in the action regulation process (Hacker, 2005). The majority of field studies to date have either been

cross-sectional or have provided descriptive figures from observations, and findings from the laboratory cannot be easily transferred to the real life context. Thus, current knowledge seems insufficient to answer the introductory questions posed about the daily process of interruptions at work.

This dissertation provides a first step in closing this gap. To this end, an integrative framework theory will be developed, providing propositions about the effects of accumulating interruptions above one work day or week. The daily process of the work characteristic interruptions is further investigated in a diary study which examines mediating and moderating effects within the relationship between work interruptions and the increase of strain and the decline of performance. Within this dissertation, using both the theoretical and the empirical part, the following questions shall be answered:

(1) How do multiple interruptions affect the workflow, performance, well-being and strain of employees over time?
(2) Why do interruptions have an impact on strain and performance?
(3) Do older workers, as compared to younger workers, have more problems in dealing with interruptions and multitasking demands?

By answering these questions, this dissertation makes the following contributions to interruption research: First, it offers an explanation of the process of interruptions within the work day or week, combining the results of laboratory and field studies. Thus, it helps to understand why interruptions -which lead in laboratory studies to short term effects like time loss, errors and negative emotions (e.g. Bailey & Konstan, 2006; Eyrolle & Cellier, 2000; Trafton, Altmann, Brock, & Mintz, 2003) - are associated with long term effects like irritation, depression or psychosomatic complaints (e.g. Grebner et al., 2003; Lühring & Seibel, 1981; Wülser, 2006). Further, it provides the first evidence of whether laboratory results in relation to interruptions can be transferred to real daily work life.

The dissertation is divided into six chapters. In the first chapter a concise overview of the current state of the art will be provided, starting with the definition of interruptions. Based on that, a theoretical framework of accumulating interruptions is described in chapter 2. In chapter 3, the methodological and contextual frame of two subsequent empirical studies will be outlined. In chapter 4, a study dealing with mediating effects of workload and mental demands, linking daily interruptions with irritation and satisfaction with performance, will be presented. A second study, which is presented in chapter 5, seeks evidence of age-effects as potentially moderating relationships of interruption, as well as multitasking-demands, and mood, as well as irritation. Chapter 6 provides a general discussion, integrating the results of the two empirical studies with the theoretical models and propositions.

1.1 Definition of interruptions

Interruptions can be defined as temporary suspensions of goal-directed action by a secondary, unplanned task (Brixey et al., 2007). The interrupted individuals are pulled out of their action and diverted from the actual goal (Frese & Zapf, 1994).

The focus of this dissertation will be on interruptions which are externally initiated. Internally initiated interruptions of a primary task differ from externally initiated interruptions because they can probably be anticipated and are self-initiated (Jett & George, 2003). The time point of their appearance can be controlled by the person themselves (in most cases) and will be set at a convenient point of time. Consequently it loses much of its disturbing character. Internally initiated interruptions can be (hidden) breaks, a conscious choice of (singular) task switching (because the person does not want to continue with the primary tasks for several possible reasons) or multitasking. Breaks have been defined as a resource which helps people to maintain optimal mental and physical performance (cf. Hobfoll, 1989; Jett & George, 2003; Sonnentag & Zijlstra, 2006) and task switching or multitasking can be employed as work strategies (König, Bühner, & Mürling, 2005). Consequently, including inter-

nal interruptions in this dissertation would result in a very diverse concept, making it difficult to study. To avoid this, the focus of this dissertation shall be on external work interruptions alone.

For the same reason, the focus of this dissertation will be on interruptions that lead to secondary tasks and not on pure distractions. An example of distractions is when a loud conversation in the neighbouring office catches the attention of the employee (Jett & George, 2003). Interruptions caused by secondary tasks (e. g. an incoming call or someone knocking at the door) when compared with distractions put different demands on cognitive processes such as the attention. Distractions are typically a) very short events which automatically catch the attention of a person (e. g. a sudden loud noise or people laughing in the neighbour office) or they are b) longer events, which call for active inhibition (e. g. construction noise). Following a taxonomy that has been developed within the framework of action regulation theory, these phenomena can be classified into different categories. Hacker (2005) differs between the stressors (called regulation problems) regulation obstacles, regulation uncertainty and overtaxing regulations (cf. chapter 1.2.2). Regulation obstacles are divided into interruptions and regulation difficulties (Frese & Zapf, 1994; Hacker, 2005). According to this taxonomy, longer lasting distractions do not belong to interruptions but to regulation difficulties (Hacker, 2005). They are external demands which do not interrupt the accomplishment of the task completely but they hamper it (Frese & Zapf, 1994). In any case, distractions do not provide a new (or conflicting) goal, that needs to be accomplished and they likely strain the inhibitory system more than the memory or task switching ability as interruptions by secondary tasks usually do (cf. chapter 2 and 5).

This diversity within the concept of interruptions, combined with the fact that interruptions with internal origins and distractions are not directly observable in every case, makes them hard to study. Therefore the reflections of this dissertation will be limited to interrup-

tions with an external origin and concentrate on interruptions that imply "things to do" (labelled 'interrupting tasks').

1.2 A brief outline of the existing research of interruptions

Interruptions have mainly been investigated from two independent perspectives. Laboratory studies have examined single interruptions as isolated phenomena, basically focussing on cognitive and emotional processes of single interruptions and their effects on attention and memory. On the contrary, in field studies, interruptions were measured and observed within the work context, usually following a between-subject approach. They sought to understand the impact of the work characteristic interruption on well-being and strain. In the following section, both perspectives will be presented.

1.2.1 The process of one single, isolated interruption

Cognitive and neuropsychological researchers have formulated theories on the processes that occur during the course of a single interruption – specifically, the mental processes which take place when interruptions occur, unfold and (after they) have ended. There is research evidence on many areas related to interruptions, such as the capacity limit of the memory (e.g. Broadbent, 1958; Cowan, 2001), the processes of task switching (e.g. Monsell, 2003) and attention and memory resources (e.g. Pashler, 1994; Repovš & Baddeley, 2006), all of which have been examined in laboratory studies. Based on this existing knowledge, theories of interruption processes have been developed and tested in further laboratory studies. These theories are based on a common understanding of the interruption cycle.

1.2.1.1 The interruption cycle

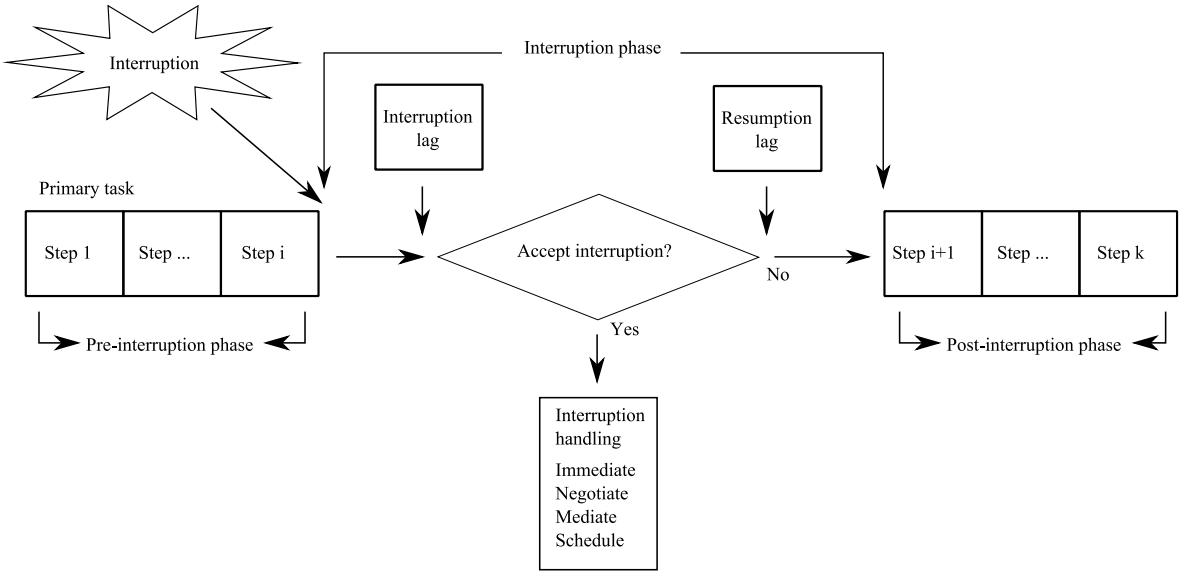

Figure 1.1. The interruption cycle (Brixey et. al, 2007, p. E39).

Figure 1.1 provides an overview of the core processes involved in an interruption event (cf., Brixey et al., 2007). Brixey et al. (2007) describe the process as follows: The pre-interruption phase is the time segment before an interruption has happened. Step i is the phase in the primary task in which the interruption is perceived. After that, the interruption lag starts (Altmann & Trafton, 2002). In this phase a decision is made as to whether, and if so when, the interruption is handled. If the interruption is accepted, several kinds of reactions will be possible. The interruption may be handled immediately (immediate), after a delay (schedule/ negotiate) or the interruption task may be delegated to somebody else (mediate) (Brixey et al., 2007). After the interruption task has been performed (or delegated) the primary task is resumed, which takes some additional time. This time lag is called resumption lag (Brixey et al., 2007). After this, the person can go back and finish the primary task. This model of Brixey et al. (2007) provides a dissection of the important time intervals of an interruption, which helps to provide an initial understanding of the serial process of an interruption. Besides identifying possible decisions, however, it reveals little about the mental processes

involved, an issue that will be addressed again in chapter 2. One attempt to describe involved mental processes is provided by the goal-activation model (Altmann & Trafton, 2002).

1.2.1.2 The goal activation theory

The main idea of the goal activation model is that interruptions lead to a distraction from the primary task's goal. A goal is "a mental representation of an intention to accomplish a task" (Altmann & Trafton, 2002, p. 39). To carry out a task, its goal needs to be activated. It is stated that the goal with the *highest* activation directs behaviour (Monk, Boehm-Davis & Trafton, 2004). If the goal of a task is not retrieved for more than two seconds (caused by a break or an interruption), it is assumed that the activation level of that goal will decrease (cf. Einstein, McDaniel, Williford, Pagan, & Dismukes, 2003). Thereby the target may dip below the 'interference level' - the activation of the most active distractor (Altmann & Trafton, 2002). If an interruption occurs, the activation level of the primary goal will consequently decrease and at the same time the new goal posed by the distractor will increase to a level which enables the interruption task to be accomplished (Altmann & Trafton, 2002). When the interruption task is finished the primary goal can be retrieved. Figure 1.2 depicts the proposed process.

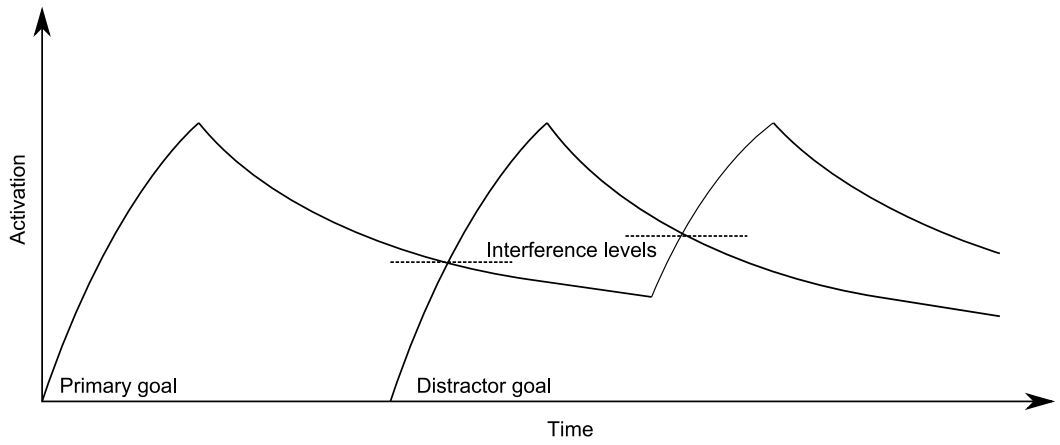

Figure 1.2. The goal activation model (Altman & Trafton, 2002, p. 48).

According to the goal activation theory, the *re*activation of the primary goal happens during the resumption lag (Altman & Trafton, 2002). The length of the resumption lag depends on the time the primary goal needs to rise above the activation of the distractor goal (Altmann & Trafton, 2002). Possibilities to reduce this time loss are explained in chapter 2.2.3. The time loss caused by interruptions is one of the main effects of interruptions, which were found in laboratory studies.

1.2.1.3 Effects of single interruptions

Several laboratory studies have provided evidence that interruptions can lead to a longer processing time of the primary and the interruption task (Bailey & Konstan, 2006; Cellier & Eyrolle, 1992; Eyrolle & Cellier, 2000; Trafton et al., 2003) and to more errors in both tasks (Cellier & Eyrolle, 1992; Eyrolle & Cellier, 2000). Bailey and Konstan (2006), as well as Zijlstra, Roe, Leonova, and Krediet (1999), report an increasing rate of anger and anxiety in the case of interruptions. Further, an increase in perceived frustration, time pressure, effort and stress levels as consequences of interruptions have all been reported (Carton & Aiello, 2009; Mark, Gudith, & Klocke, 2008).

A host of laboratory studies has aimed to find influencing factors of these relationships. For instance, the *complexity of the primary task* has been proved to moderate performance in the interruption situation (Speier, Vessey & Valacich, 2003), such that interruptions of simple tasks led to an increase, and interruptions of complex tasks to a decrease, in performance. Speier et al. (2003) argue that the subject perceives simple and monotonous tasks as ‚too easy', and therefore does not dedicate her or his full attention to them. Interruptions are assumed to increase the complexity of a task and consequently the subjects dedicate their full attention to the task (cf., Zijlstra et al., 1999). The more complex the primary task is, the more disruptive (more errors, longer resumption lags and higher values of anxiety and annoyance) the interruptions are (Bailey & Konstan, 2006; Monk et al., 2004). Further, laboratory studies

came to the conclusion that the *complexity of the interruption task* has an impact on the relationship between interruptions and time loss. Complex interruption tasks cause more time loss than non-demanding interruptions because they demand the working memory so much that it is not possible to keep the primary goal activated (Cades, Werner, Trafton, Boehm-Davis, & Monk, 2008; Monk et al., 2004). Other relevant influencing factors (found in laboratory studies) were the number of interruptions (with more interruptions causing longer processing time of the primary task; Eyrolle & Cellier, 2000), the delay of the accomplishment of the primary task (subjects finished the primary task faster and more accurately in the interruption lag condition than in the immediate response condition; Trafton et al., 2003) and the anticipation of interruptions (the anticipation condition led to a better performance of the primary task; Carton & Aiello, 2009; Ho, Nikolic, Waters, & Sarter, 2004).

Laboratory research has tried to explain the effects of single interruptions by analysing characteristics of the interruption situation (e.g. complexity of the primary and interruption task; Cades et al., 2008; Zijlstra et al., 1999) and by considering their effects on attention and working memory (cf. goal activation theory; Altmann & Trafton, 2002). Action theory integrates interruptions in a broader context. It considers the process of work action and integrates work interruptions into the dynamics of demands (or regulation requirements), stressors and resources at work (Frese & Zapf, 1994; Hacker, 2005). Hence, Action theory can be regarded as a bridge between experimental laboratory studies and the applied context.

1.2.2 Action theory: Work interruptions as a task characteristic

Action theory (Frese & Zapf, 1994; Hacker, 2005) provides a broad approach to the understanding of goal-oriented behaviours in the work context. The theory provides a useful framework for the study of interruptions. In this chapter I will first shortly introduce the basic assumptions of action theory and continue with the specific propositions of this theory about

work interruptions. Based on that, I will describe the results of field studies according to the effects of the task characteristic work interruptions.

1.2.2.1 Action process and regulation levels

Within the framework of action regulation theory, actions are defined as goal-oriented behaviour organized as a cyclic process (Hacker, 2005): Before an action can start, a goal must be set. A planning phase follows, information must be gathered (called 'orientation'), possible action plans will be developed ('plan/strategy generation') and the most appropriate one must be chosen ('decision'). Once a decision for an action plan is made, the task is executed. During and after the execution phase the achievement of the goal is monitored ('feedback') (Hacker, 2005).

According to Hacker (2005), every goal can be divided into sub-goals and this can be perpetuated for sub-goals (e.g. goal 'writing an e-mail' and sub-goal 'opening the mail program'). 'Sub actions' tend to be more stereotyped and automatic than actions. An action needs either more or less mental resources depending on task complexity and variety. Hacker (2005) distinguishes three levels of *mental regulation*: The 'sensorimotor level' is automatic, stereotyped and unconscious (e.g. typing an A). At the 'level of flexible action patterns', actions are already organized in schemas, they just have to be adjusted to the situation (e.g. writing an acceptance letter). The 'intellectual level' is the highest level and it describes a complex action which requires an analysis of the situation (e.g. writing a review). It is stated, that different actions require different levels of regulation (Hacker, 2005).

Based on this knowledge, action theory is able to explain the different impact of work interruptions in different phases of work action by describing interruptions as regulation obstacles.

1.2.2.2 Interruptions as regulation obstacles

Action theory not only makes statements about the action itself, the theory is also applicable to work behaviour in a broader sense. The accomplishment of an action is inter alia affected by types of stressors called *regulation obstacles* (Hacker, 2005). Regulation obstacles are defined as events or conditions which require additional effort or risky behaviour to achieve a goal (Oesterreich, Leitner, & Resch, 2000). Interruptions are categorized as regulation obstacles (Frese & Zapf, 1994). The interrupted person is pulled out of their action and diverted from the actual goal (Frese & Zapf, 1994). The person reacts to the interruption and returns to the actual task. It can be assumed, that both the interruption task and resumption of the actual task cost additional effort. The resumption costs possibly become higher with more resources needed in the last step of the primary action. Consequently, it can be assumed that the effort of resumption depends on the regulation level and action phase of the last step of the primary task. Hence, probably also important is when the interruption takes place. For example, an interruption at the planning phase of a complex action (intellectual level) could entail greater effort to resume the task than an interruption at the execution phase of an automated movement (sensorimotor level). The resumption of the first process step of a complex task presumably needs the reconstruction of several threads (cf. Altmann & Trafton, 2002; Hacker, 2005), whereas the resumption of a simple movement does not require a recollection of former steps. In addition to internal resources, external resources can also help to deal with regulation problems. A central external resource is control (also called ‘Handlungsspielraum’ or latitude) and a central internal resource is expertise (Frese & Zapf, 1994).

Action theory puts the concept of interruptions in a broader context and explains the impact of the timing of an interruption as well as the internal and external resources on the costs of interruptions.

1.2.2.3 Effects of work interruptions

Based on action theory, field studies have been accomplished to test effects of the task characteristic work interruptions, which are supposed to occur after a longer exposure to the stressor work interruptions. When employees are usually exposed to a high level of interruptions at work, they report higher levels of strain and health problems. Grebner et al. (2003) report a significant relationship between work interruptions and psychosomatic complaints in a sample of call-centre-employees. Furthermore, a negative relationship with mental health was found in a cross-sectional study of 348 male workers (Lühring & Seibel, 1981). In a sample of 1,234 Swiss teachers, work interruptions correlated significantly with emotional exhaustion (Wülser, 2006) and in a sample of 414 physicians a positive relationship with depression was reported (Rout, Cooper, & Rout, 1996). Moreover, work interruptions have been reported to have a significant relationship with irritation (Grebner et al., 2003; Konradt, Hertel, & Schmook, 2003), a state of mental impairment caused by goal discrepancies, including cognitive (rumination) and emotional components (e.g. reacting grumpily; cf. Mohr, Müller, Rigotti, Aycan, & Tschan, 2006). It was also found that work interruptions correlate negatively with job satisfaction (Rout et al., 1996). Hence, interruptions are related to long term consequences like the experience of strain and health problems. All of these relationships likely occur due to a prolonged exposure to stressors at work. Unfortunately, all these results are based on cross-sectional studies. The use of longitudinal studies in future investigations would be beneficial, as a condition for causal attributions.

1.2.3 The integration of both research perspectives: what we know and what we don't know

Laboratory research is able to explain the process of single, isolated interruptions and the impact of several characteristics of the interruption (i.e. Brixey et al., 2007; Carton & Aiello, 2009; Speier et al., 2003). Further, models have been developed on cognitive processes within

the interruption cycle (Altmann & Trafton, 2002). On the other hand, action theory helps to set interruptions in the context of work (Hacker, 2005). Work interruptions are classified as the task characteristic regulation obstacle, and it is explained, why they act as a stressor (Hacker, 2005).

Interruptions have been examined from a micro perspective (in seconds or even milli-seconds, e.g. the resumption lag and the activation of goals) and a macro perspective (in years; the task characteristic work interruptions and its impact on health). What is left is a meso perspective explaining the time period in between. To date, the knowledge about daily or weekly effects of work interruptions has been very limited. There have been observation studies on the occurrence of work interruptions (mostly in the health sector), but these are often descriptive (Biron, Loiselle & Lavoie-Tremblay, 2009; Weigl, Müller, Zupanc, & Angerer, 2009) and count the frequency and source of interruptions. Some found first evidence of positive relationships between interruptions and errors or the experience of workload (Scott-Cawiezell et al., 2007; Weigl, Müller, Vincent, Angerer, & Sevdalis, 2011; Westbrook, Woods, Rob, Dunsmuir & Day, 2010), but these studies usually examined just one day per person and thus between person effects, which can also be explained by other (more stable) conditions associated with interruptions (e.g. number of patients per nurse). To the author's knowledge, there have not been any diary studies examining within-subject effects in real work setting, dealing with interruptions, and their potential effects. Thus, further research is needed which tests whether the laboratory results of the process of interruptions can be transferred to the ecological context. Moreover, the process and effects of the *accumulation* of work interruptions, the way interruptions appear in every day work life, over the course of a single work day (or week) is still unknown.

Examining the process of interruptions within a work day (or week) is needed in order to understand, why interruptions -which lead in laboratory studies to short term effects like time

loss, errors and negative emotions- are associated with long term effects like depression or psychosomatic complaints. Examining the process during one or more days should aid linking the results of laboratory and field studies. Furthermore, advanced knowledge about the daily process and effects of interruptions will help to better understand the risks and may lead to evidence-based practical recommendations.

To get an insight into the daily effects of work interruptions, diary studies are a convenient option.

1.3 Advantages and necessity of diary studies when studying work interruptions

"Diaries are a method to collect data at the daily level or even several times a day" (Ohly, Sonnentag, Niessen, & Zapf, 2010, p. 79). Participants have to fill out one or several questionnaires a day above a series of days or weeks (Ohly et al., 2010). The unit of analysis is usually not individual variation but timely variation (but both can be analysed by diary studies). Diary studies allow the examination of constructs which are not stable over time (i.e. those which fluctuate or depend upon situational conditions) (Ohly et al., 2010). Short term dynamics can be analysed.

Work interruptions are such a fluctuating construct. There are days in which more interruptions happen and days in which fewer interruptions occur (cf. chapter 4.2.3 and 5.2.3). Furthermore, interruptions do vary between subjects (e.g. secretaries presumably have to deal with more interruptions than researchers). Thus, they are also a task characteristic of certain job/ position within a certain company (Hacker, 2005). In diary studies both dimensions can be examined, within-subject differences and between-subject differences.

The advantage of diary studies in comparison with cross-sectional or longitudinal (with months or years between two surveys) studies is that diary methods can be used to examine the accumulating process, mediating, as well as moderating variables of short-term effects

(e.g. performance, short-term indicators of stain) caused by work interruptions. We can get insight into the process of interruptions within a day and the knowledge of daily effects of interruptions facilitates the explanation of long-term effects of (the task characteristic) interruptions. Furthermore, assumptions of laboratory researchers can be examined in real work settings, the natural setting of interruptions (cf. Ebner-Priemer & Kubiak, 2007). In the words of Bolger, Davis, and Rafaeli (2003) "life [can be captured] as it is lived" (p.597), work interruptions are examined as they occur. However, not only can daily changes in (the number of) interruptions and their effects be examined, but also the moderating effect of between-subject variables like personality traits, abilities and general working conditions/job characteristics.

Finally, diary studies are able to add to the knowledge on intermediate processes and effects of work interruptions in their natural setting. Thus, diary studies will facilitate bridging the gap between the findings of laboratory studies of interruptions and the results of (cross-sectional) field studies of the task characteristic work interruptions.

Before describing the outline of the dissertation, a concept will be introduced which is similar to work interruptions as far as cognitive demands are concerned. It has been found that work interruptions cause task switching, a shift of attention and a change of goals in the working memory (Altmann & Trafton, 2002; Salvucci, Monk, & Trafton, 2009). According to König et al. (2005), these are typical multitasking demands. As multitasking can be described as a situation in which multiple task goals are accomplished in "the same general period by engaging in frequent switches between individual tasks" (Delbridge, 2000, p. 1; cf. König et al., 2005), it is striking to note that as soon as several interruptions appear in a short time, a similar condition could develop. Moreover, Kirmeyer (1988) found, that police radio dispatchers, who were exposed to frequent work interruptions during the day, tended to use multitasking as one strategy to cope with that demand. Since there seem to be a conjecture

between these two concepts (for a more detailed comparison, see chapter 5.1), a short introduction about the research conducted on this concept is now provided.

1.4 Excursus: The related concept multitasking

Multitasking has been examined from three different perspectives: a differential perspective, a neurological one and a cognitive one. In a differential approach cognitive abilities were tested, which are associated with the accomplishment of multitasking tasks. Within this stream of research it was found that "working memory was the most important predictor [for multitasking performance] in addition to attention and fluid intelligence" (Bühner, König, Pick & Krumm, 2006; König et al., 2005, p. 243). Personality constructs like polychronicity ("a preference for doing several tasks simultaneously"; König et al., 2005, p. 246) and extraversion showed no significant relationship with multitasking performance (cf. Baethge & Rigotti, 2010). In the neurological approach, researchers tried to find neurological structures which are important for solving multitasking tasks. The most important areas which were found to be involved in multitasking are the dorsolateral prefrontal cortex (choosing of response options) and the anterior cingulate cortex (error detection and conflict monitoring); both are part of the prefrontal cortex (Conway, Kane, & Engle, 2003; D'Esposito et al., 1995; Dreher & Grafman, 2003). Further, assumptions are made about a possible involvement of the cerebellum (Bellebaum & Daum, 2007). The third approach encompass cognitive theories explaining multitasking. The most prominent theory is 'threaded cognition' of Salvucci and Taatgen (2008). This theory is based on the bottleneck approach and proposes that "multitasking behaviour can be represented as the execution of multiple task threads, coordinated by a serial cognitive processor and distributed across multiple processing resources" (Salvucci & Taatgen, 2008, p. 102). The serial cognitive processor (a central processing unit) distributes tasks to several (e.g. perceptual or motor) resources which can act in parallel (Salvucci & Taatgen, 2008). According to this theory, it is possible to walk and to watch your step at the

same time, but it is not possible to focus your attention to two different tasks at the same time (cf. Baethge & Rigotti, 2010; Salvucci & Taatgen, 2008).

Finally, previous research has primarily examined what is needed to multitask and how multitasking is done. Multitasking as a task characteristic or work place stressor has not been in the main focus of multitasking research. Two exceptions are the studies of Madjar and Shalley (2008) and Zimber et al. (2010). In the laboratory study of Madjar and Shalley (2008) 224 students had to solve three business tasks with one multitasking (rotation) condition and one sequential condition. Students of the multitasking conditions showed greater creativity in the multitasking conditions, if they had high polychronicity values. Zimber et al. (2010) conducted an explorative study on multitasking at work. In interviews with 21 secretaries, it was found that the secretaries perceive multitasking partly as challenge and partly as hindrance stressor; they reported preferring conducting a combination of two tasks at lower regulation levels (not the intellectual level) (cf. Hacker, 2005; Zimber et al., 2010). Observations of 10 civil servants showed that 26 % of their working time was spent engaged in multitasking - considerably less than estimated by the subjects (60%) (Zimber et al., 2010). These studies have not tested the (daily) effects of the stressor multitasking at work in field settings so far. To understand whether multitasking at work is stressful an accordant study is needed. One of the empirical studies presented in this volume will therefore include multitasking demands besides interruptions.

1.5 Main research questions of this dissertation

So far, the importance of considering the daily effects of work interruptions has been highlighted. But before they can be examined in diary studies, a comprehensive theory about the processes within a day (or week) is needed. To that end, a theoretical framework is presented in chapter 2 that explores the accumulation of work interruptions and their effects within work days or weeks. The framework discloses the relationships between the effects of

single interruptions found in laboratory studies (worse performance) and the impacts on health and well-being of multiple interruptions found in applied research. A theoretical framework will be developed, including propositions to shed light on the question:

(1) How do multiple interruptions affect the workflow, performance, well-being and strain of employees over time (a work day or week)?

Based on this theoretical framework, two empirical studies on daily work interruptions have been conducted and will be presented in chapters 4 and 5. But prior to these, the contextual background of these studies (the broader research project) will briefly be outlined as well as some underlying methodological details (in chapter 3).

The first study I will present examines daily effects of interruptions on strain and performance and seeks to answer the question (chapter 4):

(2) Why do interruptions have an impact on strain and performance?

Laboratory studies and goal activation theory highlight the importance of cognitive processes in the accomplishment of work interruptions, interruptions task the attention and memory (Altmann & Trafton, 2003; König et al., 2005; Monk et al., 2004). Further, most of these studies discuss time loss (a prolonged resumption lag) as one of the main issues of interruptions and task switching (Altmann & Trafton, 2007; Hodgetts & Jones, 2006; Monsell, 2003). The first study shall examine whether these explanations of detrimental effects of interruptions in laboratory settings can be transferred into the workplace setting. The potential mediating role of time pressure and mental demands linking interruptions and its effects will be tested.

Finally the second study deals with the question (chapter 5):

(3) Do older workers, as compared to younger workers, have more problems in dealing with interruptions and multitasking demands?

According to the review of Hedden and Gabrieli (2004), the working memory and attention abilities decline over the life span. As these abilities have been shown to be important for performance in multitasking situations, older employees should experience more strain when confronted with cognitively demanding conditions such as work interruptions and multitasking. This assumption will be tested employing a three-wave interaction between interruptions and multitasking demands on the one hand, and calendar age, as well as cognitive abilities as an indicator of functional age, on the other.

In chapter 6 a final discussion is presented about the extent to which these questions are able to be answered by the present studies. Conclusions including practical implications, as well as an outlook for future research, will be presented.

Chapter 2:

Just more of the same or different? An integrative theoretical framework for the study of accumulating interruptions at work[1]

Abstract

We propose a theoretical framework that explores the accumulation of work interruptions and their effects. Most research studies have dealt with interruptions as isolated phenomena, leaving the simultaneous or sequential occurrence of interruptions common in everyday life as unaccounted for. We fill this gap and provide insight into the process of the accumulation of interruptions by mapping deep-level regulations onto the observable sequence of actions. Further, we explain how the accumulation of interruptions leads to qualitatively different effects because of the interaction and joint development of isolated effects, identifying some mediating and moderating factors. In doing so, we disclose the relationships between the effects of single interruptions found in laboratory studies and the impacts on health and well-being of multiple interruptions found in applied research.

[1] This framework is currently submitted for publication in a peer-reviewed journal. The paper was written by Anja Baethge (first author) and co-authored by Robert A. Roe and Thomas Rigotti.

2.1 Introduction

Do you expect to read this paper without interruptions? How many times will you be interrupted? By what or by whom? How will these interruptions affect you and your task performance? Will these interruptions affect your performance of later tasks or your mood? Questions like these will be the topic of discussion in this paper.

Interruptions at work are a part of people's daily experience in many work environments. Nearly one-third (28%) of respondents to the third European Survey on Living and Working Conditions, conducted across 15 European countries, indicated that they were interrupted several times a day "in order to take on an unforeseen task" (Paoli & Merllié, 2005, p. 86). A German survey of 20 thousand employees showed that the rate of interruptions has doubled in the last 20 years and has become one of the main stress factors in working life (BIBB-BAuA Erwerbstätigenerhebung, 2006). Because interruptions cannot be completely avoided contemporary working life, it is important to understand the origins, processes, and consequences of interruptions in real work settings. More than 2 decades of research has provided important insight into the nature and effects of interruptions (Altmann & Trafton, 2002; Einstein et al., 2003; Zijlstra et al., 1999). For instance, it has been shown that interruptions are related to consequences such as forgetting intentions, quantitative and qualitative deterioration of performance, and time loss and strain (Bailey & Konstan, 2006; Einstein et al., 2003; Grebner et al., 2003). In some work settings, interruptions have been found to pose a risk for enhancing the likelihood of errors in very sensitive areas such as medication administration in hospitals or air-traffic control (Balas, Scott, & Rogers, 2004; Biron et al., 2009; Carlton & Blegen, 2006; Ho et al., 2004). Furthermore, in cross-sectional studies, researchers have observed positive relationships between work interruptions and depression, psychosomatic complaints and burnout among different occupational groups (Grebner et al., 2003; Rout et al., 1996; Wülser, 2006). Although interruptions may, under certain conditions, have positive

effects (Zijlstra et al., 1999), most existing research suggests that interruptions have harmful impacts on performance and well-being.

To date, most research studies have dealt with interruptions as isolated phenomena, leaving unaccounted for the simultaneous or sequential occurrence of interruptions typical of individuals' work life in almost any occupation. Thus, the evidence regarding interruptions is fragmentary and incomplete. We do not know how multiple interruptions affect the workflow and performance of people over time or how they influence people's well-being and health. This is an undesirable situation, because, without a proper understanding of interruptions, we may not be able to take effective measures against their harmful effects, and given the nature of the modern workplace the rate at which interruptions occur may continue to grow.

The aim of this paper is to integrate the current literature and to derive propositions on the effects of accumulating interruptions in real work contexts. We will develop a theoretical framework that aggregates and extends present knowledge (of laboratory research) on the process and effects of single and isolated interruptions and establishes new angles for applied research in the work context. The framework covers knowledge on (a) single, isolated interruptions and multiple, combined interruptions; (b) interruptions in lab and real-life settings; (c) features of interrupting tasks, including complexity (simple, complex) and time demand (frequency, duration); and (d) the surface- and deep-level aspects of interruptions. Meanwhile, the framework also serves as the basis for specific research models that allow for the study of (a) implications of accumulating interruptions for task performance and well-being; (b) agency, i.e., how people respond to and handle interruptions; and (c) changes over time.

Our integrative framework permits us to explain what can be expected when the single effects of interruptions accumulate. We argue that this is not just a matter of an additive increase, but that it entails a qualitative change in effects that cannot be observed in laboratory

studies. Second, we point to feedback loops and interactions among the consequences of accumulating interruptions, with single effects influencing and amplifying each other. This leads us to formulate new propositions that allow us to translate the effects of single interruptions (results of laboratory studies) into effects of long-term exposure to work interruptions as they occur in the work setting (results of field studies).

Besides arguing for qualitative and quantitative shifts in effects when moving from the laboratory to the field, we suggest that the underlying cognitive mechanisms differ, and that successful coping with multiple interruptions requires different strategies as compared with single, isolated interruptions. By doing this, we aim to advance interruption research and to enhance its ecological validity by examining interruptions in the contexts in which they appear in everyday work life.

2.2 Definition of Interruption

An interruption can be defined as a temporary suspension of a person's goal-directed action (Brixey et al., 2007, p. E30). Being interrupted means that the person stops the execution of an action before a chosen goal or sub-goal (task goals are typically broken down into sub-goals that can be executed successively or at separate time intervals) is reached, with the intention of resuming the action at a later point in time (cf. Altmann & Trafton, 2002). Thus, the activity is postponed but not ended, which implies that there is no "closure" and that the mental resources required by the activity remain activated (cf. Altmann & Trafton, 2002; Zeigarnik, 1927). In this respect, interruptions are different from voluntary breaks, which occur after (sub)actions are closed and mental resources have been released.

Interruptions can have many different origins, loosely categorized as external or internal. External interruptions comprise "calls" by clients, colleagues, superiors or others, whether orally, by telephone, e-mail, or other means; changing conditions, such as the malfunction or

status change of a machine, computer, vehicle; and ambient changes related to light or weather. Thus, the interruptions are unintended and uncontrolled. Many of these conditions force or affect a change of activity—that is, to perform another task and to give it priority over a current task. Internal origins, on the other hand, are a person's own thoughts (e.g., plans, inventions, worries), emotional states (e.g., happiness, anxiety), or physical needs (e.g., eating, drinking, urinating, changing clothes). Internal interruptions are diverse in that they may be produced intentionally or unintentionally and can be controlled or uncontrolled. This diversity, combined with the fact that interruptions with internal origins are not directly observable, makes them difficult to study. We therefore limit our study to interruptions with an external origin and concentrate on interruptions that imply "things to do" (labelled 'interrupting tasks'), although we will also consider "forced breaks".

Halting a continuous action does not mean that no further activity occurs. On the contrary, by their very nature, interruptions free up resources for other activities related to the newly presented tasks. What makes the study of interruptions worthwhile is not only the suspension of the ongoing (primary) task but also the shift to the other (interrupting, secondary) task and the resumption of the primary task after the secondary task has been completed (or rejected). This can, to some degree, be studied by observing a person's activity. However, to describe and understand what happens when people are interrupted and how this affects their performance and well-being, a conceptual framework is required that covers the mental processes involved in producing and regulating task activities. An important contribution to such a framework has been provided by action regulation theory (Frese & Zapf, 1994; Hacker, 2003, 2005), which we will discuss below. It allows a detailed description of how the interruption is handled on a cognitive level, how a new action plan for the interrupting task is generated, how this plan is executed while the existing action plan is kept activated in

memory, and how cognitive resources are released and activated as the person switches between tasks.

In the next section, we describe the cognitive processes involved in single interruptions. Then we develop ideas about what happens when interruptions accumulate and how we define such accumulation.

2.3 Anatomy of single interruptions

What happens when people are interrupted can be described at two levels—a "surface" level of observable activities and a "deep" level of underlying cognitive, emotional and energetic processes. We describe both levels and discuss the links between them, which leads to an integrated and new representation of the interruption process.

2.3.1 Surface level

Interruption researchers have typically taken an observer's perspective and tried to understand interruptions from observed changes in activities at the surface level (Brixey et al., 2007; Trafton et al., 2003). This has led them to divide the time interval around interruptions into different phases and to make inferences about underlying processes from the measured duration of these phases. A common distinction in this approach is between the pre-interruption phase during which the primary task is carried out, the interruption phase during which the person perceives and responds to the interruption, and the post-interruption phase during which the primary task is resumed and brought to an end. The interruption phase has been subdivided in a number of different ways. For instance, Zijlstra et al. (1999) have distinguished between episodes related to interruption reception and execution, interruption completion, changeover from the interrupting task to the main task, and resumption of the main task. More recently, Brixey et al. (2007) referred to an interruption lag (a period from the perception of the interruption to the acceptance of the interrupting task), acceptance of the interruption, interruption handling (following one of several strategies) and resumption lag.

These distinctions are somewhat arbitrary and unsatisfactory because the deep-level processes they refer to cannot be mapped onto observable activities in a one-to-one manner (Hacker, 2005). We therefore first analyse interruptions from the perspective of the mental processes involved in goal-directed action, and then propose a more fine-grained distinction of processes that may be useful in observational research.

2.3.2 Deep level

Action regulation theory (ART) is a psychological theory that explains how people carry out goal-directed action, which has been developed and extensively tested in Europe (Bergman & Richter, 1994; Frese & Zapf, 1994; Hacker, 2003, 2005, 2009; Richter et al., 2000). The theory posits that goal-directed actions are driven by mental representations of goals and action plans, and that, to carry out an action, the person must set an appropriate goal (subjective task) that is oriented to the work situation, develop or recall an action plan and execute the plan while monitoring progress and outcomes. An important tenet of this self-regulation theory is that increasing familiarity with the task changes the mental representations and the way these translate into actions (routinisation, automation). It distinguishes three modes of execution called "regulation levels", which involve different types of mental representations and differ in cognitive demands: automatic (stereotyped and unconscious actions, e.g., typing an A), associational (actions are already organized in schemas; they just have to be adjusted to the situation, e.g., writing an acceptance letter) and intellectual (a complex action that requires an analysis of the situation, e.g., writing a review). The theory sheds light on performance effectiveness as well as consequences for the person performing the tasks. It explains how "regulation hindrances" (among them, work interruptions) act as stressors (Greiner, Ragland, Krause, Syme, & Fisher, 1997) and how control over the work allows maintenance of a balance between performance and well-being. It also emphasizes the importance of "action efficiency", the ratio of achievement to required mental resources

(Zijlstra, Cavalini, Wiethoff, & Meijman, 1990). A final concept in ART is that of "action strategy", which refers to a deliberately chosen variant of an action plan by which the person seeks an optimal balance between the demands of the task and the constraints of the task setting on the one hand and his or her personal resources and psycho-physiological state on the other hand (Hockey, 1997; Meijman & Mulder, 1998). Strategies point at the phenomenon of human agency. People are not a passive "playing field for variables". They are aware of what happens in their work and act when too many interruptions occur, using specific strategies that allow them to "do the best possible" under varying conditions.

From the perspective of ART, there is no essential difference between the primary task and the interrupting task. Both require redefining an objective task into a subjective task, orienting to the task situation, preparing or selecting an action plan, and executing the plan at an appropriate regulation level, while monitoring its progress and results. The only difference is that the execution of the primary task is already ongoing when the interrupting task presents itself. Thus, the person must attend to the interrupting event, recognize the objective task inherent in it, define a subjective task, prioritize and schedule the old and the new task, switch over from the old to the new task at some point, prepare for and finally execute it. After this, the individual must switch back to the old task, prepare for its resumption and continue executing it from an appropriate point in time, as well as find the suitable regulation level. There are also emotional and motivational dimensions to this. The interruption of the ongoing action poses a hindrance that is likely to create irritation or anger; motivationally, the person must stay committed to the first task goal while getting motivated to carry out the second task goal.

2.3.3 An integrative framework of the interruption process

Below, we elaborate on the consequences of this pattern of mental activities. In doing so, we extend the "surface level" phases distinguished in observational research (cf. Brixey et al.,

2007) to "deep level" phases. The result is presented in Figure 2.1 and helps in gaining a deeper understanding of how interruptions unfold.

The figure shows that the processes involved in handling interruptions, even if it is a single, isolated interruption, are rather complex. There are two parts which are assumed to fulfil a key role in this process: the interruption lag and the resumption lag (Altmann & Trafton, 2002). The proposed model shows that the interruption lag comprises perception and interpretation of the interrupting event, the definition of the interrupting task, prioritizing and scheduling, task-switching and preparing for the execution of the interrupting task. After this, the interrupting task is executed and completed. What follows is a resumption lag, which includes task-switching (back to the primary task) and preparation for the execution of the primary task (Figure 2.1). The resumption of the primary task is often described as one of the main costs of interruptions (Altmann & Trafton, 2007; Bailey & Konstan, 2006; Cades et al., 2008), since it calls for additional effort and time (ART: Hacker, 2005). The degree to which this is the case depends on the amount of information that must be retrieved and the (memory) effort that is needed to do that; both factors depend on the way in which the person makes use of the interruption lag (cf. goal-activation theory, Altmann & Trafton, 2002).

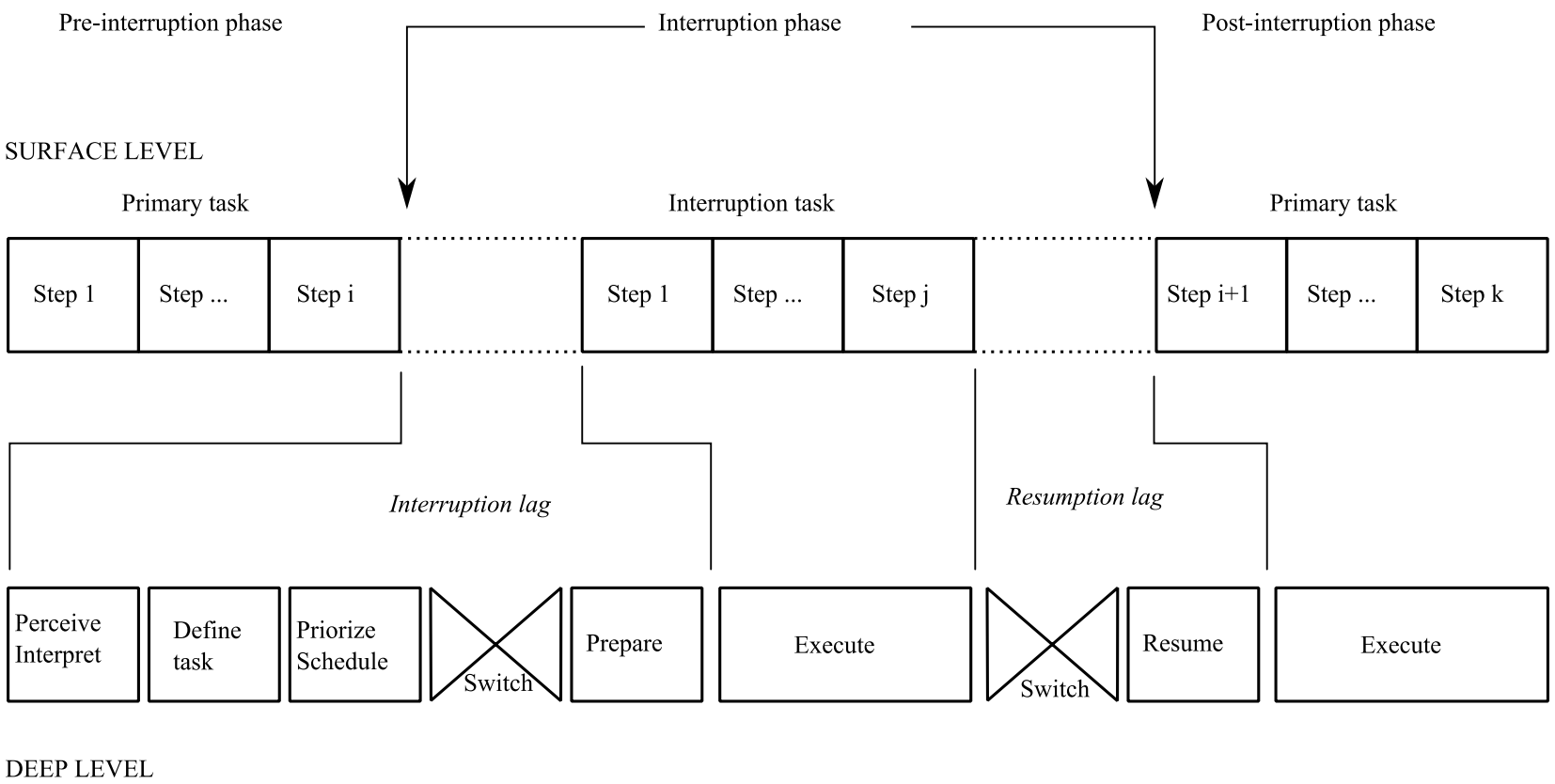

Figure 2.1. The phases of interruptions.

The amount of information to be retrieved is determined by the complexity of the primary task. If a person is interrupted during the writing of an article, the resumption will take longer than if the person was interrupted in sorting papers. Speier, Valacich, and Vessey (1999) found that interruptions of complex decision tasks (in which several calculations have to be made and a vast amount of information kept in mind) led to worse decisions than interruptions of simple tasks (short and routine additions or subtractions). This difference can be explained with the help of ART (Hacker, 2005). Complex tasks have a higher level of regulation (in the above examples, intellectual level versus rule-based level), which imply a greater use of resources—that is, they pose a greater demand on the working memory. Here are more regulations to be carried out, and the action plans are more complex. If such tasks, with more extensive action plans, have to be resumed, more effort and time are needed.

The memory-related effort needed to retrieve information on the primary task depends on the degree of distraction, which can be defined with reference to the time lag of the interruption and the working memory demand of the interruption. According to goal activation theory (Altmann & Trafton, 2002), a long time lag encourages forgetting. While this can be prevented by rehearsal, further resources are needed. Monk et al. (2004) found that interruptions by tasks led to longer resumption lags than interruptions by forced breaks. This is because breaks can be used to think about the primary task—to keep it in mind—and to reduce the resumption lag. Cades et al. (2008) suggested that the activation of primary tasks can also take place during simple non-demanding interruption tasks. They showed that less complex interruption tasks (choice of the higher of two 2-digit numbers) led to lower resumption lags than more complex interruption tasks (aforementioned complex-decision tasks plus further calculations and decisions).

Thus, the complexity of the primary and the interruption task determine the effort required for the resumption of the primary task. This can be kept low by a strategic use of the interrup-

tion lag (Altmann & Trafton, 2002). One possible strategy is to "strengthen . . . memory for the resumption point" (Boehm-Davis & Remington, 2009, p. 1125) by making notes about the steps to be taken when resuming the primary task. Alternatively, the interruption may be ignored, or the interrupting task may be delegated (i.e., transferred to another person). This will keep the time lag of the interruption short. Another option is to reduce the amount of knowledge to be recalled to re-activate the primary task (Boehm-Davis & Remington, 2009). This can be achieved by using the interruption lag to finish a subtask of the primary task. However, all this must be decided in the prioritization phase (Figure 2.1).

Interruptions and their potential impact can best be studied by simultaneously looking at surface-level and deep-level events. This is particularly true when the work setting provides many different interruptions. In the following section, we develop propositions on the consequences of this accumulation of interruptions.

2.4 Accumulating interruptions and their effects

While studies have offered useful analyses of isolated interruptions, we believe that they do not sufficiently develop an understanding of the accumulating interruptions that are typical in real work settings. During a person's work day, multiple qualitatively different interruptions may occur, producing different outcomes. Furthermore, we believe that the process of dealing with interruptions becomes much more complex and cognitively demanding as more interruptions happen. Thus, the effects of isolated interruptions found in laboratory research cannot be simply generalized to effects that occur during the working day.

At the surface level, accumulating interruptions are visible as a complex pattern of sequential episodes in which steps of primary tasks and interrupting tasks are alternating. At the deep level, this implies elevated demands on memory, attention and action regulation, as compared with situations with no or just a few interruptions. For instance, if just one single

interruption happens, the scheduling task is limited to deciding whether the interruption task should be performed now or later. If several interruptions happen during a day in which a person is working on several tasks, the scheduling task will be more demanding and involve a higher cognitive load. The sequence of cognitive processes involved in shifting from one task to another will also be more complex. In the same way, the interruption process changes when interruptions accumulate, and their effects are likely to change as well. To gain a better understanding of this, we should consider a longer period than has typically been used in past research and look at the occurrence of accumulating interruptions during the timeframe of a workday or several workdays.

Accumulating interruptions are the growing number of sequential interruptions occurring during a certain time interval (e.g., one working day). To assess their effect, we need to consider the number of interruptions during that interval and the magnitude of the interruptions in terms of their time and cognitive demands. The time demand is defined by the frequency and length of the interruptions, and can be equated to the amount of time lost by interruptions. This is the quantitative aspect of accumulating interruptions, whereas the cognitive demand can be regarded as the qualitative aspect. The cognitive demand depends on the complexity (cf. working memory demand) of the interruption and the primary task (see Figure 2.1 and "deep level"). The complexity of the primary task determines the amount of information to be retrieved after the interruption is finished and thus the duration of the resumption (Altmann & Trafton, 2002; Monk et al., 2004). The complexity of the interrupting task determines the level of distraction of attention away from the primary task (Speier et al., 1999) and the magnitude of the additional demand (e.g., additional tasks that increase workload) needed. The cognitive demand indicates how much attentional or memory resources are claimed. Therefore, the effect of accumulating interruptions can be conceived as the interaction of time

(frequency and length) and the cognitive (complexity of the primary and interruption task) demand of interruptions, with the highest expected effect when both factors are high.

We should make clear that we do not conceive of "accumulating interruptions" as a variable, ranging from few to many interruptions one after another. Because the number and type of interruptions to which people are exposed varies with occupation and work setting (consider, e.g., dispatchers, sales people, nurses, train drivers), we rather think of "interruptions profiles" that contain several serial and nested occurrences of interruptions. We use accumulation as a generic term referring more loosely to the prolonged exposure to profiles with multiple interruptions over time, where the profiles can differ.

The profile of interruptions seems to matter for the effects emerging from accumulating interruptions across occupations and settings. For example, in work settings such as hospital nursing, dozens of interruptions occur every day, yet the level of complexity of the interrupting tasks varies; meanwhile, in settings such as factory work, interrupting tasks are of a similar complexity, but the numbers vary per day. In this paper and at the actual stage of research, we cannot go into detail on such workplace-specific differences and refer to every imaginable pattern of interruption. This forces us to start discussing accumulating interruptions in a generic way, assuming that there are several dissimilar interruptions in a day over a series of multiple workdays. We will discuss a "prototypical process" of accumulating interruptions, consider different impacts of interruptions and develop propositions as to what to expect when interruptions accumulate. Adapting our ideas on specific occupations or work settings with specific interruption patterns will be the topic of future research.

Starting from the effects that have been described in laboratory and simulation studies (lower boxes, Figure 2.2), we will discuss the qualitative shift that can be expected when interruptions accumulate over time and their effects unfold. As depicted in Figure 2.2, we will present a set of propositions that includes an expected shift from time loss to time pressure,

from energetic costs to workload and need for recovery, from errors to failure, from emotional states to emotional strain, and from Zeigarnik-effects to rumination.

Particularly interesting and potentially worrisome are certain effects on strain—and hence on performance—that emerge as the consequences of several interruptions interact over time (thick upward arrow, Figure 2.2). At the end of this section, we discuss how these effects may combine in a downward spiral and consider possible buffering mechanisms (downward arrow on the right side, Figure 2.2).

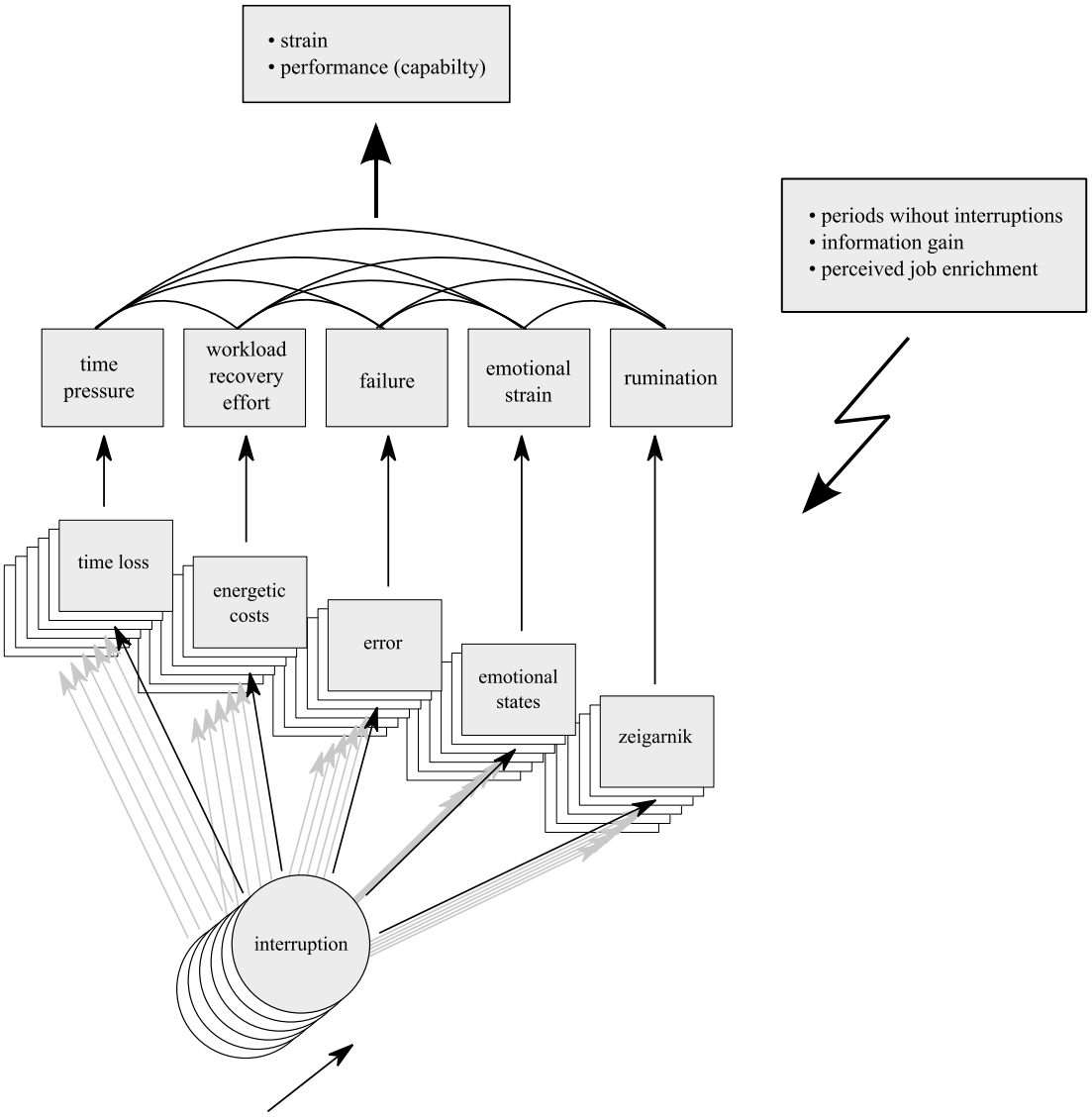

Figure 2.2. Accumulating interruptions.

2.4.1 Change of effects: From isolated to accumulated interruptions

2.4.1.1 Loss of time: Time pressure

An obvious consequence of being interrupted is that it takes more time to complete the work. Studies of isolated interruptions have shown that interruptions cause loss of time (Cellier & Eyrolle, 1992; Hodgetts & Jones, 2006; Monk et al., 2004; Zijlstra et al., 1999). It has been found that interruptions lead to more use of time in the accomplishment of both the interrupting and the interrupted tasks (Bailey & Konstan, 2006; Cellier & Eyrolle, 1992), which can be attributed to additional prioritizing, scheduling and task switching (Figure 2.1). The amount of time loss noted in laboratory research on single interruptions is small and does not allow us to make inferences about the time that is lost when people are repeatedly interrupted in their everyday work.

When looking at the issue of time loss from a wider timeframe, (i.e., a workday, or even a workweek), it is important to note that considerable time may be involved in carrying out the interrupting tasks themselves. Such additional tasks are often not a part of the planned schedule of the day (Claessens, Van Eerde, Rutte, & Roe, 2010). As a consequence, a greater amount of work (more tasks) must be done. When more interruptions occur during a working day, both kinds of time loss (attributed to additional tasks and to being interrupted) will likely increase. The magnitude of time loss will depend on the number and complexity of interruptions, as well as on the degree of nesting. When interruptions are nested, (i.e., an interrupting task interrupted by another task), the time loss will likely increase more because of the additional cognitive (scheduling and memory) demands.

We can assume that as interruptions accumulate, time loss will increase, resulting in time pressure. In a simulation study, subjects reported more time pressure when they were interrupted approximately ten times during mail editing tasks (25 minutes) than when they were not interrupted (Mark et al., 2008). A diary study of 133 nurses showed that during days with

more work interruptions than usual, the perceived time pressure was higher (Baethge & Rigotti, 2013a). Time pressure is a state of elevated arousal and activation, associated with the perception that time available is insufficient to complete one's tasks (cf. Zapf, 1993). It is an important effect of interruptions, because continuing time pressure can result in stress and a decline of productivity over the workday or work week (Kühnel, Sonnentag, & Bledow, 2012; Sonnentag, 2001). Our first proposition reads as follows.

Proposition 1: Accumulating interruptions lead to increasing time pressure.

2.4.1.2 Energetic costs: Challenge vs. hindrance stressor

Previous studies have found that interruptions cause higher workload (Mark et al., 2008; Weigl et al., 2011; Zohar, 1999). As explained above, this may be attributed to task switching, processing large amounts of information, increasing load on working memory (cf. "deep level") or the larger amount of work to be done. Generally speaking, interruptions force the regulation level upward (ART: Hacker, 2005), because a person who is interrupted during an automated routine needs to find a suitable point in the action plan at which the action could be resumed, either in terms of a well-known, if-then rule (rule-based) or a renewed plan (knowledge-based). That means that the interrupted person needs to stop the automated action and either find a proper stopping point (and later a point to resume), or decide whether to delay or ignore the interruption. This implies a rise in cognitive demands. Apart from the situation in which the person was performing a simple and monotonous task, the elevated workload calls for the mobilization of additional ("compensatory") effort, which allows accomplishing the (primary and interrupted) task in the same or *less* time (Hockey, 1997; Mark et al., 2008; Zijlstra et al., 1999). Interrupted persons may work faster (Mark et al., 2008; Zijlstra et al., 1999), which can make them report more mental workload, time pressure and frustration and a higher stress-level (Mark et al., 2008; Zohar, 1999). Hence, it seems that interruptions act as a challenge stressor (i.e., the stressor is manageable up to a certain degree only)

(Widmer, Semmer, Kälin, Jacobshagen, & Meier, 2012). Performance increases at the expense of effort and the experience of strain (Widmer et al., 2012).

Mobilizing additional effort cannot continue indefinitely. According to the compensatory control model, performance can "be protected under stress by the recruitment of further resources, but only at the expense of . . . behavioural and physiological costs" (Hockey, 1997, p. 73). Resources will ultimately be depleted, and the person will become exhausted and need recovery to restore his or her resources (Sonnentag & Zijlstra, 2006). If recovery is not possible, prolonged expenditure of effort will ultimately lead to overstrain, which means that the person will no longer be able to cope with the higher workload. This is important in situations in which interruptions keep accumulating—typically, situations characterized by multiple tasks and tight deadlines, which offer little opportunity for recovery.

Recovery normally occurs in rest breaks—that is, when people are temporarily relieved from work demands and have time to replenish their resources (Sonnentag & Zijlstra, 2006). However, situations with accumulating interruptions accompanied by elevated workload and time pressure typically offer limited opportunity for such breaks. Because of prolonged demands and little opportunity for recovery, they harbour the risk of causing chronic fatigue and stress, which could be exacerbated over time. Thus, in contrast to occasional interruptions, accumulating interruptions may result in the depletion of resources and thus the reduced ability to cope with demands, meaning that interruptions become a hindrance stressor rather than a challenge stressor.

Proposition 2: Accumulating interruptions lead to (a) increasing workload, (b) a greater expenditure of effort, and (c) a greater need for recovery.

2.4.1.3 Errors: Failure

Several observational and laboratory studies have found that interruptions are associated with an increased risk of errors in both the interrupting and the interrupted tasks (Bailey & Konstan, 2006; Biron et al., 2009; Westbrook et al., 2010). This finding can be explained by the additional cognitive demands of interruptions (cf. Figure 2.1 and "deep level").

One would expect that accumulating interruptions lead to greater numbers of and more severe errors because of the greater number of disrupting and distracting events and the abovementioned depletion of resources. Moreover, lack of resources and increasing stress produced by ongoing interruptions can lead to the use of risky strategies (Frese & Zapf, 1994), which can, in turn, increase the likelihood of further errors. Once errors occur they require a response. For instance, particular actions may have to be repeated, or undesirable outcomes may have to be corrected. This does not only produce further time loss (Brodbeck, Zapf, Prümper & Frese, 1993), but can also evoke negative emotions (Rybowiak, Garst, Frese, & Batinic, 1999). Over the course of a day or longer, we assume these effects to contribute to the subjective perception of personal failure. Failure has been defined as "the condition or fact of not achieving the desired end or ends" (Mifflin, 2002, p. 486; Boss & Sims Jr., 2008).

Proposition 3: Accumulating interruptions increase the probability of error and subsequent failure.

2.4.1.4 Emotional states: Emotional strain

Interruptions typically evoke emotional responses, both because of the semantic content of the interrupting events (e.g., good or bad news, illegitimate additional task) and the frustration caused by disruption of the ongoing action. Research suggests that negative responses prevail and are related to performance problems, high work pressure, and hindrances to a smooth

workflow. According to (laboratory) studies of isolated interruptions, typical emotional responses are anger, anxiety and feeling frustrated (Bailey & Konstan, 2006; Mark et al., 2008; Zijlstra et al., 1999).

Accumulating interruptions are likely to produce more severe and longer lasting emotional reactions, which may become detached from the interrupting events. That is, people may not be angry because of one specific interruption, but because they remain emotionally aroused. Repeated interruptions may, in other words, trigger an emotion episode (Frijda, 1993; Weiss & Cropanzano, 1996), a state of continuous emotional engagement with a heightened level of arousal and attention. During emotion episodes, even small events "take on increased . . . emotional significance" and may make the person overreact (Weiss & Cropanzano, 1996, p. 41). Beyond this, concerns about one's performance and its effects on others and about the impact on one's self-image may cause additional anxiety. Hence, we propose, that accumulating interruptions can bring a person into a state in which every additional stressor (large or small, interruption or otherwise) is experienced as a burden and contributes to the emergence of emotional strain.

Another theoretical angle is offered by the "incentive-disengagement-cycle" (Klinger, 1975). According to this theory, emotional strain is a state of losing the incentive to achieve a certain goal (Mohr et al., 2006). People become irritated by not being able to achieve anticipated goals. There are several sources providing empirical evidence for such effects. Cross-sectional studies showed a positive relationship between work interruptions and both emotional exhaustion and (emotional) irritation (Grebner et al., 2003; Wülser, 2006). Rigotti, Baethge, and Freude (2012) did a diary study in a sample of nurses and reported a positive relationship between the amount of interruptions during a morning shift and emotional irritation in the evening.

It is not only the accumulation of negative feelings that may lead to emotional strain—and in the long run to emotional exhaustion—but also the higher workload caused by the accumulating interruptions. A meta-analysis conducted by Lee and Ashforth (1993) found a positive relationship between workload and emotional exhaustion. Hence, we postulate that the accumulation of interruptions can cause emotional strain via the accumulation of negative emotions and increased workloads.

Proposition 4: Accumulating interruptions lead to emotional strain. This effect is mediated by (a) negative emotional states and (b) increased workload.

2.4.1.5 The Zeigarnik effect: Rumination

Zeigarnik (1927) found that interrupted and unfinished tasks were remembered better than finished tasks. This also applies to tasks that have been accomplished at a lower level of quality than aimed for. The assumed reason for these effects was that the intention (or need) to finish the task could not be met (Zeigarnik, 1927). The interruption is unwelcome and causes negative emotions and the experience of stress (Bailey & Konstan, 2006; Mark et al., 2008; Zeigarnik, 1927). "Stress has to do with the thwarting of goals" (Semmer, 1996, p. 85). The closer one gets to the target, the bigger the intent to finish the task (Conlon & Garland, 1993; Zeigarnik, 1927) and the more disturbing an interruption.

Single interruptions as studied in laboratory studies will probably not cause appreciable negative effects because the accomplishment of the task is delayed by some minutes at most. However, real life interruptions will cause longer delays and have the potential to jeopardize the aimed-for task accomplishment, particularly when accumulating. A possible consequence is rumination about tasks that cannot be finished. Rumination is "a class of conscious thoughts that revolve around a common instrumental theme and that recur in the absence of immediate environmental demands requiring the thoughts" (Martin & Tesser, 1996, p. 7).

Rumination can amplify negative emotions (Lyubomirsky & Nolen-Hoeksema, 1993) and can lead to cognitive interference (Dobson, 2000). It diverts attention from the actual task and increases the likelihood of distraction (Eysenck & Eysenck, 1985). It consumes cognitive resources that are needed to solve tasks and reduces performance (Bruch, Kaflowitz, & Kuethe, 1986; Day, Sibley, Scott, Tallon & Ackroyd-Stolarz, 2009; Glass et al., 1995), which can, in turn, lead to further rumination. We propose that accumulating interruptions not only cause instantaneous memory effects, but can lead to rumination and associated negative (emotional and cognitive) effects.

Proposition 5: Accumulating interruptions lead to an increase in rumination.

2.4.2 Joint effects

We have addressed effects known to be associated with isolated interruptions and discussed how they might develop as interruptions accumulate. In this section, we describe what happens when these effects interact.

2.4.2.1 Risk of a downward spiral: Strain

Although the effects of single interruptions have mostly been studied in isolation, we must consider the possibility that they interact and amplify each other. For instance, errors and failures call for corrective action, which poses an additional workload and takes additional time (Brodbeck et al., 1993). Growing workload and increasing time pressure raise the probability of error and failure (Elfering, Semmer & Grebner, 2006) and can produce negative emotions or emotional exhaustion (Barling & Macintyre, 1993). Such effects can enhance rumination (worries), which distracts attention from the work, and so on. Given such interactions, we do not expect a linear increase in the effects. In the following, we focus on two outcomes of work, (i.e., strain and performance), which seem to be influenced differentially by chains of effects such as those just mentioned.

Previous studies of interruptions suggest that strain and task performance, although related, develop differently over time. Zijlstra et al. (1999) showed that the time spent on the primary task (and the interruption task) decreased in the course of three interruptions (with a steeper decrease in the beginning and a weaker decrease in the end). At the same time, subjective effort increased, and mood and well-being decreased (Zijlstra et al., 1999). Mark et al. (2008) replicated these findings. These results are in line with the compensatory control model of Hockey (1997), which posited that, when confronted with rising demands, people initially try to maintain their performance by investing more effort. This can even lead to short-term overcompensation (Zijlstra et al., 1999) and performance increase. However, when confronted with a greater number of interruptions over a longer period (the study by Zijlstra et al. involved skilled secretaries who had to deal with three interruptions within one hour), a performance decline may be expected—that is, effort may continue to increase, resources may become depleted, and a need for recovery may be triggered. Indirect evidence comes from the study by Altmann and Trafton (2007), who interrupted people up to 12 times in the middle of a complex computer game and found a depletion effect between three 20-minutes blocks. In the last two blocks, participants needed more time to recover from interruptions than in the first one. Altogether, we expect that when people have to deal with a higher number of interruptions and/or prolonged exposure of interruptions, the previously described effects (i.e., time pressure, failure, high workload, need for recovery, emotional strain and rumination) will appear in combination and will likely amplify each other.

In this scenario, one would expect to see an accelerating development of strain (e.g., following an exponential curve). According to the compensatory control model, the effects of the accumulating interruptions will evoke compensatory responses (Hockey, 1997), namely, increased effort and physiological activation (e.g., sympathetic and musculo-skeletal responses, neuroendocrine stress patterns). These compensatory responses, in turn, will lead to a

depletion of resources and increased stress (cf. conservation of resources theory; Hobfoll, 1989). Next, it can be assumed that people will use resources to cope with interruptions. They will put more effort into the accomplishment of their tasks (try to do them faster), use existing time buffers and may ask colleagues for help. This will lead to a lack of resources, which will make them more vulnerable to additional losses (e.g., additional interruptions) (Hobfoll, 1989). They will need time to recover and regain resources (Sonnentag & Zijlstra, 2006); however, if interruptions continue and opportunities to recover are denied, subsequent demands will cause greater loss of resources (Hobfoll, 1989; Siltaloppi, Kinnunen, & Feldt, 2009). When resources become depleted, reemploying them will create higher costs (Hobfoll, 1989). Additionally the above-described amplification of effects (e.g., time pressure increases the probability of error, their handling needs further time) come into play and an upward trend of strain can be expected (see Figure 2.3 a). Keeping in mind that the precise form of the development will depend on the interruption profile that is typical for a particular occupation and work setting, we come to the following proposition.

Proposition 6: Accumulating interruptions lead to an accelerating increase of strain.

2.4.2.2 Performance

For performance, we would expect another trajectory over time. As said before, interruptions may first cause a faster accomplishment of the primary and interruption tasks (Mark et al. 2008; Zijlstra et al., 1999). Speier et al. (1999) found an increase of speed and accuracy in laboratory tasks, while in the experiment of Zijlstra et al. (1999), subjects carried out both tasks faster. The time they spent on each task even decreased, the more interruptions arose (0, 1 or 3 interruptions; Zijlstra et al., 1999). Nonetheless, the total time they needed to finish all their work increased.

If exposure to interruptions lasts longer, maintaining performance may become impossible. The accelerating increase in strain and the underlying loss of resources will likely affect the capacity to perform well. According to the compensatory control model, typical results of the above-described spiral are fatigue (subjective and physiological) and fatigue after-effects (Hockey, 1997) in the form of degraded performance (of interrupting and primary tasks) in this exhausted state. Altogether, the person performs less well.

Hockey (1997) and Hacker (2005) suggested that under such conditions, people may change their strategy and try to accomplish tasks with reduced effort, possibly resulting in risky behaviour or neglect of subsidiary actions. This does not need to be a conscious change; attentional narrowing (Hockey, 1997) or reduced memory capacity can cause people to neglect safety standards or skip subsidiary tasks even if they are not aware of it. Thus, they can still try to manage all tasks (the primary and interruption task) but accomplish them at a lower level of accuracy and quality. Kirmeyer (1988) found, in her observation study of 72 police radio dispatchers, a significant negative relationship between performance quality (rated by the employees at the end of the day) and (the observed) workload caused by interruptions. The employees spent less time than usual handling each request or complaint from the public and provided less individualized attention than usual to police officers who radioed in with requests for information or assistance. Strategies that neglect subsidiary tasks or reduce accuracy of quality raise the risk of errors (Frese & Zapf, 1994). As described above, handling of errors will consume further resources, augment the workload, and increase strain (Brodbeck et al., 1993; Hobfoll, 1989). As a result, the performance quantity may decrease, the interrupted employees cannot manage all tasks anymore, and instead of performing tasks faster, workers become slower because they are so exhausted. Adler and Benbunan-Fich (2012) found in their laboratory study of multitasking situations that performance quality decreased first, followed by performance quantity later.

The cognitive and emotional overload caused by accumulating interruptions leads to a lower ability to perform well and lower quality (and later quantity) of performance, with a range of consequences in the long run, such as unmet client expectations (because of delays, inferior quality, and errors), financial loss, and, at the personal level, guilt; reduced sense of self-efficacy or a ruined reputation are also possible effects. It is conceivable that the negative effects of interruptions will amplify each other, and the performance will degrade at an accelerating rate. Such performance degradation does not necessarily happen at the end of a long period. In a laboratory study, decreasing performance was even found in the time-frame of about an hour (Altman & Trafton, 2007).

Putting the foregoing together, we are inclined to expect that performance may develop according to an inverted U trajectory (see Figure 2.3 b) (cf. Muse, Harris, & Field, 2003; Yerkes Dodson Law: Yerkes & Dodson, 1908). Of course, the initial increase in performance is only possible if demands have not reached the maximum of people's capacity (Muse et al., 2003). If the work is already very demanding, interruptions might not lead to an initial improvement of the performance. This relationship is displayed in Figure 2.3. If the work is already very demanding, the y-axis shifts to the right so that the maximum of the inverted U trajectory intersects the y-axis and only the falling part of the curve will be visible and measurable. According to Adler and Benbunan-Fich (2012), performance quality starts to decrease before performance quantity. This is consistent with Hockey (1997), which stated that people first try to reach all their aims, but potentially neglect subsidiary tasks or try to cope with heightened demands with less effortful strategies (e.g., air traffic controllers who switch from a strategy of individual routing for each contact to a fixed procedure for all; Hacker, 2005; Sperandio, 1978). As depicted in Figure 2.3, this would imply that the inverted U trajectory of performance quality is to the left of the trajectory of performance quantity. Even in less demanding workplaces, an initial increase in the quality of performance might

not be found. As with strain, the precise curves will depend on the interruption profile and on the particular occupation and work setting.

Proposition 7: Accumulating interruptions lead to an inverted U development of performance.

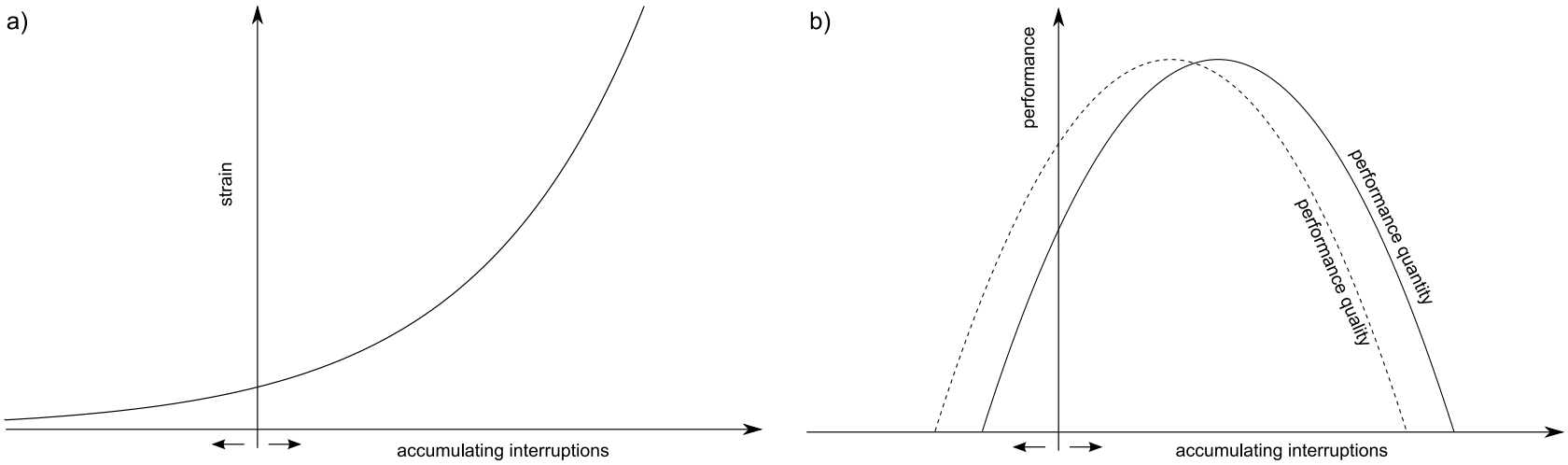

Figure 2.3. The curve of a) strain and b) performance.

2.4.3 Positive aspects of interruptions and buffering conditions

We have discussed the detrimental effects of accumulating interruptions on strain and performance. It is important to note that under certain conditions, however, interruptions may also have positive effects. Furthermore, the negative effects of accumulating interruptions might be buffered by periods without interruptions.

2.4.3.1 Information gain and positive news

Besides the negative effects of interruptions, interruptions may also have positive effects, such as information gain. For example, a colleague can point at a mistake or facilitate work progress by giving useful suggestions. In this case, problems may be handled more effectively, and performance can increase, even if the interruption has disturbed the workflow. Moreover, the information gain can be so large that it compensates or outweighs the negative effect on performance attributed to other interruptions. For example, information gain can lead to time savings, which will reduce time pressure and its associated negative effects on performance. Information gain could also reduce the error rate or increase performance quality. We assume that the occurrence of interruptions that cause an information gain can outweigh the negative effect of interruptions on performance by improving work progress (in other words, information gain can be regarded as a resource).

In addition, interruptions may be associated with positive emotions. Imagine a researcher being interrupted by an e-mail containing the acceptance of a paper in a peer reviewed journal. Even though these kinds of interruptions within the pattern of interruptions during a working day arise as single events, they might entail the potential to buffer negative effects of accumulating interruptions.

Proposition 8: Information gain can reduce the negative effect of accumulating interruptions on performance.

2.4.3.2 Job enrichment

Work interruptions can, in certain cases, be interpreted as signs of work enrichment of employees. It can mainly raise the task parameters (e.g., skill variety, task identity, task significance). If the employee accomplishes monotonous tasks (i.e.., in a production hall of an automotive company), an interruption by a trainee asking for help or a technical error can increase the skill variety, task identity and task significance. The instruction and monitoring of the trainee is a more complete task that is meaningful, and the employee has to use different skills than usual. The same could happen if the employee needs to find out why the machine is not working properly and needs to repair it. Especially in the last example, the employee will also receive very direct feedback of his or her performance. If work interruptions lead to job enrichment, it can be assumed that the employees will experience a higher job satisfaction and motivation and this, in turn, may raise the performance. Meta-analyses showed that job satisfaction and self-efficacy are positively linked to job performance (Judge & Bono, 2001; Judge, Thoresen, Bono, & Patton, 2001; Stajkovic & Luthans, 1998).

According to these assumptions, several laboratory studies found an improvement in performance when a monotonous primary task was interrupted. Mark et al. (2008), for instance, gave students e-mail-editing tasks. The subjects worked faster and wrote shorter mails, if they were interrupted. Speier et al. (1999) found that students completed their decision tasks faster and more accurately in the high-frequency interruption condition than in the low one. Similarly, Zijlstra et al. (1999) found that their subjects completed their text-editing tasks faster when interrupted than when they were not. Krediet (1999) found that interruptions can be associated with positive emotions, because "'the interruptions lead to more variety in work (. . .) you feel useful (. . .) , or because the interruption gives a refreshed view of the work" (p.21). All that these studies have in common is that their subjects were interrupted during simple, repetitive tasks. These are typical characteristics of situations in which interruptions

can facilitate work. Thus, under the special condition of monotonous work, interruptions may have the potential to raise the demands (complexity) and completeness of the work, which should lead to a number of positive effects, such as increased performance and satisfaction with their work. Correspondingly, Fisher (1998) found that interruptions can reduce perceived boredom. Whereas in most cases interruptions likely lead to job enlargement, under certain conditions, interruptions may lead to job enrichment. Until now, only laboratory studies could show that work interruptions led to increased performance when they occurred during monotonous tasks; however, it is also possible that work interruptions may be perceived as job enrichment in the case of non-monotonous tasks, as long as they increase the conditions: skill variety, task identity, task significance, autonomy and feedback (Hackman & Oldham, 1976).

Proposition 9: The occurrence of interruptions that are perceived as job enrichment will moderate the negative relationship between accumulated interruptions and performance. The effect of accumulating interruptions on performance is weaker with the occurrence of interruptions that are perceived as job enrichment.

2.4.3.3 Periods without interruptions

The downward spiral may be prevented, stopped or at least buffered by periods without interruptions. Longer periods without interruptions can mean that the effects of interruptions will not accumulate because there is enough time to compensate for potential losses of single interruptions. If there has been a longer period in which interruptions did occur and their negative effects accumulated, following periods without interruptions could stop or buffer the development of a downward spiral. As recovery occurs when stressors are absent (Demerouti, Bakker, Geurts, & Taris, 2009; Rook & Zijlstra, 2006), periods without interruptions may be used to recover from the typical demands caused by interruptions. During such intervals, the person can focus on one task, which implies less information load and, provided that there are

no other stressors, reduced concentration demands. With less effort to invest, the person can calm down and restore cognitive resources called upon earlier (e.g., time, vigour, ability to concentrate, positive mood; Hobfoll, 1989). Beside this, the time can be used to finish the current task without the disruptive effect of other tasks (and possible rumination about unfinished tasks). It may also be possible to regain some previous lost time and reduce time pressure. Finally, anger and frustration about previous interruptions may vanish and allowing the person to fully concentrate on the next tasks.

Proposition 10: Periods without interruptions reduce the effects of accumulations of interruptions. The longer the periods without interruptions, the weaker the relationship between the time and cognitive demands of previously accumulating interruptions and experienced time pressure, workload, failures, emotional strain and rumination.

2.4.3.4 Agency

We have described now how interruptions and their effects can accumulate, as well as how a loss spiral could develop and be prevented. All the previous arguments describe how situational parameters affect the experience and behaviour of the interrupted people. Because individuals are active agents who can shape their own situations, they will be able to influence the development of effects and stop a possible downward spiral themselves.

Laboratory researchers described strategies to respond to single interruptions. They name delaying and ignoring interruptions, delegation and making notes to reduce the resumption lag (cf. Brixey et al., 2007). However, the time loss of a long resumption lag (as it may occur during a working day) is negligible when compared to the time loss by the interruption task. Accordingly, delaying the interruption and note-taking will not cause an appreciable time gain. Moreover, ignoring an interruption is often not possible in real working life and may just increase the amount of interruptions because the ignored person will likely call again until

they are acknowledged. We can conclude that strategies that are helpful in the case of single interruptions are not sufficient in the case of accumulating interruptions.

When considering accumulating interruptions, other possible strategies may be considered. According to the compensatory control model, the first strategy that people will choose is to expend more effort to manage all interruptions and primary tasks (Hockey, 1997). When this strategy fails, a reasonable strategy change would be to stop trying to complete all tasks and instead give priority to the main tasks (Hockey, 1997). They could actively redefine their work, including reorganizing their work schedules, skipping irrelevant or less relevant tasks and delegate others. All these strategies still serve as responses to the situation. Another possibility would be to prevent, or at least schedule, incoming interruptions by actively generating interruption-free periods (e.g., closing and opening the door/ mail program, switching the mobile phone off or on).

All these strategy examples are possibilities of how each person can influence the accumulation of effects when series of interruptions occur. Thus, when examining effects of interruptions, it will be important to consider the strategies people use.

2.5 Investigating of the propositions

It is clear that work interruptions are a complex phenomenon involving various cognitive processes and that the form it takes and the effects it has are influenced by many factors. In developing our integrative framework, we have focused on a prototypical description of accumulating interruptions in the workplace and pondered about the likely interaction between their effects. However, we have acknowledged that the number, duration and complexity of interruptions, and the way in which they interweave with the primary tasks vary across jobs and organizational settings. Gaining a better understanding of how interruptions affect the workflow and the experience of the person, how people manage interruptions and

how their performance and well-being are ultimately affected, will therefore profit from studies that distinguish between interruption profiles in different occupational groups and organizational settings. We would expect that nurses, pilots, dispatchers and managers have different interruption profiles in terms of frequency, variability, duration and complexity of interruptions. For instance, secretaries could be exposed to more and more varied interruptions of comparable duration and complexity, while engineers could possibly experience more variance in complexity and duration, but a fewer and less variable (number of) interruptions. Such differences might also reflect in the outcomes of interruptions. For example, in some occupations, errors might be more prevalent.

Our suggestion is that, to examine the propositions about the effects of accumulating interruptions, study designs need to be developed that allow for investigating a few variables at the time. Following the distinction between occupational groups, the variables to be examined in a particular study could be chosen according to the form of the interruption profile. In the example, it would be reasonable to examine the main effect of the number of interruptions in the case of secretaries and the interaction effect of complexity and duration in the case of engineers on performance and strain.

In drawing up such research models, it would be helpful to distinguish between factors and processes that need to be studied temporally (within subjects) and differentially (between subjects). Considering the process character of our overall model, the ideal design for studying accumulative interruptions would be temporal—that is, processes should be identified and time series data collected to assess dynamic trajectories of surface-level and deep-level indicators. Diary studies over several working days are a possibility to examine accumulating interruptions as they appear in the workplace (Baethge & Rigotti, 2013a). Focusing on the occupation-specific characteristics of interruptions, a tally could be kept, counting and specifying the appearing interruptions. These can be related to performance and strain during the

day. A long-term (respectively more differential) approach would be to relate different interruption profiles (over different occupations) on long-term effects of performance and strain. Further differential analysis would be appropriate to study the moderating effects of workplace, task and personal factors.

In our opinion, these combinations of temporal and differential research will be a recommendable way to examine the proposed effects.

2.6 Conclusion

Previous research has mainly shown the effects of isolated interruptions in laboratory studies and the effect of a general work characteristic "being exposed to many interruptions". Both research traditions seemed to exist independently from each other. None of the previous research dealt with interruptions as they appear in *daily* work, in accumulation. This paper discusses exactly this missing piece in interruption research, integrating findings from both research traditions.

We develop a theoretical framework that allows for integrating extant knowledge on interruptions, exploring implications of well-established theories, and guiding future research on interruptions in real work-settings, with a focus on the accumulation of interruptions over time. The framework integrates and extends knowledge on (a) single, isolated interruptions and multiple, combined interruptions; (b) interruptions in lab and real-life settings; (c) features of interrupting tasks, including complexity (simple, complex) and timely characteristics (number, length); and (d) surface- and deep-level aspects of interruptions. This framework is the basis for an integrative model and propositions about accumulating interruptions. This integrative model enables us to make predictions on the effect of accumulating interruptions, changes over time, implications for task performance and well-being and agency, how people respond to and handle interruptions in real work settings. The theoretical framework

and the proposed model is complex, but the paper explains how it can be used to set up studies to test the propositions.

The model provides a sophisticated understanding of the psychological process of accumulating work interruptions—the typical manner in which interruptions arise at work. Overall, 10 propositions have been formulated, dealing with the underlying mechanisms of accumulating interruptions by mapping deep-level regulations onto the observable sequence of actions. Furthermore, we discussed mediating and moderating factors in the process of accumulating interruptions. In doing so, we disclosed the relationships between the effects of single interruptions found in laboratory studies and the health and performance outcomes of interruptions found in applied research. We explained how the accumulation of interruptions likely leads to a new quality of effects. Time loss becomes time pressure, errors become failures, emotional states may—along with a higher workload—culminate in emotional strain and raised effort, and a short-term increase of performance leads to overstrain and reduced performance quality (and ability) in the long run.

If all these effects act together in a downward spiral, and there is not enough opportunity for recovery, the mechanisms proposed may serve as an explanation for the relationships between interruptions and health impairments reported in applied research. Grebner et al. (2003) reported a significant relationship between work interruptions and psychosomatic complaints in a sample of call-centre-employers ($r = .23$). Furthermore, a negative relationship with mental health was found in a cross-sectional study of 348 male workers (Lühring & Seibel, 1981). In a sample of 1,234 Swiss teachers, work interruptions correlated significantly with emotional exhaustion (Wülser, 2006) and, in a sample of 414 physicians, a positive relationship with depression was reported (Rout et al., 1996). It was also found that work interruptions correlate negatively with job satisfaction (Rout et al., 1996). Hence, interruptions have been related to long-term consequences such as the experience of strain and health

problems. A major limitation of all these studies is their cross-sectional designs. There is clearly a need for longitudinal studies to shed light on causal effects of accumulating interruptions. Further, the examination of interruptions in the state in which they appear at work (i.e., in accumulation) leads to new proposed relationships. To achieve that aim, accumulating interruptions need to be quantified. Following the evidence and theoretical reasoning brought together in this paper, we claim that it is not enough to purely count the number of interruptions. According to the proposed model, the time demand and cognitive (working memory) demand needs to be considered. These aspects have so far been widely neglected in applied research.

Furthermore, in our propositions, we also discussed buffering mechanisms on the largely negative effects of accumulating interruptions. The most important factors are interruption-free periods and strategy adjustment (agency) within a stressful day and longer periods of time. These strategies differ from the strategies that laboratory researchers suggest, as the accumulation of interruptions during a working day (or longer period) leads to new qualities of effects. Restructuring of work sequences will likely reduce the incidence of evitable interruptions and help to cope with interruptions that cannot be prevented. Contextual factors, like participative decision making, leadership styles and provision of job autonomy, might be interesting boundary conditions to consider in future research.

Because interruptions at work usually rank either second or first among the most important stressors at work (BIBB-BAuA Erwerbstätigenerhebung, 2006), we call for a more differentiated investigation of their antecedents, processes and consequences in real work settings. This will help to gain ecologically valid insights and to provide evidence-based guidelines for job design, and training.

Chapter 3:

The research and methodological context

Before presenting the two empirical studies, in which an examination of work interruptions in the daily context are presented, I will describe the contextual conditions (the general research project) under which the empirical studies have been developed and the data has been gathered. In addition, I will give a brief introduction to the methodological background of the two empirical studies which are not mentioned in chapters 4 and 5.

3.1 The general research project

The two empirical studies were conducted in the context of a research project called "Work interruptions and multitasking in information-intensive occupations - effects on performance and work ability, health and productivity under particular consideration of ageing employees". It was supported by the German Federal Institute of Occupational Safety and Health (Bundesanstalt für Arbeitsschutz und Arbeitsmedizin). The general aim of this project was the investigation of the impact of work interruptions and multitasking on well-being and performance of nurses. Further, the moderating effect of age was to be considered. The project spanned two and a half years and was led by Thomas Rigotti. It was split into four work packages including a literature review (work package 1), empirical studies (work package 2), recommendations for future laboratory studies (work package 3) and practical implications (work package 4). Work package 2 was divided into a qualitative pilot study (16 interviews, 15 shift observations) and a diary study of 145 nurses of 10 German hospitals. A full description of the sample is available in Baethge and Rigotti (2013b).

3.2 Details on the study design of the diary study

The diary study was conducted between June and December 2010. Five consecutive days were examined using experience sampling. The participants filled in a morning survey about

their wellbeing, three shift questionnaires about their working conditions and their mood, and one evening questionnaire about working conditions, well-being and performance - using a handheld computer (Eten Glofiish X610/50; software: Izy Builder Research). The morning questionnaire was filled in after getting up and the evening questionnaire before going to bed. A signal informed the participants to fill in the shift questionnaires. This signal occurred pseudorandomized at three intervals between 7:30 am and 1 pm (at the beginning, in the middle and at the end of the shift) with the condition that at least one hour had to elapse between two signals. If the signal occurred during a very busy situation (e.g. reanimation) or directly after a break, the nurses were allowed to fill in the questionnaire half an hour later. The study was set up to try to avoid evaluating non-working time and to ensure that the disturbance caused by the assessment was as small as possible. In addition to the diary assessment, the participants filled in a (paper-pencil-)questionnaire and they took part in a computer test about cognitive abilities. This was done in the following order, see Figure 3.1.

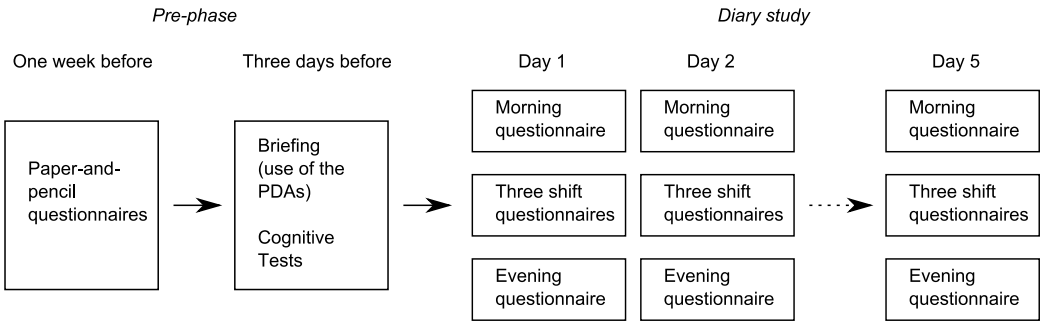

Figure 3.1. The design of the diary study.

One week before the diary study, the participants received the general questionnaire by mail. Approximately three days before the start of the examination (one group contained between 6 and 25 participants), the participants were given an introduction to the use of the handheld computers (PDAs) in a conference room of their hospital. They followed a slide show and filled in every PDA questionnaire once and further possible technical errors were

discussed. After the presentation the participants performed the cognitive tests in a separate quiet room in the hospital using laptops from the University of Leipzig. The tests took approximately half an hour and the presentation one hour. Additionally they had to submit the general questionnaire at this time.

During the week of the diary study, the participants had the opportunity to call a hotline in case any problems occurred. After this week, the devices were collected by the nursing director and fetched by a member of the project team or the nursing director sent them by mail to the university. The data was downloaded and the devices were recharged and prepared for the next cohort.

3.3 Data preparation

The data of the general paper-pencil questionnaire were entered into SPSS and the data of the computer tests were in csv format and were converted into sav. The data preparation of the PDA data was more complex. The data of each participant were saved as html-log files and needed to be imported into a database. Preparation and checking of the data involved three steps.

First, the dates needed to be controlled and the day code (day 1, day 2, day 3, etc.) needed to be changed. The data were clustered by a subject code and the date (resulting in day codes). If a person filled in an evening questionnaire past midnight, the day code needed to be changed.

Second, data needed to be deleted. Data which were typed in before the start of the examination (e.g. during the introduction of the handheld computers) were deleted. Further, doublings needed to be deleted. In some cases, the program shut down in the middle of the data entry, in these cases the nurses usually started the questionnaire again and filled in the complete questionnaire again. Another typical reason for doublings was that the subjects on

occasion mistakenly opened the wrong questionnaire (e.g. a morning questionnaire in the evening). In this case, they filled in the morning questionnaire and afterwards (few minutes later) the evening questionnaire. In such cases, there were two morning questionnaires for one day and one (the latter one) had to be deleted. Unintentional questionnaires usually had the following characteristics: a) the starting time was just minutes before the starting time of another questionnaire, b) the starting time was at an unusual time (e.g. morning questionnaire in the evening) and c) the values typed in did not vary (e.g. all items of all scales got the value one).

The third task was to evaluate compliance. The actual time participants filled in the questionnaire was compared with the time they should have filled in the questionnaire and two non-compliance items were generated. Each (morning, three shifts, evening) questionnaire of each day got value 1 or 0. The rules and numbers of both non-compliance values are presented in Table 3.1. The non-compliance rate of non-compliance A varied between 10.8-12.4% and of non-compliance B between 1.7-9.8%.

The non-compliance rate was calculated to generate the possibility to exclude non-compliant data points from the analyses. They were not excluded from the analyses of study 1 and 2 (chapter 4 and 5) for the following reasons: The central hypotheses of both studies using the complete data set and the data sets without the data points of non-compliance rules A and B were tested and the results were compared. Generally excluding data points which did not match the non-compliance rules A led to the same pattern in both studies as if all data points had been included, with three exceptions. In study 1, there were two exceptions out of eight cases. The mediator of hypothesis 3b lost its significance and the mediator of hypothesis 4b became significant when excluding the non-compliant data points. In study 2, there was one exception. The interaction effect of hypothesis 7a of study 2 lost its significance, when data points were excluded which did not match the non-compliance A rules. Since non-compliance

A rules are very strict, maybe too strict, the more liberal non-compliance B rules were tested. The following considerations led me to this assumption: If the shift of nurses started at 6 am, it could be possible that they may go to bed as early as between 7 and 8 pm (for example if they have a long commute to the hospital and thus need to get up before 4 am). Further, the random signal within the shift could occur within a lunch break, a ward round led by the chief physician or an emergency case. In these cases it would be sensible to postpone the completion of the questionnaire. Therefore, non-compliance B rules were generated and data points were excluded accordingly. Generally the resulting data set led to the same pattern in both studies as if all data points were included, with only one exception. The interaction effect of hypothesis 6a of study 2 lost its significance when data points were excluded which did not match the noncompliance B rules. As this is the only exception, the non-compliant B data points were not excluded for power purposes.

Table 3.1. Non-compliance rules.

Questionnaire	Scale			
	Non-compliance A		Non-compliance B	
	Rule	Number	Rule	Number
Morning	The start time of the questionnaire is between 4 am and 6 am.	70 of 650 (10.8%)	The start time of the questionnaire is between 3.30 am and 6 am.	64 of 650 (9.8%)
Shift	The start time of the questionnaire is 0-1 hour past ringing.	232 of 1864 (12.4%)	The start time of the questionnaire is between 7:30 am and 2:30 pm. There is minimum a half hour break between two entries.	31 of 1864 (1.7%)
Evening	The start time of the questionnaire is between 8 pm and 2 am.	66 of 613 (10.8%)	The start time of the questionnaire is between 7 pm and 2 am.	24 of 613 (3.9%)
	If the condition is true, non-compliance = 0, else non-compliance = 1.		*If the condition is true, non-compliance = 0, else non-compliance = 1.*	

After the three steps of the data check, the data were converted to a sav-file and added to the two other data blocks (general questionnaire, computer tests). After that descriptive and scale analyses were conducted and scale means were calculated.

3.4 Notes on the instruments of the diary study

The instruments used in the two empirical studies include measures of work interruptions (diary, shift measure: 6 items), multitasking (diary, shift measure: 4 items), time pressure (diary, shift measure: 1 item, evening measure: 3 items), mental demands (diary, shift measure: 1 item, evening measure: 3 items), valence (diary, shift measure: 2 items), calmness (diary, shift measure: 2 items), energetic arousal (diary, shift measure: 2 items), irritation (diary, evening measure, 7 items), forgetting of intentions (diary, evening measure: 1 item), satisfaction of the employee with his/her performance (diary, evening measure: 1 item), age (general questionnaire: 1 item). The scales are described in the appropriate chapters (Variables of study 1: chapter 4; variables of study 2: chapter 5). The descriptive analysis of the scales (of study 1 and 2) are attached in appendix A and a correlation matrix is shown in Table A.1. Further, the general and the diary questionnaire are attached in appendix B.

As most of these measures have less than 3 items (and work interruptions is an index scale) a factor analysis of single scales is obsolete. Further the multilevel structure of the data necessitates a multilevel confirmatory factor analyses, which needs at least 4 items for not being underidentified. Multitasking was assessed with four items. For the multilevel confirmatory factor analyses mean scores were used per item across the day as manifest variables. A one factor model showed to have a good fit to the data ($\chi 2 = 27.08$, df = 4, CFI = .97, TLI = .91, $SRMR_{within} = .009$, $SRMR_{between} = .047$). All factor loadings on the within, as well on the between level were above .40 and significant. Thus, the assumed factor structure (one factor) was confirmed. Confirmatory factor analyses to test whether dependent (study 2, chap-

ter 5) and moderator variables (study 1, chapter 4) are distinct constructs, have been conducted and are reported in the appropriate chapters.

3.5 The data analysis

In the following, the statistical technique used in the studies will be introduced. To this end, the choice of the statistical method is first explained, along with the preconditions of this method and finally, important statistical details of the method are explained. Since the methods are also discussed in the following two chapters, the primarily focus here is on information which did not fit into the format of a journal article.

3.5.1 The choice of multilevel analysis

In diary studies single observations "are not independent from each other" (Hox, 1999; Ohly et al., 2010, p. 88). Observations from the same person will be more similar than observations from different persons. The result is that a precondition of hierarchical regression analysis is not met: uncorrelated residuals (Tabachnik & Fidell, 2001). Thus, a method is needed which considers these dependencies. Multilevel analysis is able to do that (Twisk, 2006). It considers the nested structure of diary data (single observations are nested within persons), by differing between several levels (Ohly et al., 2010). In our case there are two levels, days (level 1) are nested within persons (level 2). To test whether the proposed nested structure is meaningful (whether the residuals within one group are correlated), the intra class correlation is calculated (ICC). The ICC estimates "the ratio of the between group variance [in the case of diary studies: the between person variance] and the total variance" of the dependent variable (Twisk, 2006, p. 46). It is an indication of the dependency of single observations within one person (Twisk, 2006). If the ICC is greater than zero, the total variance of all observations can partly be explained by differences between people, which means that a multilevel analysis is indicated. The ICCs of the dependent variables of the two studies are

presented in chapter 4.2.3 and 5.2.3. All were greater than zero, thus a multilevel analysis was the best strategy to choose.

3.5.2 Preconditions of multilevel analysis

"Multilevel analysis is an extension of 'standard' linear regression analysis" (Twisk, 2006, p. 26), thus the preconditions of multilevel linear regression analysis are based on the preconditions of 'standard' linear regression analysis. According to Tabachnik and Fidel (2001), the following five preconditions are central: a) ratio of cases to independent variables, b) outliers, c) multicollinearity, d) normality, linearity and homoscedasticity and e) independence of errors. In most published research preconditions of multilevel analysis are generally not tested, in some frequently cited multilevel literature, preconditions are not even mentioned (e.g. Hox, 1999, 2010). One reason for this could be that the nested structure of diary data complicates the test of propositions so much that some of them cannot be tested completely (Snijders & Bosker, 2003). Nevertheless, I want to offer at least a discussion of the preconditions.

The *ratio of cases to independent variables* refers to the power of analysis. In multilevel analysis there is the rule of thumb that where main effects are tested (as in study 1) 30 individuals are necessary and where cross-level-interaction effects are tested (as in study 2), 50 individuals are needed (Maas & Hox, 2005). In the two studies data of 123-133 persons were analysed, thus the condition is met. More accurate sample predictions can be made when using the power test suggested by Hox (2010). When an effect size of .20 is expected and an alpha of 5% and a power of 80% is desired (with 5 measurement occasions), the necessary sample size ranges from 61 (in the case of an ICC of .24, cf. chapter 4.2.3) to 117 (an ICC of .68, cf. chapter 5.2.3) subjects. In both studies more than 117 persons were analysed.

Twisk (2006) argues that it is important to test whether certain data points influence the model coefficients. In diary data such *outliers* can occur at the level of the person or of certain data points. Cook's distance can be calculated at both levels. An accordant analysis for the central hypotheses of both studies was done. Cook's distance values for every central statistical model of study 1 and 2 (the mediation hypotheses of study 1 and the three-way interaction hypotheses of study 2) have been calculated for every person and every time point. If the Cook's distance is above 1, the person or day is an outlier for this specific multilevel model. The results of these analyses show that none of the data points or individuals had a leverage effect. In study 2, data of cognitive tests were used. In terms of this data, the common practise of laboratory research governed our behaviour. In laboratory research it is not usual to prove leverage effects but to exclude outliers which exceed a certain distance from the mean or median of the sample (Ratcliff, 1993). Six nurses were excluded from our analyses (before calculating the Cook's distance) because their errors or reaction times in the cognitive tests were more than 3 SD above (or below) the mean of all participants (cf. Ratcliff, 1993).

Multicollinearity can appear when independent variables are highly correlated. In such a case it is difficult to predict the impact of a single predictor on the outcome compared with the other one with which it is highly correlated. There are multicollinearity tests for 'simple' linear regression analyses, but the nested structure of the diary data prohibits the use of these tests (Kreft & DeLeeuw, 1998). Kreft and DeLeeuw (1999) tried to test multicollinearity in a sample case by an approximation. Based on the results, Kreft and DeLeeuw (1999) offer the rule of thumb, that "group mean centering improves the multicolinearity situation considerably" (p. 137). Thus in both studies, all level 1 variables were group centred.

The *normality, linearity and homoscedasticity* refer to the normal distribution and variance of the residuals. The nested structure of diary data leads to several (nested) residuals. Snijders and Bosker (2003) discuss possible solutions to test correspondent preconditions (variance

and normal distribution of level 1 and level 2 residuals respectively random coefficients). A conclusion of their considerations is that satisfactory solutions are "impossible to give" (Snijders & Bosker, 2003, p. 121).

According to Twisk (2006), the precondition *independence of errors* is the reason for performing multilevel analysis in the first place. For that purpose the ICC has been calculated in each study. Twisk (2006) argues that multilevel analysis considers the nested structure of the data (and therefore correlated residuals) and as a consequence, "the problem of these correlated residual is more or less solved" (Twisk, 2006, p. 27).

3.5.3 Two specifications of multilevel analysis

In multilevel analyses two main decisions need to be made: a) the method of centring needs to be chosen and b) it needs to be decided whether a random or simple slope model will be tested. With regard to the first point, there are three possibilities for level 1 predictors and two options for level 2 predictors. Level 1 and level 2 variables can be left uncentred or they can be centred at their grand mean. Level 1 variables can additionally be centred at their group mean. According to Enders and Tofighi (2007), metric predictors with no meaningful zero point should be centred in any case. The main advantage of centring is that it makes the intercept interpretable (Hox, 2010). The intercept describes the value of the dependent variables if all predictors are zero (or in the case of centring: are at their mean value). As there is just one option of centring for level 2 variables, metric level 2 variables should therefore be centred at their grand mean (Enders & Tofighi, 2007). In the case of level 1 variables a decision between grand and group mean centring has to be made. Group mean centring means that the variable is centred within the cluster (in the case of diary studies, within the person) (Enders & Tofighi, 2007). The individual means are subtracted from the corresponding daily scores. Thus, in contrast to grand mean centring group mean centring causes a completely different model (compared to a model with uncentred predictors). All the between subject

variance of the group mean centred predictor is excluded (Hox, 2010). Consequently, the predictor is not a merge of between subject variance and within subject variance, thus pure statements about the effect of the within subject variance of a predictor on the outcome can be made. In the case of a significant positive main effect between the group mean centred predictor work interruptions and strain, the following can be assumed: If more interruptions occur than on an average day for that person, the person experiences more strain. If work interruptions are grand mean centred, then it can be stated that on days in which more interruptions happen than on average in the sample, the person will experience strain (cf. Ohly et. al, 2010). It will still be unknown whether this is the case because of between subject differences or within subject differences or both. Therefore, Enders and Tofighi (2007) recommend to use group mean centring when the research hypothesis is about the relationship between two level 1 variables or when the hypothesis involves an interaction between two (or more) level 1 variables or between level 1 and level 2 variables. Further, group mean centring lowers the risk of multicollinearity (Kreft & DeLeeuw, 1999). Therefore, grand mean centring was chosen for the level 2 variables and group mean centring for the level 1 variables.

The next decision which has to be made is whether to allow random slopes or not. In multilevel analysis slopes for every group (in daily diary studies every person) are calculated and then a mean relationship of the predictor and the outcome is conducted. The presumption of a random slope model is that the relationship between the predictor and the outcome for every group (person) is different. In a simple slope model it is assumed that it is the same for every group (person). According to Nezlek, Schröder-Abé, and Schütz (2006) and Nezlek (2001), the first assumption is the more probable one in the case of diary studies. As every person and every person's working conditions are different, different relationships of work interruptions and possible outcomes can be expected. Nevertheless, in some cases the simple slope model is the better choice. The advantage of the simple slope model is that it is the

easier model; it has fewer assumptions. According to the principle of Occam's razor, the model needs to be chosen that makes the best predictions with least variables/assumptions. Thus, random slope models were tested against simple slope models (in study 2). If the random slope models did not have a significantly better fit, the simple slope model was chosen (Nezlek et al., 2006). When testing mediation effects Zhang, Zyphur, and Preacher (2009) recommend testing simple slope models instead of random slope models. Random slope models "add unnecessary complications to [mediation] models, resulting in increased rates of nonconvergence" (Zhang et al., 2009, p. 702). Thus, simple slope models were conducted in study 1.

Chapter 4:

Interruptions to work flow: their relationship with irritation and satisfaction with performance, and the mediating roles of time pressure and mental demands[2]

Abstract

Understanding the mechanisms of work flow interruptions is crucial for reducing employee strain and maintaining performance. This study investigates how interruptions affect perceptions of performance and irritation by employing a within-person approach. Such, interruptions refer to intruding secondary tasks, such as requests for assistance, which occur with within the primary task. Based on empirical evidence and action theory, it is proposed that the occurrence of interruptions is negatively related to satisfaction with one's own performance and positively related to forgetting of intentions and the experience of irritation. Mental demands and time pressure are proposed as mediators. Data were gathered from 133 nurses in German hospitals by means of a five-day diary study (four measurements taken daily; three during a morning work shift and one after work, in the evening). Multilevel analyses showed that work flow interruptions had detrimental effects on satisfaction with one's own performance, the forgetting of intentions, and irritation. The mediation effects of mental demands and time pressure were supported for irritation and (partially) supported for satisfaction with performance. They were not supported for the forgetting of intentions. These findings demonstrate the importance of reducing the time and mental demands associated with interruptions.

[2] Baethge, A., & Rigotti, T. (2013). Interruptions to workflow: Their relationship with irritation and satisfaction with performance, and the mediating roles of time pressure and mental demands. *Work & Stress*, *27*(1), 43–63.

4.1 Introduction

Work flow interruptions are part of everyday experience in many occupations. The third European Survey on Living and Working Conditions, conducted across 15 European countries, showed that almost one third (28%) of employees indicated that they are interrupted several times a day "in order to take on an unforeseen task" (Boisard, Cartron, Gollac, Valeyre, & Besançon, 2003, p. 3). Work flow interruptions can be defined as temporary suspensions of goal-directed action (Brixey et al., 2007, p. E30). We focus on interruptions that are externally initiated and caused by intrusions of secondary, unplanned tasks within the accomplishment of another (a primary) task. For example, a nurse who is washing a patient (primary task) is interrupted by a student nurse (externally initiated interruption) asking for help because an elderly patient has slipped. The nurse will stop her/his action to join the student nurse in helping up the patient (accomplishment of the second task). Such interruptions break the continuity of task performance (Brixey et al., 2007, p. E32). A plethora of experimental, as well as cross-sectional, field studies has shown that interruptions can be classified as severe stressors. Interruptions at work have been shown to be negatively related to job satisfaction (Kirkcaldy & Martin, 2000) and positively related to irritation and psychosomatic complaints (Grebner et al., 2003), as well as depressive moods (Rout et al., 1996). Furthermore, there is evidence that work flow interruptions not only decrease performance (Bailey & Konstan, 2006) but also increase the risk of medication errors in hospitals (Balas et al., 2004; Carlton & Blegen, 2006).

Despite this research, to date, the underlying mechanisms linking interruptions with negative outcomes in real work settings are underexplored. In this study two potential mediators of the relationship between work flow interruptions and strain and performance are proposed and empirically tested, namely mental demands and time pressure. So far, in field studies, interruptions have only been examined in cross-sectional or purely descriptive observation

studies. This study, to the best of our knowledge, is the first to apply a daily diary method, collecting data over five consecutive working days both during a work shift and before going to bed. Since interruptions are highly prevalent in the health care sector (Boisard et al., 2003), we chose to carry out this research among nurses. As the prevalence of work flow interruptions is likely to vary from day to day, the diary method provides a methodologically sound opportunity to test for within-person effects, instead of between-person effects. Furthermore, the (partial) separation of measures of the independent (work flow interruptions during the work shift), mediator (mental demands and time pressure during the work shift and in the evening) and dependent (performance and irritation in the evening) variables reduces the bias of common-method variance. We first review theoretical and empirical evidence of the relationship between interruptions and performance and irritation before presenting arguments for proposing mental demands and time pressure as mediators.

4.1.1 Work flow interruptions: Relationships with performance and irritation

According to action regulation theory (Hacker, 1973, 2005), work (flow) interruptions are classified as stressors – so-called regulation obstacles. Regulation obstacles thwart the achievement of action goals, with the result that additional effort or risky behaviour is needed to achieve these goals (Hacker, 1973, 2005; see also Frese & Zapf, 1994). Work (flow) interruptions can cause decreased performance (Bailey & Konstan, 2006). The accomplishment of the interruption task, the demands of task switching and the resumption of the actual task all cost additional effort and time (Brixey et al., 2007). This additional effort is likely to be the cause of the decreased performance. The results of laboratory studies have shown that interruptions prolong the processing time of both the interrupted and the interrupting task and lead to more errors in both tasks (Bailey & Konstan, 2006; Eyrolle & Cellier, 2000; Trafton et al., 2003). In observation studies, work flow interruptions were found to be a risk factor for medication errors and for errors in air traffic control (e.g., Balas et al., 2004; Carlton &

Blegen, 2006; Ho et al., 2004). The interruption, and consequential delay to the actual task, forces a person to defer their intended actions, which requires the use of prospective memory (McDaniel & Einstein, 2000). The person must "remember to self-initiate performance of the uncompleted intention[s]" (Einstein et al., 2003, p. 148), which requires a high level of activation of the intentions in the working memory. If this activation level cannot be maintained because of a complex interruption task, *forgetting of intentions* is the consequence (Einstein et al., 2003; cf. goal-activation theory: Altmann & Trafton, 2002). The interrupted person forgets the task which she/he was originally engaged in and/or any tasks she/he wanted to do afterwards (which were already in the prospective memory). In three laboratory experiments, under several conditions, Einstein et al. (2003) showed that interruptions cause forgetting of intentions.

Research has also found positive effects of interruptions; interruptions of monotonous tasks may lead to a faster accomplishment of the interrupted tasks (Mark et al., 2008; Speier et al., 1999; Zijlstra et al., 1999) because interruptions increase complexity and full attention is therefore paid to task fulfilment. However, these conditions do not apply to the work of nurses. Hence, we do not expect positive consequences of work flow interruptions on the performance of nurses in this study.

Not only do interruptions mean that work flow is disturbed (and the task is delayed), but they can also lead to additional tasks having to be accomplished, i.e., the number of tasks which have to be accomplished during the working day increases. One possible consequence is that the person does not manage to complete all tasks (both the actual and the interruption tasks) and must leave some unfinished. This equals a reduction in the quantity of tasks accomplished. However, in many occupations there are tasks which cannot be left unfinished. Nurses, for example, must give every patient their medication, wash them all and serve each of them their meals every day. Regardless of compensation effects related to greater efforts,

work flow interruptions are likely to decrease performance quality (Hockey, 1997) and in turn, the satisfaction of an individual with their own performance.

In an interview study, 16 nurses reported that stressful working days with a lot of work flow interruptions caused them to spend less time on activities such as talking and listening to patients. On such hectic days, they were dissatisfied with the quality of the work accomplished (Baethge & Rigotti, 2013b). Similarly, Kirmeyer (1988) observed 72 police radio dispatchers and found that interruptions decreased the quality of their performance. They "spent less time than usual handling each request or complaint from the public" or "provided [...] less individualized attention than usual to police officers who radioed in with requests for information " (Kirmeyer, 1988, p. 623). This leads to the following hypotheses:

Hypothesis 1: a) A high frequency of work flow interruptions is positively related to forgetting of intentions. b) A high frequency of work flow interruptions is negatively related to the satisfaction of an employee with his/her performance.

Interruptions are demanding; additional effort is needed to cope with the situation created by interruptions (Hacker, 1973, 2005), task switching requires cognitive resources and the number of tasks increase. Frequent interruptions utilize a lot of mental resources and can be overtaxing. In addition, the greater workload caused by the higher number of tasks reduces opportunities to recover (Baethge & Rigotti, 2010), which likely leads to higher strain. Cross-sectional studies have found relationships between interruptions at work and health-related factors like depression (Rout et al., 1996), psychosomatic complaints (Grebner et al., 2003) and emotional exhaustion (Wülser, 2006). Action regulation theorists and researchers in cognitive sciences consider the deferral of goals to be a problem and stress factor caused by interruptions (Altmann & Trafton, 2002; Frese & Zapf, 1994). "Stress has to do with the thwarting of goals" (Semmer, 1996, p. 85). What does this mean though? Not only can work

flow interruptions delay the achievement of single goals by the intrusion of a new task, but the accumulation of work flow interruptions may even jeopardize the achievement of the targets of the day. This happens because of the increasing number of tasks created as a result of interruptions. Consequently, the work sequence may need to be reorganized and some tasks may need to be skipped. This is likely to cause strain. Possible consequences include rumination by interrupted individuals on their unfinished tasks or the low quality of their performance (Zeigarnik, 1927). Furthermore, feelings of frustration and a loss of control can result (Mark et al., 2008).

Irritation is a concept that involves both emotional and cognitive strain. Irritation describes a state of mental impairment caused by goal discrepancies and includes both cognitive (rumination) and emotional dimensions (e.g., reacting grumpily; Mohr et al., 2006). Cross-sectional studies provide preliminary indications that interruptions are associated with a higher level of irritation. In a sample of 339 call-centre-employees (Grebner et al., 2003), interruptions were significantly and positively correlated with irritation. Likewise, Konradt et al. (2003) reported a positive relationship between work (flow) interruptions and irritation in a sample of 72 employees (data processing, telecommunication, financial services). Furthermore, irritation has been shown to be a mediator of the relationship between stressors at work and the deterioration of well-being, including depression and psychosomatic complaints, in both cross-sectional (Höge, 2009; Jacobshagen, Rigotti, Semmer & Mohr, 2009) and longitudinal studies (Dormann & Zapf, 2002). This leads to the following hypothesis:

Hypothesis 2: A high frequency of work flow interruptions during the working day is positively related to irritation in the evening.

4.1.2 Potential mediators

As outlined above, work flow interruptions are assumed to relate to lowered performance and the experience of greater strain. We have considered several approaches in trying to explain these relationships, which can be clustered into two main types that seem to mediate the relationship between work flow interruptions and its outcomes: these types are mental demands and time pressure.

4.1.2.1 Mental demands

Work flow interruptions cause high mental effort. We have already mentioned the additional effort that interruptions entail. Interruptions disturb the intended sequential process of action (Hacker, 1973, 2005). The interrupted person must become involved in a new task and then resume the former task later (Brixey et al., 2007), i.e., task switching is needed. This "mental 'gear changing'" (Monsell, 2003, p.135) requires considerable mental regulation. Attention must be shifted, goal states and action rules must be retrieved (Monsell, 2003) and when the primary (interrupted) task is resumed (Trafton et al., 2003), all these steps must be repeated. The delay of the actual task obliges the person to defer intended action. This deferral of the action goal involves the danger of forgetting intentions. To avoid forgetting (of the primary task), sometimes rehearsal is carried out during the accomplishment of the interruption (Einstein et al., 2003; Monk et al., 2004). All this puts demands on attentional processes and working memory (prospective memory, McDaniel & Einstein, 2000; Monsell, 2003). The interrupted person needs to be highly focused. Cross-sectional studies provide support for this. In a sample of 232 office workers (Zapf, 1993) and 339 call-centre employers (Grebner et al., 2003), work interruptions correlated significantly with concentration demands and in an observational study of 34 eligible doctors, workflow interruptions were significantly related to subjective workload (Weigl et al., 2011).This leads to our first set of mediation hypotheses:

Hypothesis 3: Mental demands mediate the relationship between work flow interruptions and a) forgetting of intentions, b) satisfaction of the employee with his/her performance, and c) irritation.

4.1.2.2 Time pressure

Another factor which may mediate the effect of work flow interruptions on performance and strain is time pressure. Interruptions are not only disturbing because of the mental regulations they require, but also because of the time they take (Eyrolle & Cellier, 2000). On the one hand, time is lost by additional regulations that are caused by interruptions (e.g., resuming the primary task). Laboratory studies have shown that interruptions lead to an increased amount of time taken in the accomplishment of the interrupting and the interrupted tasks (Bailey & Konstan, 2006; Eyrolle & Cellier, 2000). On the other hand, the 'interruption task' itself needs time to be accomplished. Work flow interruptions usually involve additional tasks that were not part of the planned schedule of the day. The consequence is that more tasks have to be done in the same amount of time. The more work flow interruptions that occur, the more time that is lost (by the accomplishment of these additional tasks) and the accumulating time loss likely leads to time pressure. Mark et al. (2008) found a significant positive relationship between interruptions and perceived time pressure in a simulation study in which 48 study participants had to solve mail editing tasks. If time pressure goes beyond a certain level, it has negative effects on performance and increases irritation (Durham, Locke, Poon, & McLeod, 2000; Höge, 2009). In laboratory studies it was found that severe time pressure leads to worse performance in complex decision making tasks (Durham et al., 2000) and to increased relapse errors (Betsch, Haberstroh, Molter, & Glöckner, 2004). A significant relationship between time pressure and irritation was found in a cross-sectional study of 576 nurses (Höge, 2009) – an occupation with a high occurrence of interruptions (Baethge & Rigotti, 2013b). Grebner et al. (2003) found significant correlations in a cross-sectional study of 339 call-centre employ-

ees between both interruptions and time pressure and between time pressure and irritation. Based on the above theoretical analysis and empirical evidence, we formulated the following hypotheses:

Hypothesis 4: Time pressure mediates the relationship between work flow interruptions and a) forgetting of intentions b) satisfaction of an employee with his/her performance and c) irritation.

Figure 4.1 graphically presents the research design and all hypotheses of this study.

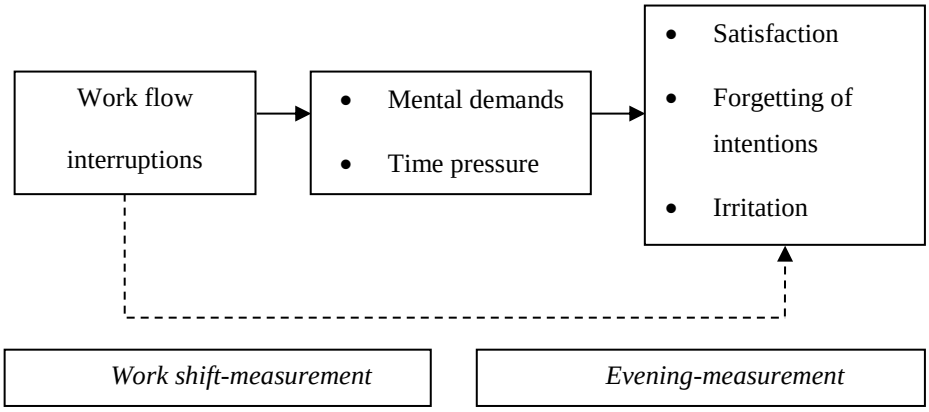

Figure 4.1. The model of relationships in the study.

4.2 Method

4.2.1 Procedure and sample

The nursing directors of 56 hospitals were contacted, 10 of whom agreed to take part in the study. Once the time scale for fieldwork was agreed the respective nursing directors sought volunteers who had (or could arrange to have) five consecutive morning shifts during that period of time. Before the diary study started, the participants completed a paper-and-pencil questionnaire that collected demographic data, and they were introduced to using the handheld computers for the study (ETEN glofiish X610/50; software: Izy Builder Research).

During the five days of the diary study all participants were working morning shifts. Each day they were expected to report any stressors and demands at three points during their work shift. A signal, at pseudo-randomized intervals (randomized within three different intervals – at the start, middle and end of the work shift, with the constraint that there had to be an hour between two signals), prompted them to fill in the work shift questionnaires. In addition, they were required to complete an evening questionnaire before they went to bed regarding their well-being and performance. The data collection for all participants took place between June and December 2010.

The sample consisted of 133 nurses (8.3% males) from 10 German hospitals. We chose this occupation to test our hypotheses because of the frequency of work flow interruptions in this setting (on average 62 times during the morning shift, Baethge & Rigotti, 2013b; see also Gadbois, Bourgeois, Goeh-Akue-Gad, Guillaume, & Urbain, 1992). The age of participants ranged from 21 to 61 years with an average age of 41 years (*SD* = 11.5). Participants worked in wards for internal medicine (24.8%), surgery (17.3%), neurology (14.3%), paediatrics (7.5%), intensive care (6.0%), gynaecology (5.3%), ENT (4.5%), geropsychiatry (3.0%), dermatology (1.5%), urology (0.8%), emergency ward (0.8%) and others (8.3%). Organizational tenure ranged from 0 to 43 years; average tenure was 18.3 years (*SD* = 12.4). Most of the participants (80.5%) were employed full-time and on a permanent contract (82.0%).

4.2.2 Measures

It is recommended that daily measurements are kept as short as possible in order to avoid decreasing participation and to minimize intrusive effects (Reis & Gable, 2000). To this end, we used short scales for both the work shift questionnaire and the evening questionnaire.

4.2.2.1 Work shift measures

Work flow interruptions. The participants were required to estimate the number of interruptions occurring from six different sources (doctors, nurses, patients, assistants, technical problems, telephone) during the previous half hour at three times during the work shift. The sum of each of the six sources was calculated. An example item is: "How often have you been interrupted by a nurse during the last half hour?"

Mental demands. For the work shift assessment we used an item from the Task Load Index (TLX, Hart & Staveland, 1988): "How high were the mental demands during the last half hour?" Answers were given on a twenty-point scale ranging from (1) "very low" to (20) "very high" using a scroll bar.

Time pressure. We used one item from the TLX-scale (Hart & Staveland, 1988): "How fast was the pace at which you had to accomplish your tasks during the last half hour?" Answers were given on a twenty-point scroll bar ranging from (1) "very low" to (20) "very high".

4.2.2.2 Evening measures

Mental demands. We used an adapted version of the ISTA Scale 'concentration demands', which examines mental demands like attention and memory demands (Semmer, Zapf, & Dunckel, 1999). The scale consists of three items. An example item is: "There were situations at work which demanded the highest level of concentration for short intervals". Answers were given on a five-point Likert scale ranging from (1) "strongly disagree" to (5) "strongly agree". The α reliability ranged from .78 to .85 during the five days.

Time pressure. We used an adapted version (cf., Binnewies, Sonnentag, & Mojza, 2009) of the ISTA Scale 'time pressure' (Semmer et al., 1999). It consists of three items. An example item is: "Today, I was pressed for time." Answers were given on a five-point Likert scale

ranging from (1) “strongly disagree” to (5) “strongly agree”. The α reliability ranged from .91 to .94 during the five days.

We conducted confirmatory factor analyses to test whether the two mediators, time pressure and mental demands (evening measures), represent distinct constructs. Analyses revealed a significantly better fit for the two-factor model (χ^2 = 117.40, *df* = 8, $p < .001$, *RMSEA* = .086, *CFI* =.984, *NFI* =.983), with all items loading on their corresponding factors, than for a one-factor model ($\Delta \chi^2$ = 641.658, Δdf =1, $p < .001$).

Forgetting of intentions. We measured the forgetting of intentions during the evening assessment with one item: “Today, did you forget to complete a task you had started or planned to do?” Answers were (0) “no” and (1) “yes”.

Satisfaction of the employee with his/her performance. Satisfaction was assessed using one item (on the basis of Abramis, 1994): “Today, I satisfied the personal expectations I have of my work.” Respondents had to indicate the extent to which they agreed with the statement using a five-point Likert scale ranging from (1) ”strongly disagree” to (5) ”strongly agree”.

Irritation. Irritation is defined as a state of psychological impairment caused by perceived goal discrepancy, and includes rumination on problems at work (cognitive irritation) and irritability (emotional irritation; see Mohr et al., 2006; Mohr, Müller, & Rigotti, 2005). We used an adapted version of the scale which measured irritation in the evening but referred to the extent of irritation felt during the day. Example items are: ‘‘If other people talked to me, I reacted grumpily’’ for emotional irritation; and ‘‘Even at home I thought of my problems at work’’ for cognitive irritation. Answers were given on a seven-point Likert scale ranging from (1)”strongly disagree” to (7) “strongly agree”. The α reliability ranged from .84 to .88 during the five days.

4.2.3 Analyses

We conducted multilevel analyses because the daily assessments are not independent of each other (using hierarchical linear modelling [HLM] software; Raudenbush, Bryk, & Congdon, 2009). They are nested within persons (Ohly et al., 2010). Multilevel analysis accounts for dependencies among the levels of analysis due to repeated measures and therefore is more appropriate than other techniques that assume independent observations (Ohly et al., 2010). In the present study, predictor, mediator and outcome variables were at the day level and predictor and mediator variables were centred to the respective person mean to strictly reflect intra-individual processes. Centring day-level variables at the person mean allows the removal of between-person variance from these variables. This eliminates the role of stable differences in explaining participant's day-levels of perceived stressors, performance and strain (see also Ohly et al., 2010). In accordance with Zhang et al. (2009), we used fixed effects to avoid increased rates of non-convergence.

To test whether our data needed the use of multilevel modelling, we calculated the intra-class correlations (ICC) on the basis of the intercept-only models. The ICC explains how much of the variance can be attributed to the different levels of analysis. The between-person variance was 24.1% for forgetting of intentions, 38.5% for satisfaction with one's own performance and 55.3% for irritation. The within person variance (variance from one day to another) was 75.9% for forgetting of intentions, 61.5% for satisfaction with one's own performance and 44.7% for irritation. These figures imply that there was enough variance attributable to both between- and within-persons in day-level irritation and performance to support the use of multilevel modelling in our study.

To test for mediation effects we first examined the required conditions for mediation following Baron and Kenny (1986; cf. Zhang et al., 2009): a) the predictor must be related to the dependent variable b) the predictor must be related to the mediator and c) the mediator

must be related to the dependent variable. If these conditions are all in the predicted direction, the predictor–outcome relationship will become non-significant (full mediation), or significantly weaker (partial mediation) after the inclusion of the mediator. To examine the significance of the mediating effects we applied the Sobel z-test. If the outcome variable was dichotomous, we used logarithmic regression.

According to Baron and Kenny (1986) there are two sources of bias in the mediational chain: an overestimation of the effect of the independent variable on the dependent variable and the problem of feedback (that the mediator and dependent variables are interchangeable). We counteract the feedback problem by measuring the mediators during the work shift i.e. before the dependent variable. As a result, it can be assumed that the mediator measured during the work shift is not caused by the outcome variable measured in the evening. The overestimation problem occurs when the relationship between independent variable and dependent variable is overestimated and there is a danger of overlooking a potential mediator. It can be minimized by a reliable mediator. During the work shift, we were only able to use a one-item measure for the mediator variables in order not to prolong the interruption caused by our measurement. To address this weakness we also measured the mediator variables in the evening with longer scales which had good reliability. Consequently, we test the mediation effect *twice*: once with a more reliable mediator (measured at the same time point as the outcomes: in the evening) and once with a temporally spaced mediator (measured during the work shift, thus at a different time point than the outcomes).

4.3 Results

Table 4.1 presents the means, standard deviations and intercorrelations for all the variables included in the study.

Table 4.1. Means, standard deviations and correlations among study variables (N = 133 employees, n = 582-619 occasions).

	Variable	*M*	*SD*	1	2	3	4	5	6	7	8
1	Work flow interruptions	3.92	6.73	-	.29**	.24**	.28**	.44***	.30***	-.19*	.12
2	Time pressure (work shift)	11.20	3.73	.33***	-	.83***	.57***	.56***	.27**	-.21*	.22*
3	Mental demands (work shift)	10.96	3.80	.27***	.75***	-	.43***	.53***	.22*	-.17*	.14
4	Time pressure (evening)	3.15	1.11	.30***	.51***	.38***	-	.67***	.37***	-.30**	.19*
5	Mental demands (evening)	3.60	.92	.40***	.49***	.46***	.66***	-	.30***	-.26**	.20*
6	Irritation	2.39	1.08	.23***	.26***	.24***	.38***	.28***	-	-.59***	.26**
7	Satisfaction with one's own performance	3.91	.88	-.17***	-.19***	-.16***	-.27***	-.22***	-.50***	-	-.37***
8	Forgetting of intentions	.13	.33	.14**	.18**	.13**	.11**	.12**	.20***	-.24***	-

Note. Correlations below the diagonal are day-level correlations, for which variables 1, 2 and 3 were averaged across the three work shifts. Correlations above the diagonal are person-level correlations.

* $p < .05$, ** $p < .01$, *** $p < .001$.

Hypothesis 1 proposed a) a positive relationship between work flow interruptions and forgetting of intentions and b) a negative relationship between work flow interruptions and individuals' satisfaction with their performance. Hypothesis 2 proposed a positive relationship between work flow interruptions and irritation. Both hypotheses are the first prerequisite condition for hypotheses 3 and 4 (Baron & Kenny, 1986). As shown in Table 4.2, results support interruptions having a significant positive relationship with forgetting of intentions (*odds-ratio* = 1.08, $p < .01$), a negative relationship with satisfaction with one's own performance ($\beta = -.13$, $p < .05$) and a significant positive relationship with irritation ($\beta = .16$, $p < .01$). Thus, hypotheses 1 and 2 were supported.

The results of the analyses to test for the second and third prerequisite conditions (Baron & Kenny, 1986) are presented in Tables 4.3 and 4.4. Hypothesis 3 proposed that the predicted direct relationships (hypotheses 1 & 2) between work flow interruptions and performance (a, b) and irritation (c) were mediated by mental demands. Hypothesis 4 proposed that the predicted direct relationships (hypotheses 1 & 2) between work flow interruptions and performance (a, b) and irritation (c) are mediated by time pressure.

Table 4.2. Multilevel estimates of hypotheses 1 and 2 and of the first mediation prerequisite condition according to (Baron & Kenny, 1986): independent variable → dependent variable (*N* = 133 employees, and *n* = 624 occasions).

	Forgetting of intentions		Satisfaction with one's own performance		Irritation	
	Odds ratio	CI	*B* (SE)	*β* (SE)	*B* (SE)	*β* (SE)
Intercept	0.12***	[0.09; 0.17]	3.89 (.06)***		2.40 (.08)***	
Interruption	1.08**	[1.02; 1.14]	-0.02 (.01)*	-0.13 (.05)*	0.02 (.01)**	0.16 (.06)**

Note. *B* = unstandardized coefficient; *β* = standardized coefficient; CI = 95% confidence interval.

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

Table 4.3. Multilevel estimates of the second mediation prerequisite condition according to (Baron & Kenny, 1986): independent variable → Mediator (*N* = 133 employees, and *n* = 624 occasions).

	Mental demands				Time pressure			
	Work shift		Evening		Work shift		Evening	
	B (SE)	*B* (SE)	*B* (SE)	*β* (SE)	*B* (SE)	*β* (SE)	*B* (SE)	*β* (SE)
Intercept	10.93 (.27)***		3.61 (.06)***		11.17 (.27)***		3.15 (.07)***	
Interruption	0.18 (.02)***	1.45 (.17)***	0.04 (.01)***	0.36(.05)***	0.20 (.02)***	1.60 (.16)***	0.06 (.01)***	0.45 (.06)***

Note. *B* unstandardized coefficient, *β* standardized coefficient.

*** $p < .001$.

Table 4.4. Multilevel estimates of the third mediation prerequisite condition according to (Baron & Kenny, 1986): mediator → dependent variable (*N* = 133 employees, and *n* = 624 occasions.).

		Forgetting of intentions		Satisfaction with one's own performance		Irritation	
		Odds ratio	95 % CI	*B* (SE)	*β* (SE)	*B* (SE)	*β* (SE)
Model1	Intercept (Mental demands, work shift)	0.12 ***	[0.09; 0.17]	3.89 (.06)***		2.40 (.08)***	
	Mental demands	1.12^{t}	[0.99; 1.27]	-0.03 (.01)*	-0.12 (.05)*	0.08 (.01)***	0.31 (.05)***
Model2	Intercept (Mental demands evening)	0.12***	[0.09; 0.17]	3.90 (.06)***		2.39 (.08)***	
	Mental demands	1.36	[0.89; 2.06]	-0.16 (.05)**	-0.15 (.04)**	0.28 (.05)***	0.26 (.04)***
Model 3	Intercept (Time pressure, work shift)	0.12***	[0.09; 0.17]	3.89 (.06)***		2.40 (.08)***	
	Time pressure	1.14*	[1.00; 1.29]	-0.03 (.01)*	-0.12 (.05)*	0.07 (.01)***	0.25 (.05)***
Model 4	Intercept(Time pressure, evening)	0.13***	[0.09; 0.17]	3.90 (.06)***		2.40 (.08)***	
	Time pressure	0.15	[0.81, 1.64]	-0.14 (.04)**	-0.15 (.04)**	0.32 (.04)***	0.35 (.04)***

Note. *B* = unstandardized coefficient; *β* = standardized coefficient; CI = 95% confidence interval.

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

The results show that the second precondition of mediation was supported in all hypotheses. Work interruption had a significant effect on the mediator's time pressure (both evening and work shift measurement) and mental demands (evening- and work shift measurement). The third precondition was fully supported for hypotheses 3b, 3c, 4b and 4c. The mediator's time pressure (evening and work shift measurement) and mental demands (evening and work shift measurement) had a significant negative effect on satisfaction with one's own performance and a significant positive effect on irritation. The precondition for hypotheses 3a and (partly) 4a is not supported. Time pressure evening (*odds ratio* = .13, p = .444) and mental demands (evening: *odds ratio* = 1.36, p = .153; work shift: *odds ratio* = 1.12, p = .077) did not have a significant effect on forgetting of intentions. The exception was time pressure work shift (*odds ratio* = .12, $p < .05$). Thus, hypothesis 3a is rejected. The final mediation test of hypotheses 3b, 3c, 4b and 4c is presented in Table 4.5.

Table 4.5. Multilevel estimates of the mediation: independent variable + mediator → dependent variable (N = 133 employees, and n = 624 occasions).

		Satisfaction with one's own performance			Irritation		
		B (SE)	β (SE))	*Sobel*	*B* (SE)	β (SE)	*Sobel*
Model1	Intercept (Mental demands, work shift)	3.89 (.06)***			2.40 (.08)***		
	Interruption	-0.01 (.01)	-0.09 (.06)		0.01 (.01)	0.05 (.06)	
	Mental demands	-0.02 (.01)	-0.09 (.06)	-1.54	0.08 (.01)***	0.29 (.06)***	4.41***
Model 2	Intercept (Mental demands, evening)	3.89 (.06)***			2.40 (.08)***		
	Interruption	-0.01 (.01)	-0.08 (.06)		0.01 (.01)	0.06 (.06)	
	Mental demands	-0.14 (.05)**	-0.13 (.04)**	-2.65**	0.26 (.05)***	0.24 (.04)***	4.22***
Model 3	Intercept (Time pressure, work shift)	3.89 (.06)***			2.40 (.08)***		
	Interruption	-0.01 (.01)	-0.09 (.06)		0.01 (.01)	0.06 (.01)	
	Time pressure	-0.02 (.02)	-0.08 (.06)	-1.38	0.06 (.02)***	0.23 (.06)***	3.59***
Model 4	Intercept (Time pressure evening)	3.89 (.06)***			2.40 (.08)***		
	Interruption	-0.01 (.01)	-0.08 (.06)		0.00 (.01)	0.02 (.06)	
	Time pressure	-0.12 (.04)**	-0.13 (.04)**	-2.66**	0.31 (.04)***	0.35 (.04)***	5.26***

Note. *B* = unstandardized coefficient; β = standardized coefficient, * $p < .05$; ** $p < .01$; *** $p < .001$.

Hypotheses 3c and 4c were supported by the results since the significant effect of work interruptions on irritation became non-significant after including the mediators time pressure (evening: β = .02, p = .710; work shift: β = .06, p = .288) and mental demands (evening: β = .06, p = .258; work shift: β = .05, p = .425) respectively. Hypotheses 3b and 4b were partially supported by the results since the significant effect of work interruption on satisfaction with one's own performance also became non-significant after including the mediators time pressure (evening: β = -.08, p = .179; work shift: β = -.09, p = .165) and mental demands (evening: β = -.08, p = .165; work shift: β = -.09, p = .104) respectively. However, the mediators time pressure (work shift: β = -.08, p = .108; *Sobel* = -1.38, p = .169) and mental demands (work shift: β = -.09, p = .119; *Sobel* = -1.54, p = .123) also became non-significant themselves. The results of the mediation test of hypothesis 4a (work shift) mean that this hypothesis cannot be supported (time pressure: *odds ratio* = 1.07, p = .363; interruption: *odds ratio* = 1.07, $p < .05$; *Sobel* = .91, p = .364).

To further rule out common method bias, and underscore the direction of causality within our results, we tested - using multilevel analysis - whether our outcome variables measured in the evening (irritation, satisfaction, forgetting of intentions) had an effect on the number of interruptions reported the following day. There were no significant effects (irritation: β = .43, p = .148; satisfaction with performance: β = -.26, p = .443; forgetting of intentions: β = .06, p = .948). This indicates that the number of reported interruptions on a given day is not influenced by the 'state' of participants as a result of interruptions during the previous day.

4.4 Discussion

In this study we examined work flow interruptions on the job as a daily stressor by applying a within-person approach. The number of work flow interruptions experienced during a working day was found to be related to an increase in the forgetting of intentions, a decrease in the satisfaction with one's own performance and heightened irritation in the evening.

Furthermore, mental demands, as well as time pressure, were shown to act as mediators in the relationship between work flow interruptions and both satisfaction and irritation. They did not mediate the relationship between work flow interruptions and forgetting of intentions however.

These results are in line with the assumptions of action theory (Hacker, 2005) and goal-activation-theory (Altmann & Trafton, 2002). Accordingly, interruptions can be classified as stressors, which are related to decreased performance and increased strain.

The impact of work flow interruptions on forgetting of intentions was not mediated by time pressure or by mental demands, although both emerged as related to work flow interruptions. The non-significant mediation, i.e., that time pressure and mental demands were not related to forgetting of intentions in our sample of nurses, is nonetheless interesting. Although Einstein et al. (2003) assumed that forgetting of intentions is caused by the demands put on the prospective memory and intended actions have to be delayed and kept in the memory due to the demands of a current task or situation, our non significant findings suggest that other mechanisms may be at play. Given our results, further research may be needed to examine which attributes or consequences of interruptions do cause errors in prospective memory. The intensity of the distraction, for example, might be a relevant avenue of enquiry. What is more, mental demands may be too general a concept. Instead, the length of the delay (until the primary task can be resumed) or the complexity of the interruption task might be better predictors of the likelihood of forgetting of intentions. According to goal activation theory (Altman & Trafton, 2002), the length of the delay influences the activation of the action plan; long delays raise the risk of forgetting of intentions. A possible coping strategy is to keep the primary goal (as opposed to the intention to do the interrupted task) activated during the accomplishment of the interruption task (Monk et al., 2004). If the person already has further intentions in her/his prospective memory (tasks which she/he does not want to forget), the

memory demands will be even higher and this is a typical strategy used by nurses to cope with high workload (Grundgeiger & Sanderson, 2009). Keeping the primary goal activated is only possible if the interruption task is not too complex (Monk et al., 2004). Based on this reasoning, the length of the delay and the complexity of the interruption are factors that seem likely to influence the memory demands triggered by interruptions. Hence, these qualitative features might explain the link between work flow interruptions and forgetting of intentions better than the number of work flow interruptions.

There were mixed results with respect to the mediation effects in the relationship between work flow interruptions and satisfaction with one's own performance. All conditions of the classic mediation model (Baron & Kenny, 1986) were met. That is, there was a significant negative relationship between work flow interruptions during the day and satisfaction with one's own performance in the evening. Furthermore, interruptions were positively related to the potential mediators mental demands and time pressure, whether they were assessed during the work shift or in the evening. However, the proposed mediation effect was only supported for mediators assessed in the evening. A possible explanation for these results may be found in the day-to-day routine of nurses. Work flow interruptions and the (work shift-) mediators were measured three times a day. The last measurement was one to two hours before the end of the work shift. In these last hour(s) the workload tends to decrease. The patients often have an afternoon rest and the nurses and therapists complete their patient care documentation. During that time it is possible to accomplish any unfinished tasks, which may have an effect on the satisfaction a nurse feels with their own performance, which is rated in the evening. Accordingly, the probability of finding a mediation effect using the evening mediators, which are also retrospective, rather than taking the work shift mediators, which are measured during a comparatively high workload period (i.e., most parts of the day), may be higher.

It is possible that the effect of interruptions on performance in hospitals may be buffered by the workload level (interruptions, time pressure, mental demands) at the end of the work shift. Tables 4.3 and 4.5 show that work shift measures (of the mediators and the independent variable) are more weakly related to satisfaction with one's own performance than evening measures (of the mediators). This buffering effect seems not to apply to the outcome irritation. The impact of interruptions on irritation (i.e., rumination and emotional strain) was mediated by time pressure, as well as mental demands, regardless of whether they were assessed during the work shift or in the evening. Thus, future studies may usefully test the buffering effect of reduced workload at the end of the work shift.

In conclusion, we found that the daily number of work flow interruptions was related to two different factors related to performance: forgetting of intentions and satisfaction with one's own performance. This replicates findings of laboratory studies (Bailey & Konstan, 2006; Eyrolle & Cellier, 2000; Trafton et al., 2003) but has ecological validity. Further, we demonstrated that interruptions also have an impact on irritation on a continued daily basis, adding to prior results of cross-sectional studies (Grebner et al., 2003; Konradt et al. 2003). Our study provides the first evidence of the possible intervening processes explaining the effects of work flow interruptions. Interruptions lead to higher time pressure and higher mental demands, which can explain decreasing (satisfaction with) performance and increasing irritation. Our findings support the assumptions of action theory (Hacker, 2005) that interruptions are a stressor because of the additional effort, through the higher mental demands, that they require. The accumulating time loss leads to increased time pressure. These demands decrease the performance and increase the perception of irritation. The intervening processes linking work flow interruptions with forgetting of intentions require further examination through exploring alternative mechanisms such as those more related to memory. Thus, future research should address other explanatory mechanisms (third variables) of work flow

interruptions. Possible third variables to examine may include memory demands, task load or the need to multitask.

4.4.1 Limitations and suggestions for future research

The design of this study has a number of advantages over cross-sectional field studies dealing with correlates of work flow interruptions at work. However, a number of limitations of the research also need to be considered.

First, all measures were assessed using self-report data. This potentially entails the risk of self-serving bias and socially desirability in responses. However, since we were examining within-person effects in this study, and centred predictor variables around the respective person mean, the reported effects cannot be attributed to between person differences. Future research should nonetheless try to replicate these findings by employing more objective measures. Interruptions could be observed by trained raters. Either during observations, but also in self-reported data, further features of work flow interruptions could be investigated. As we know from laboratory research, the timing of interruptions (Monk et al., 2004), the complexity and interference of tasks or the similarity of tasks (Gillie & Broadbent, 1989) can make a difference.

Also, performance indicators could be obtained from supervisors. Alternatively, objective indicators could be used, such as strain measured using physiological indicators. For any indicators used it is important that they are sensitive enough to reflect short term fluctuations.

Second, the assessment of certain variables was carried out at the same time point (e.g., the independent variable and the proposed mediators, or the mediators and the dependent variables at three occasions during the work shift and in the evening). This may be the cause of common method variance (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). However, data were gathered over the course of five days and the independent variable, the mediators

and the dependent variables were at least partially separated in time. Further, as the last assessment during the work shift was circa one or two hours before the end of the work shift, it is possible that during the remaining time of the work shift our respondents had time to accomplish unfinished tasks. Time pressure and mental demands might be lower at the end of the work shift. Future research may also opt to assess job demands at the end of the working day, in order to avoid this problem.

Third, carrying out the assessment during an individual's work shift may be seen as intrusive since the reminder provided by the handheld device to key in responses is in itself an additional interruption (Ohly et al., 2010). However, in an observation study, an average of 62.8 interruptions (*SD* = 36.7, *range*: 13-149, Baethge & Rigotti, 2013b) were recorded during a morning shift of a nurse. Thus, three additional interruptions account for less than 5% of the average number of daily interruptions in this occupational group. Furthermore, the time needed to complete the daily survey was very short – on average 3 minutes. Therefore it is unlikely that reported effects are caused by the extra efforts entailed in participating.

Fourth, within a sample of nurses interruptions are very frequent events. An interesting question might be whether these results can be replicated in other occupations with fewer interruptions. The majority of field research on interruptions has been conducted in hospitals (Rivera-Rodriguez & Karsh, 2010; Tucker & Spear, 2006). We speculate that in different occupations interruptions and the mediators may have different effects. There is evidence that interruptions and time pressure may also act as challenge factors (Mark et al., 2008; Widmer et al., 2012). Mark et al. (2008), for example, found that interruptions (of simple and repetitive tasks, during a limited time frame) led to a faster accomplishment of tasks at the expense of increases in effort, time pressure, frustration and mental demands. Thus it can be assumed that in certain occupations conditions exist in which interruptions (and time pressure) act as challenge stressors. According to Hockey (1997), stressors can lead to increased performance

at the expense of raised effort, but this cannot be sustained indefinitely. In the occupation of nursing, interruptions happen too frequently and time pressure is too prominent to act as a challenge stressor. To assess the generalizability of our findings it would be worthwhile studying other occupational fields. General job characteristics (assessed as between-person factors on level 2), such as average complexity, time pressure and decision latitude may act as cross-level moderators.

Finally, although predictors and criteria were assessed at different points in time, we cannot make causal inferences. Experimental designs would be necessary in order to definitively rule out reverse causations. The use of a cross-lagged panel design would permit the identification of such reverse effects. However, in our study we were able to prove that the evening measures of performance satisfaction, forgetting of intentions and irritation did not have a substantial relationship with work flow interruptions reported the next day. In addition to this, a longitudinal design with longer time lags would provide further insights into the process of interruptions and long-term effects.

4.4.2 Practical implications

The findings point to promising directions for interventions in the field of occupational health promotion. We found that work flow interruptions decrease performance and increase irritation (a mediator between stressors and severe health problems like depression and psychosomatic complaints, Dormann & Zapf, 2002; Höge, 2009). Therefore, employers and employees alike should be interested in reducing unnecessary interruptions and in furthering their knowledge of the potential coping strategies of interruption events. As work flow interruptions mainly occur as a social phenomenon they should also be dealt with at the team or even organizational level. A promising instrument in establishing comprehensive health promotion in the workplace is the participative approach of health circles. According to Aust and Ducki (2004), health circles can be described as "[…] discussion groups, formed at the

workplace, to develop change options for the improvement of potentially harmful working conditions" (p. 259). Health circles allow employees – the experts in their jobs and of their working conditions – to find opportunities to reduce workflow interruptions. A group of 6-15 employees, each of them a possible interrupter her/himself, analyses the occurrence of interruptions and discusses ideas for their reduction, during the course of between 6 and 10 meetings.

Having knowledge of mediating variables can also help to avoid the negative effects of work flow interruptions. Since work flow interruptions have a negative effect on irritation (and satisfaction with one's own performance) via high mental demands and time pressure, a possible intervention would be to keep interruptions short, i.e., reducing time pressure. Further, strategies can be used to reduce mental demands after the occurrence of work flow interruptions. In experimental studies it was found that a delay in the accomplishment of interruptions leads to better performance (Ho et al., 2004). The time slot between the occurrence of an interruption (e.g., the sound of a telephone bell) and the accomplishment of the interruption (e.g., answering the telephone call) can be used to finish the interrupted task or at least to finish parts of the interrupted task. This will disburden the working memory and reduce the time taken to resume the task (Monk et al., 2004). An alternative is to make notes about the steps of the interrupted tasks, in order to take the load off the prospective memory and prevent the forgetting of intentions.

Moving from the laboratory to the field, and applying a within-person approach, this study provides original evidence that interruptions at work can be classified as daily stressors. Interruptions are likely to become one of the most frequent demands in modern working life. Learning about the mechanisms linking work flow interruptions to lowered performance and higher strain in ecological contexts is therefore a valuable research avenue to pursue.

Chapter 5:

Three-way interactions among interruptions / multitasking-demands, age, and cognitive abilities: A diary study[3]

Abstract

In this study, we examined the within-person relationships between workday "cognitive" stressors (multitasking demands and workflow interruptions) and strain (mood throughout the day and irritation in the evening). We hypothesized that chronological age and indicators of functional age (working memory capacity and alertness) would moderate these relationships in that older employees with low alertness and working memory abilities would suffer most from the stressors. We conducted a 5-day diary study in a sample of 133 nurses with four measurements per day (three taken during the work shift and one taken in the evening) and one survey (age) and computer-based cognitive performance test before the diary survey. Multilevel analyses showed that multitasking and workflow interruptions have detrimental effects on mood (valence and calmness) and irritation. No main effect was found on energetic arousal. Age and alertness moderated the relationships between multitasking demands and interruptions and irritation. Furthermore, age and working memory moderated the relationships between multitasking demands and interruptions and valence and calmness. Additionally, age and alertness moderated the relationships between multitasking demands and valence. Three-way interactions did not show the predicted pattern. Basic cognitive abilities (working memory ability and alertness) do make a difference for the coping of stressors for younger employees but not for their older colleagues. According to the findings older employees seem to have abilities to deal with the stressors that outweigh possible cognitive losses.

[3] This study is currently submitted for publication in a peer-reviewed journal. The paper was written by Anja Baethge (first author) and co-authored by Thomas Rigotti.

5.1 Introduction

Having two deadlines in one day, communicating by messenger while working on a text, trying to concentrate on one task while interrupted by a call, and having not finished this call, when somebody is knocking on the door—some working days are fragmented, overloaded, and characterized by workflow interruptions and multitasking demands. The question addressed in this study is whether older employees have more difficulties to cope with these demands. Workflow interruptions and multitasking situations call for a high alertness (i.e. processing speed) and high level of memory skills (König et al., 2005). These abilities are known to decline with age (for a meta-analysis see Hedden & Gabrieli, 2004). If these important resources for coping with multitasking and work interruptions (König et al., 2005) deteriorate over the lifespan, it can be assumed that these stressors will lead to more strain.

To test this assumption, we conducted a diary study over five consecutive working days, measuring multitasking demands and workflow interruptions during the work shift and strain (mood and irritation) during the work shift and in the evening. Before the diary assessment, we tested the alertness and working memory of the participants using cognitive performance tests. Thus, we considered two conceptualizations of age on the stressor-strain relationship: chronological age and an aspect of functional age (cognitive abilities, cf. Schalk et al., 2010). We chose to examine nurses, as interruptions and multitasking demands are highly prevalent in health care (Boisard et al., 2003).

As we are confronted with an aging workforce, it is important to test, whether older employees are able to cope with increasing demands of interruptions and multitasking. We sought to make two contributions to age research. First, we extended the actual research on age effects by considering both chronological age and cognitive abilities (as an indicator of functional age) using a multisource approach. Second, we matched specific stressors (cognitively demanding interruptions and multitasking) that are particularly relevant in the examined

occupation with their adequate resources (attention and working memory) (cf. Jonge, Dollard, Dormann, Le Blanc, & Houtman, 2000), instead of measuring the effect of age and more general coping strategies on stressors.

We will first review theoretical and empirical evidence on the relationship of the interruptions and multitasking demands with strain (mood and irritation). Then we will present arguments for proposing age and the cognitive resources (alertness and working memory) as moderators.

5.1.1 Workflow interruptions and multitasking demands

Work interruptions have been defined as temporary suspensions of goal-directed action (Brixey et al., 2007). The interrupted persons are pulled out of their action and diverted from an actual goal (Frese & Zapf, 1994). We focused on interruptions that are "*externally* initiated and caused by intrusions of secondary, unplanned tasks *within* the accomplishment of another (a primary) task" (Baethge & Rigotti, 2013a, p. 44; cf. Jett & George, 2003). For example, a nurse who is doing a documentation (primary task) is interrupted by a student nurse (externally initiated interruption), who is asking for help because he or she cannot find a certain medicine. The nurse will stop his or her action to go to the medicine cupboard to look for the medicine (accomplishment of the second task). The workflow of the interrupted person has been distracted. The person has to switch his or her attention from the primary task to the interruption task. The status of goals and action rules of the interruption task must be retrieved (Monsell, 2003), and the new task needs to be accomplished. After finishing the interruption task, attention has to be shifted back and the primary task needs to be resumed. Workflow interruptions are not only demanding of the employees' attention but also of their working memory. During the accomplishment of the interruption task, the person needs to keep the intention to do the primary task in mind (Einstein et al., 2003). Beyond that, the resumption of the primary task will be faster if the person is able to store information related to the primary

task during the accomplishment of the interrupting task than if the person is not able to do that (Altmann & Trafton, 2002).

In this regard, the demands of work interruptions are comparable to the demands of multitasking. Multitasking can be described as a situation in which multiple task goals are accomplished in "the same general period by engaging in frequent switches between individual tasks (Delbridge, 2000, p. 1)" (König et al., 2005, p. 244; Law et al., 2004). For example, a nurse is checking laboratory results of a patient and is answering questions from a doctor about another patient. Multitasking is commonly a continuous sequence of task switching (cf. König et al., 2005) with a higher pace than in the case of work interruptions (Salvucci, Taatgen, & Borst, 2009). Multitasking leads to ongoing high demand on attention and working memory (Bühner et al., 2006; König et al., 2005). The person has to keep and handle two tasks at once in the working memory and has to switch his or her attention continuously between these tasks. A high information-processing speed is needed. But multitasking is, in contrast to dealing with work interruptions, self-determined (Salvucci, 2005). The person can choose the best switching points.

5.1.2 Main effects of work interruptions and multitasking on mood and irritation

Despite differences in processing, multitasking and work interruptions cause a high workload, put high demands on the person's working memory and attention (Mark et al., 2008). An ongoing overload of the working memory and attention resources is likely to increase the risk of overtaxing the person and lead to strain. According to the compensatory control model (Hockey, 1997); such high-load situations can be handled by investing more effort (Colligan & Bass, 2012; Mark et al., 2008). The higher effort (e.g., higher concentration, working faster, fewer breaks) can prevent declining performance, but it leads to compensatory costs. Compensatory costs are "unwanted side-effects of the compensatory behaviour helping to maintain primary performance under extreme conditions" (Hockey, 1997, p. 86), namely

negative affect, physiological arousal, and fatigue (Bolger, Delongis, Kessler, & Schilling, 1989; Hockey, 1997). The person feels discontent, tired, and tensed.

5.1.2.1 Mood

The conceptualization of mood, as suggested by Schimmack (1999) and Wilhelm and Schoebi (2007), covers these three aspects. Mood is an empirically well confirmed short-term indicator of strain (Barling & Macintyre, 1993; Brose, Schmiedek, Lövde´n, & Lindenberger, 2011; Jones & Fletcher, 1996). Experimental and simulation studies (of office work) found that a high rate of interruptions increased mental workload and effort (Mark et al., 2008), and as a result, the persons perceived more stress and negative emotions (Bailey & Konstan, 2006; Mark et al., 2008). A positive relationship between work interruptions and fatigue and negative affect at the end of the day was also found in a field study with military parachute trainers (Zohar, 1999). Also, multitasking demands are associated with negative affect and fatigue at the end of the day. Costa (1993) found a decreasing positive state of mood and increasing fatigue from the beginning until the end of the shift in a sample of air traffic controllers who experienced increasing workload and multitasking demands during their shift. Barling and Macintyre (1993) found that daily overload (i.e., dealing with too many tasks at once) led to negative mood; and Healy and McKay (2000) found that a high workload led to negative mood in a sample of 129 nurses. Thus, we assumed that demands such as multitasking and interruptions can overtax the person and lead to negative mood in terms of valence, calmness, and energetic arousal.

5.1.2.2 Irritation

Besides the short-term effect on mood, we also assumed that interruptions and multitasking demands would strain the person for a longer duration than just the working time. This likely spillover effect is consistent with the compensatory control model (Hockey, 1997) and the conservation of resources theory (Hobfoll, 1989). In the compensatory control model,

higher effort (e.g., a high concentration level to cope with ongoing multitasking demands and work interruptions) enables good performance in high-load situations but at the expense of compensatory costs (Hockey, 1997). The constraint is that this higher effort cannot be sustained indefinitely, and exhaustion and declining performance become more likely (i.e. fatigue aftereffects, Hockey, 1997).

According to the conservation of resources theory, loss of resources can cause further losses and this will lead to a loss spiral (Hobfoll, 1989). The person will be less able to cope with future stressors (e.g., further work interruptions or multitasking situations, cf. Hobfoll, 1989). Research in the field of cognitive psychology showed that continuous work interruptions and long-lasting multitasking can decrease performance (Funke, Matthews, Warm, & Emo, 2007; Trafton et al., 2003). Overloading and stressful working conditions and the associated losses (cf. Hockey, 1997; Hobfoll, 1989) can also reduce the ability to recover (Berset, Elfering, Luethy, Luethi, & Semmer, 2011). The person is exhausted, decreasing performance leads to feelings of frustration and dissatisfaction (Gabriel, Diefendorff, & Erickson, 2011; Mark et al., 2008), and the person might ruminate about the stressful working day and goals not achieved (Semmer, 1996).

A good medium-term indicator of this kind of strain is irritation. It involves both emotional (e.g., reacting grumpily) and cognitive strain (rumination) (cf. Mohr et al., 2006). A positive relationship between work (flow) interruptions and irritation was found in a sample of 72 employees (data processing, telecommunication, financial services, Konradt et al. , 2003). Furthermore, Jacobshagen, Amstad, Semmer, and Kuster (2005) reported in their study with 143 top managers that overload (too many tasks at once) was significantly positively related to irritation. This led us to the following hypotheses:

Hypothesis 1: A high frequency of work interruptions during the working day is negatively related to mood—(a) valence, (b) calmness, and (c) energetic arousal—during the working day and positively related to (d) irritation at the end of the day.

Hypothesis 2: High multitasking demands during the working day are negatively related to mood—(a) valence, (b) calmness, and (c) energetic arousal—during the working day and positively related to (d) irritation at the end of the day.

5.1.3 Age as moderator in the cognitive stressors-strain relationship

When examining age, different conceptualizations can be considered (Schalk et al., 2009). Age can be divided into chronological (the calendar age), functional (physiological age), psychosocial (own and other stereotypes about the age of one person), organizational (job tenure) and life span (private situation) age (Schalk et al., 2009). When examining age in the context of dealing with 'cognitive' workplace stressors -such as multitasking and interruptions- chronological, functional and organizational age seems to be most important. As chronological and organizational age (job tenure) are often highly confounded (in our sample: $r = .99$; $p < .001$). We decided to focus on chronological age. Facing the aging workforce, our primary interest was to explain, if older employees can cope with demands like work interruptions and multitasking to draw on the actual public and scientific discourse on the demographic change (Roth, Wegge, & Schmidt, 2007; Schalk et al., 2009; Silverstein, 2008). To advance the discussion we also include indicators of functional age (i.e. cognitive abilities), as they could be shown to be important aspects in dealing with multitasking demands, or task switching (e.g., Kray & Lindenberber, 2000).

5.1.3.1 Cognitive loss over the lifespan

Multitasking and work interruptions put high demands on working memory, processing speed, and other attentional facets. These cognitive functions decline across the adult

lifespan—starting at the age of 20–25 years (Hedden & Gabrieli, 2004). Working memory has been described inter alia as "the process by which a remembered stimulus is held 'on-line' to guide behaviour in the absence of external cues or prompts" (Goldman-Rakic as cited in Owen, McMillan, Laird, & Bullmore, 2005, p. 46). This definition is consistent with the above-described cognitive demands necessary to cope with multitasking or workflow interruptions.

Attention has two main aspects: the intensity and the selectivity aspect (Cohen, 1993; Posner & Boies, 1971). The selectivity aspect describes the ability to divide and to focus attention. The intensity aspect "captures the ability to respond quickly on briefly presented stimuli" (König et al., 2005, p. 250). The attention intensity is the basic aspect of attention and constitutes the basis for the more complex and capacity-demanding attention selectivity (Sturm & Willmes, 2001). It is also called alertness or processing speed. Alertness can be differed in tonic and intrinsic or phasic alertness. The tonic alertness is the state of being awake (thus a fluctuating alertness within days or hours) and the intrinsic and phasic alertness describes the ability to focus the attention and is thus more stable. In this paper we will focus on the latter (stable) type of alertness and when we use the word alertness, we refer to a stable trait. Prior empirical evidence has led researchers to conclude that alertness is positively related to multitasking performance (Bühner et al., 2006; König et al., 2005). Persons with high alertness are able to react quickly in a changing situation; they can switch between the tasks at high speed (Kray & Lindenberger, 2000). As stated in the "processing-speed theory of adult age differences in cognition" (Salthouse, 1996), processing speed (i.e. alertness) is assumed to be the core mediator in the relationship between age and a variety of cognitive performance indicators. Through meta-analysis, researchers have corroborated that cognitive slowing with age is a very consistently reported phenomena (Salthouse, 1985).

We can conclude from this that older people on average have fewer resources to cope with the demands of multitasking and interruptions. In line with this, laboratory and simulation studies showed that older people (about 60 years) perform worse in interruption and multi-tasking tasks than younger ones (20–30 years) (Alm & Nilsson, 1995; Kliegel, Mackinlay, & Jäger, 2008; Monk et al., 2004; Riby, Perfect, & Stollery, 2004).

A lower working memory capacity and lower alertness may also result in higher strain when confronted with demands that require those resources. The coping with multitasking and workflow interruptions is likely to produce higher compensatory costs (fatigue, negative affect, tension) (Hockey, 1997). Stawski, Almeida, Lachman, Tun, and Rosnick (2010) found that fluid cognitive ability (working memory, alertness, and executive functions) moderated the positive relationship between daily work overload and negative mood, such as, that people with lower fluid cognitive abilities perceived a higher degree of negative mood in overloading situations than people with high alertness, working memory abilities, and executive functions. Higher compensatory costs also mean a higher loss of resources and, according to the compensatory control model, more difficulties in regaining these resources (Hobfoll, 1989). Consequently, they should result in more difficulties to recover. Hence, we assume that multi-tasking demands and interruptions lead to more negative moods and an increase of irritation for older employees than for their younger colleagues.

5.1.3.2 Motivational and emotional trajectories related to aging

In contrast to the cognitive loss hypothesis, there are assumptions of developmental psychologists that older people perceive less emotional strain for two reasons. First, they have a higher motivation to maximize well-being (Brose et al., 2011; cf. socioemotional selectivity theory: Carstensen, Fung, & Charles, 2003). Second, they have higher affective skills, which facilitate the management of their emotions and interpersonal interactions (Blanchard-Fields, 2007). Accordant to these hypotheses, there are findings that older people have less variety in

their emotional reactions than younger ones and react less negatively to stressors (Brose et al., 2011).

Additionally, other studies found no differences between older and younger persons in their emotional reaction to stress (e.g., Stawski, Almeida, Sliwinski, & Smyth, 2008). The peculiarity of these studies is that they compare extreme groups and that the older group usually is retired. In one study, Brose, Scheibe, and Schmiedek (2013) showed that the decreased variety of emotional reactions of older (retired) people can be widely explained by the difference between older and younger persons in their contextual factors. Older (retired) adults "(a) experienced fewer stressors overall, (b) had less heterogeneous stressor profiles, and (c) reported that stressors had less impact on daily routines" (Brose et al., 2013, p. 148).

Further developmental studies have not specifically focused on "cognitive stressors" such as multitasking and interruptions but, rather, have addressed stressors such as social, financial, or health-related problems. To cope with these stressors, likely not working memory and alertness will be relevant but rather affective skills, which are assumed to grow and not to decline with age (Rauschenbach & Hertel, 2011). For the kind of stressors that we examine, cognitive resources play a major role. Stawksi et al. (2010) found just moderating effects of fluid intelligence (working memory, alertness) for the effect of overload stressors and not for the effect of interpersonal stress on negative mood. Thus, moderating effects seem to be contingent upon the type of stressor studied. In our case of cognitive demanding stressors, we expect that the cognitive loss theory would be more relevant than the socioemotional selectivity theory. This leads us to the following hypotheses:

Hypothesis 3: Age moderates the relationship between work interruptions and mood and irritation, such that work interruptions will have more negative relationships with (a) valence, (b) calmness, and (c) energetic arousal and a more positive relationship with (d) irritation when age is high than when age is low.

Hypothesis 4: Age moderates the relationship between multitasking and mood and irritation, such that multitasking will have more negative relationships with (a) valence, (b) calmness, and (c) energetic arousal and a more positive relationship with (d) irritation when age is high than when age is low.

5.1.3.3 Consideration of higher variability in older age: Three-way interactions

We have discussed that older employees should have more difficulties in coping with multitasking demands and work interruptions than their younger colleagues because of their comparatively lower fluid cognitive abilities. But laboratory studies showed that this decline was not experienced by every older person to the same extent (Hedden & Gabrieli, 2004). The variability across individuals concerning alertness and working memory ability increases with age (Hedden & Gabrieli, 2004). Fontani (2004) tested people of different age groups with a battery of simple and complex attention and working memory tests (tests for attentional performance [TAP]). He showed that age groups above 46 years showed worse mean performance in alertness and working memory tests as younger participants but that between-person variance was significantly higher than in the younger groups. Hedden and Gabrieli (2004) reported that there were older people who showed the same performance as persons in their mid-twenties (Hedden & Gabrieli, 2004). However, young people showed just a small between-person variance in their working memory and alertness performances. Thus, we assumed that there are older employees who have similar cognitive resources as their younger colleagues in dealing with multitasking and interruptions. Because these cognitive abilities seem to be crucial for dealing with workflow interruptions and multitasking, this group should show equally low difficulties in coping with such tasks as their younger colleagues. This led us to the following hypotheses:

Hypotheses 5 and 6: There will be a three-way interaction among work interruptions, age, and alertness in explaining mood and irritation. Specifically, (H5) work interruptions, and

(H6) multitasking-demands will have the strongest negative association with mood—(a) valence, (b) calmness, and (c) energetic arousal—and the strongest positive association with (d) irritation when age is high and the alertness is low. In all the other cases, the relationship between work interruptions and mood and irritation will be weaker.

Hypotheses 7 and 8: There will be a three-way interaction among work interruptions, age, and working memory in explaining mood and irritation. Specifically, (H7) work interruptions and (H8) multitasking demands will have the strongest negative association with mood—(a) valence, (b) calmness, and (c) energetic arousal—and the strongest positive association with (d) irritation when age is high and the working memory ability is low. In all the other cases, the relationship between work interruptions and mood and irritation will be weaker.

5.2 Method

5.2.1 Sample and procedure

We recruited study participants by approaching 56 hospitals by phone and requesting participation. Ten agreed to take part in the study. After the nursing directors expressed their intention to participate, we settled the period of the examination, and the nursing directors looked for volunteers who had (or could arrange to have) five consecutive morning shifts during that study period. Prior to the diary study, participants were asked to complete a general survey that assessed demographic data; they performed cognitive tests and were introduced to the use of handheld computers (Eten Glofiish X610/50; software: Izy Builder Research). The cognitive tests were done in a separate quiet room in the hospital using laptops from the (authors') university. During the five days of the diary study, participants estimated their stressors and mood three times during their shift. A signal in pseudo-randomized intervals (randomized within three different intervals—at the beginning, in the middle, and end of

the shift; with the constraint that at least one hour had to be between two signals) informed them to fill in the shift questionnaires. Furthermore, they were asked to fill in an evening survey about their irritation before they went to bed. The data acquisition from all participants took place between June and December 2010.

The general survey, the diary survey, and the cognitive tests were completed by 129 nurses. We chose this occupation to test our hypotheses because interruptions and multi-tasking are experienced very frequently in this setting (on average, 63 interruptions and 67 multitasking situations during the morning shift) (Baethge & Rigotti, 2013b).We excluded six nurses from our analyses because their errors or reaction times in the cognitive tests were more than 3 SD above (or below) the mean of all participants (cf. Ratcliff, 1993). The final sample consisted of 123 nurses (7.3% males) from 10 German hospitals. Mean age was 40.81 years (*SD* = 11.59; *range* = 21–61 years) and mean organizational tenure was 18.33 years (*SD* = 12.25; *range* = .10–43 years. Most of the participants (81.3%) were employed full time and in a permanent position (82.1%). They worked in inpatient wards in the following specialties: internal medicine (24.4%), surgery (17.9%), neurology (14.6%), paediatrics (7.3%), intensive care (6.5%), gynaecology (5.7%), ENT (3.3%), dermatology (1.6%), geropsychiatry (0.8%), urology (0.8%), emergency ward (0.8%), and others (8.1%).

5.2.2 Measures

It is recommended that daily measurements be constructed as short as possible to avoid decreasing participation and to minimize intrusive effects (Reis & Gable, 2000). To this end, we used short scales for both the work shift questionnaire and the evening questionnaire.

5.2.2.1 Shift measures

A mean value of all three measurement occasions for one day was calculated for each scale (workflow interruptions, multitasking demands, valence, calmness and energetic arousal).

Workflow interruptions. The participants were required to estimate the number of interruptions occurring from six different sources (doctors, nurses, patients, assistants, technical problems, telephone) during the previous half hour at three times during the shift. An example item was: "How often have you been interrupted by a nurse during the last half hour?"

Multitasking demands. To measure multitasking demands, we used four items that measured demands that come along with multitasking. Wording of the items were: "I had to keep several things in mind during the previous half hour." "I got tasks, which I had to accomplish simultaneously, during the last half hour." "It happened during the last half hour that several persons simultaneously asked me to do something." "There were tasks during the last half hour that required full concentration for short periods of time." Answers were given on a 5-point Likert scale, ranging from 1 (*never*) to 5 (*always*). The α reliability ranged from .77 to .90 (M = .85) during the 15 points of measurement, (three times per work shift across five days).

Mood. We measured mood with six bipolar items from the scale developed by Wilhelm and Schoebi (2007). The scale contains three subscales, with two items measuring valence (V), calmness (C), and energetic arousal (E). Example items are: "At this moment, I feel: tired–awake (E); unwell–well (V), relaxed–tense (C)." The scales had seven steps. Their end-points 1 and 7 were associated with the label "very." Correlations of items within subscales ranged between .67 and .82 (M = .76) for valence, .56 and .79 (M = .69) for calmness, and .64 and .84 (M = .75) for energetic arousal.

5.2.2.2 Evening measures

Irritation. Irritation is defined as a state of psychological impairment caused by perceived goal discrepancy and includes rumination on problems at work (cognitive irritation) and irritability (emotional irritation; cf. Mohr et al., 2006; Mohr, Rigotti, & Müller, 2005). We used an adapted version that measured irritation in the evening but referred to the extent of irritation felt during the day. Example items were: ‘‘If other people talked to me, I reacted grumpily’’ for emotional irritation; and ‘‘Even at home I thought of my problems at work’’ for cognitive irritation. Answers were given on a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The α reliability ranged from .82 to .88 during the five days (M = .86).

Construct validity. Because the variable interruption was calculated as the sum of reported interruptions from different sources, classical psychometric tests were not applicable to this index. For all other variables under study, we conducted a set of two-level confirmatory factor analyses with Mplus 7; a one-factor model on the four items to assess multitasking demands yielded a good fit to the data ($\chi 2$ = 15.40; df = 4; p = .004; comparative fit index [*CFI*] = 0.98; root-mean-square error of approximation [*RMSEA*] = 0.07), all factor loadings were above .40 and significant. To examine whether the dependent variable mood had the three defined subscales, we compared a three-factor model with a one-factor model. The three-factor model with all items loading on their respective factors ($\chi 2$ = 27.50; df = 12, p = .007; *CFI* = .985; *RMSEA* = .049,) obviously fit the data better ($\Delta\chi 2$ = 256.32, Δdf = 6, p < .001) than the one-factor model ($\chi 2$ = 283.82; df = 18; p < .001; *CFI* = 0.74, *RMSEA* = 0.17). All factor loadings were above .40 and significant.

Furthermore, we conducted confirmatory factor analyses to test whether the two distinct sets of dependent variables, mood (with its facets valence, calmness, energetic arousal), and irritation represented distinct constructs. Analyses revealed a better fit ($\Delta\chi 2$ = 1182.48, Δdf = 20, p < .001) for a four-factor model ($\chi 2$ = 262.29, df = 134, p < .001, *RMSEA* = .04, *CFI* =

.95), with all items loading on their corresponding factors, than for a one-factor model ($\chi 2$ = 1444.77, *df* =154, $p < .001$, *RMSEA* = .13, *CFI* = .52).

5.2.2.3 Person level measures

Alertness. The subtest "alertness" of the TAP (test for attentional performance) of Zimmermann and Fimm (2002) provides a reasonably stable assessment of processing speed (Sturm et al., 1999; Zimmermann & Fimm, 2012). The retest-reliability for a time span of approximately 25 days (*M*=25.06 days, *SD*=5.75 days) has been reported to be as high as *r* = .81 (Zimmermann & Fimm, 2012). In the alertness test, a reaction time task was presented to the participant in two blocks of 20 trials. The target was an "x" appearing in the middle of the computer screen. An acoustic warning stimulus preceded the target (this condition was also referred to as cued RT). The participant responded to the appearance of the target by pressing the response key as fast as possible. Then, or at the latest after 2,000 msec, the target disappeared. The individual score is the median time in milliseconds between the presentation of the target and the response of the participant. The test takes about 5 minutes. The split-half reliability in our sample equalled *r* = .92 (comparing the two blocks).

This subtest could be shown to have significant relationships to other attention tests such as divided attention, inhibitory control, and task switching (Zimmermann & Fimm, 2002). ADHD and aphasic patients showed worse performances in the alertness test than healthy people (Zimmermann & Fimm, 2002).

Working memory. Working memory was tested with the subtest "working memory" of the TAP of Zimmermann and Fimm (2002). This subtask is an n-back task (cf. Gevins & Cutillo, 1993). A sequence of numbers (from 1 to 9) was presented randomly one-by-one in the middle of the computer screen, and the button has to be pressed when the number shown is the same as the second to last (2-back task). The number of trials was set to 100. The false positive errors were counted. TAP based results are recommended as a valid indicator for

working memory performance, and they are related to age and narrative speech (Fontani, 2004; Pereiro Rozas, 2003). The test takes about 5 minutes.

Age. Age was assessed in years in a paper-and-pencil questionnaire with a single survey item.

5.2.3 Analyses

We conducted multilevel analyses because the daily assessments are nested within persons, and are thus not independent from each other (Ohly et al., 2010). We used the software package HLM 6 (Raudenbush et al., 2009). Centring day-level variables at the person mean allowed the removal of between-person variance from these variables. This eliminated the role of stable differences in explaining a participant's day levels of perceived stressors and strain (Ohly et al., 2010). Moderator variables, as they were assessed on level 2, were centred at the grand mean. We allowed random slopes and tested them against simple slope models. If the random slope models did not have a significantly better fit, we chose the simple slope model as grounds of Occam's razor (Nezlek et al., 2006).

To test whether our data needed the use of multilevel modelling, we calculated the intra-class correlations (ICC) on the basis of the intercept-only models. The ICC explains how much of the variance can be attributed to the different levels of analyses. The between-person variance was 68.2% for mood (E: 66.0%, V: 64.4%, C: 63.0%) and 54.5% for irritation. The within-person variance (variance from one day to another) was 31.8% for mood (E: 34.0%, V: 35.6%, C: 37.0%) and 45.5% for irritation. These results indicated that there was sufficient variance attributable to both between- and within-persons in day-level irritation and mood to support the use of multilevel modelling in our study. To test the hypotheses, we first tested the main effects, then we added the two-way interaction of age and interruptions (respectively age

and multitasking), and in the last step, we added the two-way interaction of the cognitive test results and interruptions and multitasking as well as the respective three-way interaction.

5.3 Results

Means, standard deviations, and intercorrelations of the study variables are shown in Table 5.1.

Table 5.1. Means, standard deviations, and zero-order correlations of all study variables.

	Variable	M[a]	SD[a]	M[b]	SD[b]	1	2	3	4	5	6	7	8	9
1	Age	41.06	11.50			-								
2	Alertness[c]	266.99	44.34			.24	-							
3	Working memory[c]	6.15	6.77			.38	.14	-						
4	Interruption	19.01	6.53	19.04	7.80	.14	.15	.07	-	.54	-.16	-.30	.00	.21
5	Multitasking	3.14	0.59	3.14	0.76	-.10	.12	-.06	.55	-	-.23	-.37	-.02	.23
6	Valence	5.18	0.84	5.17	0.99	.32	.04	.07	-.16	-.21	-	.78	.72	-.48
7	Calmness	4.91	0.88	4.91	1.05	.24	-.03	.11	-.28	-.35	.82	-	.47	-.48
8	Energetic arousal	5.26	0.93	5.26	1.09	.40	.09	.07	.01	-.03	.78	.52	-	-.23
9	Irritation	2.40	0.87	2.38	1.08	-.02	.16	-.05	.25	.16	-.58	-.57	-.32	-

Note. Correlations below the diagonal are person-level correlations (N = 123). Correlations above the diagonal are day-level correlations (n = 578).
Person-level correlations of $r > .10$ are significant with $p = .001$, those of $r > .13$ are significant with $p = .01$, and those of $r > .08$ are significant with $p = .05$.
Day-level correlations of $r > .15$ are significant with $p = .001$.
[a] Means and standard deviations at the person level. [b] Means and standard deviations at the day level. [c] High scores reflect worse cognitive functioning (alertness: reaction time; working memory: errors).

5.3.1 Interruption and multitasking: Main effects

To test the proposed main effects of interruptions and multitasking demands, we estimated a series of regressions in HLM with level 1 variables to predict the three dimensions of mood and irritation. Results of these analyses are presented in Tables 5.2 to 5.5. Six of eight direct effect hypotheses were supported (see Model 1 in Tables 5.2, 5.3, 5.4, and 5.5). A high frequency of work interruptions was significantly negatively related to mood—(a) valence and (b) calmness—and positively related to (d) irritation, supporting hypothesis 1 a, b, and d. High multitasking demands were significantly negatively related to mood—(a) valence and (b) calmness—and significantly positively related to (d) irritation, supporting hypothesis 2 a, b, and d. Neither multitasking nor work interruptions were significantly associated with energetic arousal.

Table 5.2. HLM estimates for models predicting valence during shift.

	Work Interruption					Multitasking			
			Cognitive Ability				Cognitive Ability	
Parameter	Model 1	Model 2	Alertness Model 3a	Working Memory Model 3b		Model 1	Model 2	Alertness Model 3a	Working Memory Model 3b
Intercept	5.16***	5.16***	5.16***	5.13***	Intercept	5.16***	5.16***	5.16***	5.13***
Level 1					Level 1				
Interruption	-0.03**	-0.03***	-0.03***	-0.04***	Multitasking	-0.31***	-0.31***	-0.33***	-0.34***
Level 2					Level 2				
Age		0.02**	0.02**	0.03***	Age		0.02**	0.02**	0.03***
Cognitive Ability			-0.00	-0.01	Cognitive Ability			-0.00	-0.01
Interactions					Interactions				
I × Age		0.00	0.00	0.00	M × Age		0.00	0.00	0.00
I × Cog			-0.00	-0.00	M × Cog			0.00	-0.00
Age × Cog			0.00	0.00	Age × Cog			0.00	0.00
I × Age × Cog			0.00	0.00*	M × Age × Cog			0.00*	0.00*
Model Summary					Model Summary				
R^2_{L1}	0.03	0.03	0.03	0.05	R^2_{L1}	0.08	0.08	0.08	0.08
ΔR^2_{L1}		0.00	0.00	0.01	ΔR^2_{L1}		0.00	0.01	0.01
R^2_{L2}		0.11	0.11	0.12	R^2_{L2}		0.11	0.11	0.11
ΔR^2_{L2}			0.00	0.01	ΔR^2_{L2}			0.00	0.01

Note. Values are unstandardized regression coefficients. Level 2: $N = 123$. Level 2: $n = 578$. The scores of the Level 1 variables were centred at the individual's means to eliminate between-individual variance. The scores of the Level 2 variables were grand-mean centred. HLM 6.08 hierarchical linear modelling.
R^2_{L1} = explained variation on Level l; R^2_{L2} = explained variation on Level 2.
* $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

Table 5.3. HLM estimates for models predicting calmness during shift.

	Work Interruption					Multitasking			
			Cognitive Ability				Cognitive Ability	
Parameter	Model 1	Model 2	Alertness Model 3a	Working Memory Model 3b		Model 1	Model 2	Alertness Model 3a	Working Memory Model 3b
Intercept	4.89***	4.89***	4.89***	4.89***	Intercept	4.89***	4.89***	4.89***	4.89***
Level 1					Level 1				
Interruption	-0.05***	-0.05***	-0.05***	-0.06***	Multitasking	-0.51***	-0.50***	-0.48***	-0.55***
Level 2					Level 2				
Age		0.02**	0.02**	0.02*	Age		0.02**	0.02**	0.02*
Cognitive Ability			-0.00	0.00	Cognitive Ability				0.00
Interactions					Interactions				
I × Age		-0.00	-0.00	0.00	M × Age		-0.00	-0.00	0.00
I × Cog			0.00	-0.00	M × Cog			0.00	-0.00
Age × Cog			0.00	0.00	Age × Cog			0.00	0.00
I × Age × Cog			0.00	0.00**	M × Age × Cog			-0.00	0.00**
Model Summary					Model Summary				
R^2_{L1}	0.11	0.11	0.12	0.13	R^2_{L1}	0.17	0.17	0.18	0.19
ΔR^2_{L1}		0.00	0.00	0.02	ΔR^2_{L1}		0.00	0.00	0.01
R^2_{L2}		0.05	0.06	0.05	R^2_{L2}		0.04	0.05	0.04
ΔR^2_{L2}			0.01	0.00	ΔR^2_{L2}			0.01	0.00

Note. Values are unstandardized regression coefficients. Level 2: $N = 123$. Level 2: $n = 578$. The scores of the Level 1 variables were centred at the individual's means to eliminate between-individual variance. The scores of the Level 2 variables were grand-mean centred. HLM 6.08 hierarchical linear modelling.
R^2_{L1} = explained variation on Level l; R^2_{L2} = explained variation on Level 2.
* $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

Table 5.4. HLM estimates for models predicting energetic arousal during shift.

	Work Interruption					Multitasking			
			Cognitive Ability				Cognitive Ability	
			Alertness	Working Memory			Alertness	Working Memory
Parameter	Model 1	Model 2	Model 3a	Model 3b		Model 1	Model 2	Model 3a	Model 3b
Intercept	5.25***	5.25***	5.24***	5.21***	Intercept	5.25***	5.25***	5.24***	5.21***
Level 1					Level 1				
Interruption	-0.00	-0.01	-0.01	-0.01	Multitasking	-0.00	-0.00	-0.01	-0.02
Level 2					Level 2				
Age		0.03***	0.03***	0.04***	Age		0.03***	0.03***	0.04***
Cognitive Ability			-0.00	-0.02	Cognitive Ability			-0.00	-0.02
Interactions					Interactions				
I × Age		0.00	0.00	0.00	M × Age		-0.00	-0.00	-0.00
I × Cog			-0.00	0.00	M × Cog			0.00	-0.00
Age × Cog			0.00	0.00	Age × Cog			0.00	0.00
I × Age × Cog			0.00	0.00	M × Age × Cog			0.00	0.00
Model Summary					Model Summary				
R^2_{L1}	0.00	0.00	0.00	0.01	R^2_{L1}	0.00	0.00	0.01	0.00
ΔR^2_{L1}		0.00	0.00	0.01	ΔR^2_{L1}		0.00	0.00	0.00
R^2_{L2}		0.18	0.18	0.19	R^2_{L2}		0.18	0.18	0.19
ΔR^2_{L2}			0.00	0.01	ΔR^2_{L2}			0.00	0.01

Note. Values are unstandardized regression coefficients. Level 2: $N = 123$. Level 2: $n = 578$. The scores of the Level 1 variables were centred at the individual's means to eliminate between-individual variance. The scores of the Level 2 variables were grand-mean centred. HLM 6.08 hierarchical linear modelling.
R^2_{L1} = explained variation on Level l; R^2_{L2} = explained variation on Level 2.
*** $p \leq .001$.

Table 5.5. HLM estimates for models predicting irritation at end of workday.

	Work Interruption					Multitasking			
			Cognitive Ability				Cognitive Ability	
			Alertness	Working Memory			Alertness	Working Memory
Parameter	Model 1	Model 2	Model 3a	Model 3b		Model 1	Model 2	Model 3a	Model 3b
Intercept	2.40***	2.40***	2.45***	2.43***	Intercept	2.40***	2.40***	2.45***	2.43***
Level 1					Level 1				
Interruption	0.03**	0.03***	0.04***	0.04***	Multitasking	0.50***	0.51***	0.55***	0.51***
Level 2					Level 2				
Age		-0.00	-0.00	-0.00	Age		-0.00	-0.01	-0.00
Cognitive Ability			0.00^{+}	-0.00	Cognitive Ability			0.00^{+}	-0.00
Interactions					Interactions				
I × Age		-0.00	-0.00	-0.00	M × Age		-0.00	-0.01	-0.01
I × Cog			0.00	0.00	M × Cog			0.00*	0.01
Age × Cog			-0.00**	-0.00	Age × Cog			-0.00**	-0.00
I × Age × Cog			-0.00*	-0.00	M × Age × Cog			-0.00*	-0.00
Model Summary					Model Summary				
R^2_{L1}	0.03	0.03	0.04	0.03	R^2_{L1}	0.11	0.11	0.13	0.11
ΔR^2_{L1}		0.00	0.01	0.00	ΔR^2_{L1}		0.00	0.02	0.00
R^2_{L2}		0.00	0.10	0.00	R^2_{L2}		-0.02	0.08	-0.01
ΔR^2_{L2}			0.11	0.01	ΔR^2_{L2}			0.10	0.01

Note. Values are unstandardized regression coefficients. Level 2: $N = 123$. Level 1: $n = 578$. The scores of the Level 1 variables were centred at the individual's means to eliminate between-individual variance. The scores of the Level 2 variables were grand-mean centred. HLM 6.08 hierarchical linear modelling.
R^2_{L1} = explained variation on Level l; R^2_{L2} = explained variation on Level 2.
$^{+}$ $p \leq .10$. * $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

5.3.2 Moderating effect of age

To test the two-way interactions between interruptions, respectively multitasking demands with age, we expanded the main-effect models, including age as a main effect, as well as the interaction between age and the respective stressor in a subsequent step. The two-way interaction hypotheses (3 a–d and 4 a–d)—proposing age as a moderator between the independent variables interruption and multitasking and the dependent variables mood and irritation—were not supported (see Model 2 in Tables 5.2, 5.3, 5.4, and 5.5).

5.3.3 Three-way interaction of age and cognitive abilities

Finally, a set of multilevel regressions were estimated, including the main effects of interruptions or multitasking demands, age, and one of the two cognitive indicators per model, all possible two-way interactions, as well as a three-way interaction among stressor, age, and the cognitive indicator. Seven of sixteen three-way interactions turned out to be significant (see Models 3a, and 3b in Tables 5.2, 5.3, 5.4, and 5.5). The three-way interaction among work interruptions, age, and alertness in explaining irritation (hypothesis 5d) was significant. But there were no significant three-way interactions among work interruptions, age, and alertness in explaining mood (hypothesis 5 a–c). With regard to multitasking, the three-way interactions among multitasking, age, and alertness in explaining irritation and valence (hypothesis 6 a, d) were significant, but not among work interruptions, age, and alertness in explaining calmness and energetic arousal (hypothesis 6 b, c).

There were significant three-way interactions among work interruptions, age, and working memory in explaining valence and calmness (hypothesis 7 a, b), but no significant three-way interactions among work interruptions, age, and working memory predicting variance in energetic arousal and irritation (hypothesis 7 c, d). And last but not least, the three-way interactions among multitasking, age, and working memory in explaining valence and calmness

(hypothesis 8 a, b) were significant but not among work interruptions, age, and alertness in explaining variance in energetic arousal and irritation (hypothesis 8 c, d).

The Tables show B-values close to zero to be highly significant. This is because these regression coefficients are not standardized and the independent and moderator variables had a much higher range than the dependent variables. For example, the range of irritation was [1; 4.34] and the value-range of interruptions was [6; 72.67] (alertness [190; 416]; age [21; 61]). Referring to Model 3a in Table 5.5, the significant B-value describes a change of the irritation value [1; 4.34] if the interaction term interruption *age* alertness, with a theoretical range of [23,940; 1,844,073.92] shows an increase of 1; thus even very low B-values can be practically meaningful. Still, the effect size of three-way interactions can be considered to be low, when applying conventional criteria. Cohen, Cohen, West, and Aiken (2003) proposed to label effect sizes of .02, .15, and .35 as small, medium or large. However, Aguinis, Beaty, Boik, and Pierce (2005) found a mean effect size of f^2 = .009 across 636 published moderator analyses.

The graphs (Figure 5.1) and the slope difference tests provided in Table 5.6 show that all of the reported three-way-interaction effects were not in the assumed direction. According to our results, stressors do not have the strongest negative association with mood and strongest positive association with irritation when age is high and the alertness or working memory ability is low. The results showed another pattern. Whether the alertness and working memory abilities were high or low made a difference in the association between the stressors and the outcomes for the younger nurses, but not for the older ones. Overall, the findings did not support hypotheses 5–8 a–d but pointed toward a consistent pattern of results, other than hypothesized.

Table 5.6. Slope difference tests for three-way interactions.

		Irritation	Valence		Calmness
		Alertness		Working Memory	
Predictor	Pair of slopes	*t*	*t*	*t*	*t*
Interruption	(1) and (2)	-1.01		1.76	1.18
	(1) and (3)	-1.79		2.06*	1.98*
	(1) and (4)	0.60		0.29	-1.22
	(2) and (3)	-0.72		0.62	0.96
	(2) and (4)	1.35		-1.16	-1.93
	(3) and (4)	2.06*		-1.61	-2.61*
Multitasking	(1) and (2)	0.22	1.81	1.63	1.54
	(1) and (3)	-2.34*	1.48	1.66	1.98+
	(1) and (4)	1.23	0.45	0.11	-0.76
	(2) and (3)	-2.17*	-0.12	0.39	0.78
	(2) and (4)	0.94	-1.31	-1.29	-1.94
	(3) and (4)	3.10**	-0.96	-1.47	-2.38*

Note. For alertness the median of the reaction time was measured, for working memory the errors. (1) High Age, High RT/Error. (2) High Age, Low RT/Error. (3) Low Age, High RT/Error. (4) Low Age, Low RT/Error.
* $p \leq .05$. ** $p \leq .01$.

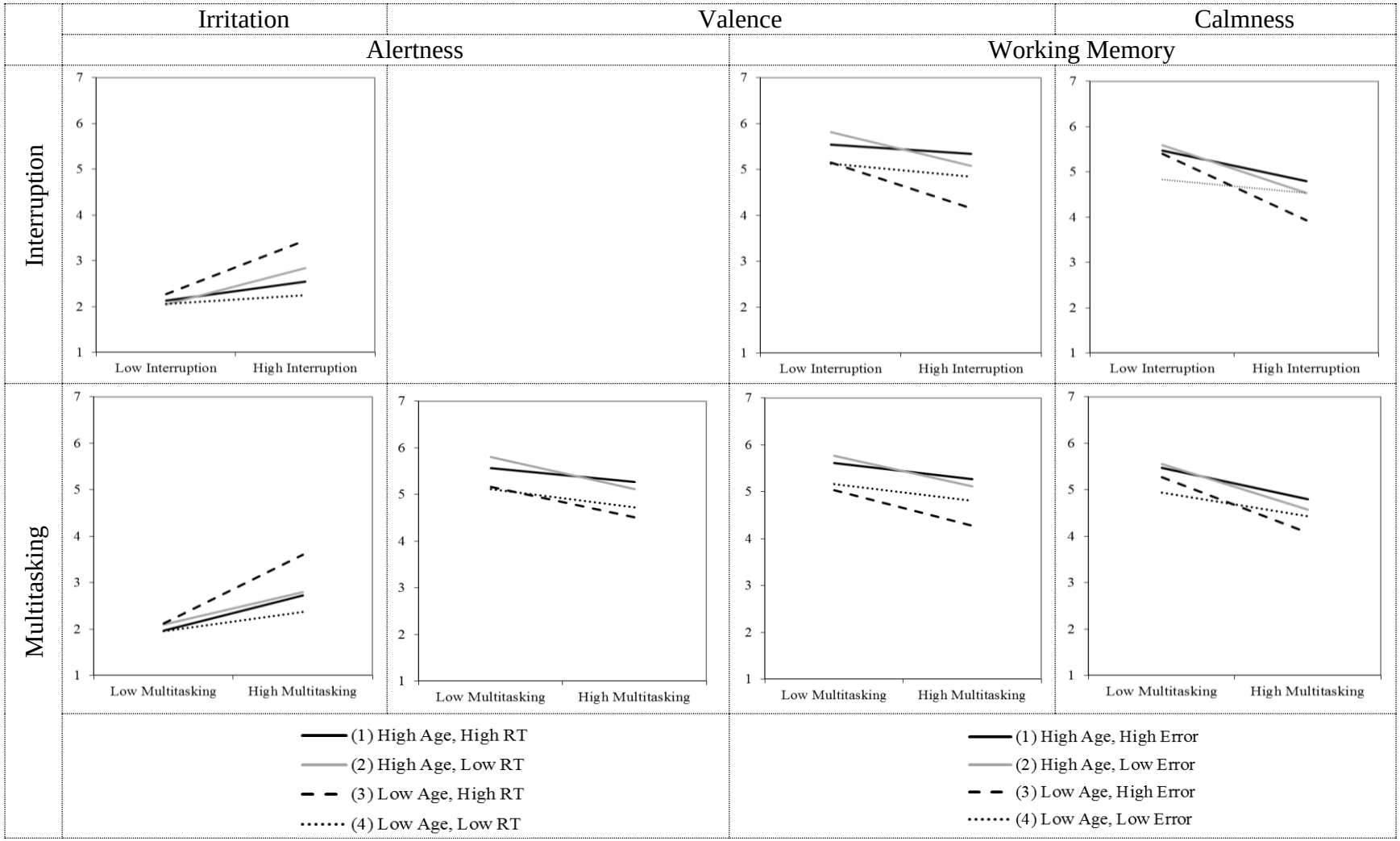

Figure 5.1. The three-way interaction graphs.

5.4 Discussion

In this study, we examined the moderating effects of age and cognitive functions on the daily relationship between work interruptions and multitasking and mood and irritation. We found that multitasking and work interruptions led to a significant decrease of valence and calmness during the shift and to a significant increase of irritation in the evening (cf. Baethge & Rigotti, 2013a). Multitasking demands and the amount of workflow interruptions during the shift were not related to energetic arousal. The relationships between the stressors multitasking and workflow interruptions and the outcomes mood and irritation were not moderated by age. However, we found that the relationships of interruptions and multitasking and irritation were moderated by the interaction of age and alertness. On the contrary, the interaction of age and working memory moderated the relationship between interruptions and multitasking and mood (valence and calmness). Furthermore, there was a significant three-way interaction among multitasking, age, and alertness in explaining valence. Surprisingly, the interactions did not show the predicted pattern. We found no three-way interactions among work interruptions and multitasking, age, and working memory in predicting irritation (and energetic arousal). There were further no three-way interactions among work interruptions and multitasking, age, and alertness in explaining mood, with one exception (multitasking-age-alertness → valence).

5.4.1 Main effects of interruptions and multitasking demands

The main effects reported in this study confirm our assumptions that were based on the compensatory control model of Hockey (1997) and the conservation of resources theory of Hobfoll (1989). Our results are consistent with preliminary findings of experimental (Bailey & Konstan, 2006; Mark et al., 2008) and cross-sectional field studies (Jacobshagen et al., 2005; Konradt et al., 2003) in a daily diary setting. A higher amount of the stressors work interruptions and multitasking demands led to an increase of negative mood and tension

during the shift and to an increase of irritation in the evening. The stressors had no effect on the energetic arousal (i.e., we found neither two- nor three-way interaction effects on energetic arousal). One reason for this could be that these stressors did not have an impact on energetic arousal. Likewise, Temple et al. (2000) did not find any effect of a high workload condition (of a 12-minute task) on energetic arousal but a negative effect on valence and calmness in their experimental study. Correspondingly, stress was defined as a perception of a disagreeable state of tension (Greif, 1991). Another reason could have been that a high amount of work interruptions and multitasking demands led at first to a higher energetic arousal (when the person tries to cope with the demands through higher effort) and later to a lower energetic arousal because the person was exhausted (fatigue aftereffect) (Hockey, 1997). Because we took the mean of the three measurement occasions above the shift, there may have been no difference between stressful and more relaxed days.

5.4.2 Absence of a moderating effect of age

The absence of the moderation effects of age were unexpected and need further explanation. According to our results, older employees did not seem to suffer more from workflow interruptions and multitasking in terms of their mood and irritation. Neither the socioemotional selectivity theory nor the cognitive loss theory can explain these results. However, there were significant positive main effects of age on the three dimensions of mood. This result is consistent with the assumptions of the socioemotional selectivity theory (Carstensen et al., 2003) that older people have a higher motivation to maximize their well-being and thus experience more positive emotions. Interestingly, there is no such effect on irritation. This result is consistent with the findings of the meta-analysis of Rauschenbach, Krumm, Thielgen, and Hertel (in press), who found no main effect of age on irritation. The socioemotional selectivity theory originated in the field of emotion research and was later adapted to other facets of strain and well-being (Brose et al., 2011), but it seems not to hold for the concept of irri-

tation. We can conclude that according to our results, we could only partially support the socioemotional theory concerning the main effect of age on mood, but not with regard to a buffering effect on the cognitive stressors.

5.4.3 Unexpected three-way interactions

Contrary to our expectations, our findings suggested that older employees do not benefit from a better working memory and a higher alertness, but younger ones do! Younger employees seem to depend on good cognitive abilities to cope with the stressors multitasking demands and interruptions.

Presumably, older employees have other coping mechanisms to deal with these stressors. According to Salthouse (1996), the "performance in cognitive tasks is limited by general processing constraints, [. . .] restrictions of knowledge [. . .], [and limits of] the efficiency or effectiveness of specific processes" (p. 404). Some of these limits can be overcome by experience (Salthouse, 1996). Correspondingly, Fofanova and Vollrath (2011) found in their driving simulation study that older and younger drivers were comparably distracted by an additional task during lane changing, although older drivers were worse in overall driving performance. They solved this special condition by focusing their attention on the most important task: the lane changing (Fofanova & Vollrath, 2011). Thus, their experience helped them to make the best decision in the dual task condition. It can be assumed that older people have more effective coping strategies than younger ones in dealing with workflow interruptions and multitasking—typical demands in the occupation of nursing.

Thus, younger ones need to fill this gap by being faster and having a higher working memory capacity. There may be other resources relevant for coping with interruptions and multitasking demands. For instance, prioritizing can be regarded as a crucial factor in dealing with interruptions and multitasking situations (cf. Baltes & Baltes, 1989; Colligan & Bass,

2012). It can save a lot of time and effort (Colligan & Bass, 2012; Ho et al., 2004). Another important resource could be affective skills, which help to reduce the risk that stressors will lead to negative emotions (as proposed by socioemotional theorists) (cf. Carstensen et al., 2003). Future studies should address these issues. Overall, neither the socioemotional theory nor the cognitive loss theory was able to explain our findings concerning the role of age in the stressor-strain relationship. There is a big pool of coping possibilities that seem to increase and decrease with age, and we still do not know all of them. Based on the results of our study, we can conclude that younger employees profit from high alertness and good working memory abilities. The question remains, what resources are used by older employees?

The difference between older and younger employees (in the impact of their cognitive abilities on the stressor-strain relationship) was one consistent result of our study. A further consistent pattern that emerged was that alertness moderated the effect on irritation in the evening and working memory performance moderated the effect on valence and calmness during the shift for younger participants. So working memory showed to be more important for short-term effects, whereas alertness seems to be more relevant for delayed effects. Prior studies showed that alertness is a relevant resource for coping with multitasking demands and interruptions (Bühner et al., 2006; König et al., 2005). Taking our results, we may assume alertness to be relevant for coping, such that a high reaction time is helpful in coping with high workload and time pressure, as consequences of multitasking and interruptions (Mark et al., 2008; Weigl et al., 2011). Also, multitasking is supposed to happen during situations of high workload (Colligan & Bass, 2012; Kirmeyer, 1988). An ongoing demand of multitasking and workflow interruptions—and the associated increasing time pressure and workload—will stress the cognitive resources. Alertness, as the basis of all other attentional abilities (Sturm & Willmes, 2001), helped younger employees deal with these overloading demands. The marginal positive relationship between alertness (reaction time) and irritation can be interpreted

as a hint to classify processing speed as a general coping resource. However, the role of basic cognitive abilities as coping mechanisms in daily working life needs further examination.

5.4.4 Strengths and limitations

This study has several strengths. It combines self-report data and performance testing in the form of a diary study with an appropriate sample size. Furthermore, we measured not only age differences but also two potential explaining third variables (alertness and working memory ability). We extended the actual research on age effects by considering both chronological age and cognitive abilities (as one partial/particular indicator of functional age). Moreover, our choice of variables had the advantage that we matched specific stressors with their adequate resources. Another strength is that the independent and dependent (and moderating variables) were measured on separate points in time (except for mood and the stressors). Besides this, the study is not without limitations. As is explained below, however, these limitations do not prevent the study from making a contribution to the literature.

One limitation is that we examined a special occupational group: nurses, which may hamper generalizability. We chose this group because its members experience a high level of workflow interruptions and multitasking demands during their shifts (more than 60 times per morning shift) (Baethge & Rigotti, 2013b). Thus, we believe that our results can be generalized to other occupational groups with similar demands. However, there might be occupational groups for which other stressors are more prominent. And perhaps our findings cannot be replicated in these groups. If we want to understand the relationship of stressors and resources, the investigation of context-specific patterns seems generally recommendable.

We chose alertness and working memory as cognitive parameters because they are the most important basic functions for dealing with interruptions and multitasking. Other less basic and more complex parameters (such as task-switching ability) may have led to different results.

Another limitation was that alternative measures for the independent variables under study may produce distinct results. We measured the amount of workflow interruptions and the magnitude of multitasking demands. Laboratory studies could show that not only quantitative but also qualitative aspects of interruptions can make a difference (e.g., complexity) (Monk et al., 2004). Furthermore, an expert-based, independent observation of multitasking events and workflow interruptions would be a worthwhile strategy when replicating our findings. However, multitasking situations and interruption events in applied work settings are not entirely observable, particularly throughout extended periods, such as in our case. Similar arguments refer to our dependent variables under study. We were interested in the experience of strain, which cannot be observed, because it is an inner feeling. Nevertheless, future research may opt to use physiological data as an indicator for employees' strain or expand our results by including other types of outcomes, such as performance (which may be rated by supervisors).

5.4.5 Practical implications

Our findings contradicted the popular belief that older employees are less able to cope with the demands at work. Surprisingly, there was no age effect concerning the experience of strain following the cognitive stressors of workflow interruptions and multitasking demands. Even for older people with lower cognitive skills, the stressors did not strain them more as compared to their younger colleagues. On the contrary, younger employees with lower cognitive skills suffered significantly more from interruptions and multitasking demands. Obviously, older employees have coping skills that younger colleagues miss. An implication can be that younger nurses need to learn from older colleagues how to handle these work demands or how to prevent strain. A possible intervention would be to offer an age-diverse seminar on coping strategies in which all participants share coping strategies. If older employees have skills that need a longer examination and learning phase, tandems of young and old employ-

ees could be generated as a mentoring approach. Another idea would be to integrate coping strategies with strain into the standard trainee program so that trainees learn not only to fulfil the tasks but also to cope with the stressors. Studies on age-diverse teams show that a high diversity increases performance in complex tasks (Wegge, Roth, Neubach, Schmidt, & Kanfer, 2008) because the different age groups benefit from working with each other.

5.4.6 Conclusion

With this diary study, we could show that workflow interruptions and multitasking demands during a morning shift of nurses can be classified as daily hassles because they showed to be negatively related to mood during work and irritation in the evenings. In contrast to the cognitive loss theory, it was the young nurses with lower basic cognitive abilities who suffered more from these stressors. Older nurses, contrary to widespread stereotyping, were able to handle these daily hassles more efficiently than their younger colleagues. Furthermore, basic cognitive abilities did not show to be predictive for differences within older employees. Further research is needed to understand underlying age-specific coping mechanisms.

Chapter 6:

General discussion

Having presented three different approaches for examining the process and effects of daily work interruptions, the results of the different papers will now be summarized and integrated. The aim of the first part of this chapter is to answer the research questions outlined in chapter 1, and to integrate the results of the two studies into the theoretical framework of chapter 2. This will be followed by an overview on limitations of the work, resulting in recommendations for future research and finally I will present implications for practice and a short résumé.

6.1 Contributions of this dissertation

Two research areas have investigated interruptions independently from one another. Laboratory research examined the (mainly cognitive) process of single interruptions within milliseconds, seconds and minutes (e.g. Altmann & Trafton, 2002; Bailey & Konstan, 2006; Eyrolle & Cellier, 2000; Trafton et al., 2003). Contrastingly, in field studies and research on the action regulation theory, work interruptions were interpreted differentially - as a work characteristic (Hacker, 2005) which differs between people or workplaces and thus it is assumed to be relatively stable. Effects on health have been examined which will probably develop within months or years (e.g. Grebner et al., 2003; Konradt et al., 2003; Wülser, 2006). In this dissertation both perspectives are combined, the within and between person approach. By examining the time in between the daily or weekly processes, it is possible to provide the first evidence of answers to the question of what happens between the time loss and errors produced by one single interruption (found by laboratory studies) and the long-term health outcomes associated with a high level of work interruptions (found by field studies). In this dissertation the daily process of the task characteristic work interruptions and a related phenomenon – multitasking demands - was investigated.

6.1.1 Multiple interruptions within days or weeks

In the theoretical framework in chapter 2, it was stated that work interruptions happen in accumulation within the work day or week. Thus, to get insights into the daily (or weekly) process of work interruptions, it is necessary to ask:

How do multiple interruptions affect the workflow, performance, well-being and strain of employees over time?

In chapter 2, the extant knowledge about cognitive processes and immediate consequences (found by laboratory research) was adapted to the work setting. The short term effects of single interruptions, such as time loss, errors, raised energetic costs, negative emotions and memory effects, were described and that they could even develop into more serious effects such as time pressure, failure, increasing workload/effort/need for recovery, emotional strain and rumination. When these effects interact and amplify one another, an exponential curve of strain can develop. Incorporated into the theoretical framework was Hockey's (1997) finding that high-load situations (like accumulating interruptions and effects) lead to an increase of effort which will exhaust the person in the long run. This assumption is in line with our findings in the second study (chapter 5). A significant relationship between a higher number of interruptions than usual and a more negative mood, increased exhaustion and tension was observed. This raised effort will likely have an impact on performance. It was proposed that raised effort could increase the performance at first (Mark et al. 2008), but that the depletion of resources (Hobfoll, 1989) and the subsequent overload and exhaustion would cause a change of direction causing the performance to start to decrease (cf. chapter 2). Thus, an inverted U curve of performance was proposed, whereupon the initial increase is not supposed to occur in a demanding working environment (e.g. in the occupation of nurses). In line with that, a decrease of performance was found in study 1 when the number of interruptions was high. Nurses were less satisfied with their performance that day and reported a higher proba-

bility of forgetting their intentions during days with a higher number of interruptions than usual.

The results (study 1 and 2) further suggest that the mentioned effects of strain and performance will not only affect the employees within the shift, but there will be also a spill-over effect to the evening. Nurses experienced more irritation after work days with a high intensity of interruptions (cf. chapter 4 and 5). In chapter 2, it was explained that accumulating interruptions can involve depletion of resources (Hobfoll, 1989), an increasing need for recovery and, if this need cannot be met, an increase in strain and a decrease in performance consequently leading to worries. A possible consequence of a high stress level at work can be that the person is not able to recover after work (Demerouti et al., 2009; Meijman & Mulder, 1998). One indicator of this is irritation – a state of rumination about work and irritability (Mohr et al., 2006). Other indicators of incomplete recovery are, for example, a low sleep quality, a high level of cortisol or other physiological parameters (Demerouti et al., 2009; Hockey, 1997). This state is called allostatic load; it is a pathophysiological outcome and acts as a mediator for further health impairments (Demerouti et al., 2009; McEwen, 1998). In line with this, irritation has been shown to be associated with health problems like depression and psychosomatic complaints (Dormann & Zapf, 2002; Höge, 2009; Jacobshagen et al., 2009). Thus, this dissertation provides first theoretical and empirical hints of a possible conjuncture of results of laboratory and field studies (immediate consequences of single interruptions vs. long-term health impairments).

6.1.2 Mediation effects of interruptions

Once the effects caused by interruptions are known, it is also useful to understand why they occur. To this end, this dissertation seeks to answer the question:

Why do interruptions have an impact on strain and performance?

Laboratory researchers highlight the cognitive demand that interruptions cause and interpret this as the main demand of interruptions (cf. chapter 2.2.3, Altmann & Trafton, 2002; Boehm-Davis & Remington, 2009). Goal activation theory suggests that interruptions put high demands on the working memory (Altmann & Trafton, 2002) since different goals and intentions have to be kept in mind, inhibited and retrieved (Einstein et al., 2003; McDaniel & Einstein, 2000). The task switching literature (e.g. Cellier & Eyrolle, 1992; Monsell, 2003) also suggest that attentional abilities are central - attention must be shifted back and forth between the primary and the interruption task (cf. chapter 5.1.1). The errors and time loss which occur when dealing with interruptions are mostly explained by the high attentional and memory demands of the interruption situation in laboratory studies (e.g. Bailey & Konstan, 2006; Cellier & Eyrolle, 1992). Simulation and cross-sectional field studies have shown a relationship between work interruptions and mental demands (Grebner et al., 2003; Mark et al., 2008; Zapf, 1993). The question is whether the cognitive demands interruptions cause can explain negative outcomes of interruptions in the workplace setting.

Besides the cognitive demands of interruptions, laboratory researchers also focus on the time loss caused by interruptions (Cellier & Eyrolle, 1992; Hodgetts & Jones, 2006; Monk et al., 2004). They mainly examine the time loss caused by switching costs respectively the resumption lag (Brixey et al., 2007; Monk et al., 2004) and have tried to find strategies to reduce this time loss by reducing the cognitive demands involved in the accomplishment of interruptions (Boehm-Davis & Remington, 2009). In the workplace, however, not only can the time loss caused by the cognitive demands of interruptions have an impact, but also the time loss caused by the (additional) interruption task itself (cf. chapter 2.4.1). Thus, time loss likely has another (probably higher) significance in field settings and is more than just a consequence of raised mental demands. A simulation study provided first evidence that (addi-

tional) interruption tasks increase the workload and lead to time pressure (Mark et al., 2008; cf. chapter 2.4).

In accordance with these two main demands or consequences of interruptions mentioned in laboratory and field research, the time and cognitive demand were suggested as central characteristics of accumulating interruptions (in chapter 2.3). The time demand, defined as the frequency and duration of interruptions, indicates the time loss caused by interruptions. The cognitive demand indicates how much attentional or memory resources are claimed. Based on the results of previous (mainly laboratory) research, it was assumed that these demands would determine the impact (accumulating) interruptions have on possible outcomes like performance and strain.

In study 1 these assumptions were tested in the work setting. It was hypothesised that the experience of mental demands and time pressure (as a consequence of time loss) would mediate the relationship between interruptions and performance (forgetting of intentions, satisfaction with the performance) and strain (irritation). These assumptions were supported for irritation and (partly) for satisfaction with one's own performance. The interpretation of non-significant results in the case of forgetting of intentions is that mental demands and time pressure are too unspecific for the specific outcome forgetting of intentions (cf. chapter 4.4). Nevertheless, the results show that it can be possible to adapt assumptions about the mode of action of work interruptions gathered mainly from laboratory research into the work setting. Time pressure and mental demands can explain the effect of work interruptions on certain facets of performance or strain.

6.1.3 A cross-level perspective: the impact of age and cognitive abilities

So far it has been shown that interruptions raise mental demands on individuals and tax their working memory and attention. But as working memory and attentional abilities vary

between people, especially between individuals of different ages – a life-long decline is reported by Hedden and Gabrieli (2004) – the following question arises:

Do older workers, as compared to younger workers, have more problems in dealing with interruptions and multitasking demands?

As explained in chapter 5.1.3, older employees have lower working memory and attentional abilities than younger employees and show a worse performance in interruption tasks and other task switching conditions (multitasking) in laboratory settings (Hedden & Gabrieli, 2004; Monk et al., 2004). Thus, they might also have difficulties in dealing with interruptions and multitasking at work.

The implicit or explicit basic assumption (derived from goal activation theory or the task switching paradigm) of most laboratory studies on interruptions is that the effect of interruptions on time loss and errors of the primary or interruption task can be explained by the raised working memory or attentional demands. If these demands can be dealt with more easily because of higher capacities, it can be assumed that there will be fewer errors, less time loss and less energetic costs. According to the proposed theoretical framework (chapter 2), this will lower the probability of failures, the perception of a high workload and it will decrease the experienced effort. Fewer effects will interact and finally, the probability of a downward spiral decreases. Consequently, people with higher cognitive abilities will probably experience less strain. According to action regulation theory (Hacker, 2005), the personal resources of working memory and attentional abilities will act as internal resources and help to cope with the regulation hindrance that is an interruption (Frese & Zapf, 1994). Contrary to these arguments, no significant interaction effects were found between interruptions and the cognitive abilities (working memory or attention) when explaining mood or irritation in study 2. Further, no significant two-way interactions were found between interruptions and age when explaining mood or irritation.

The pattern of the observed three-way interactions led to the conclusion that older employees do have other resources (probably based on their work experience) which can outweigh their capacity losses (cf. chapter 5.4). On the contrary, younger employees need good cognitive abilities to prevent strain. The additional resources used by older employees can act at different points of the process of (accumulating) interruptions, however, before discussing these the mechanisms of cognitive capacities will first be explained. According to previous laboratory research (e.g. Altmann & Trafton, 2002; Boehm-Davis & Remington, 2009; Brixey et al., 2007), cognitive capacities change the accomplishment of the interruption. They can reduce the interruption lag (cf. Brixey et al., 2007), they have an impact on the success of the accomplishment of the interruption task (inhibiting the primary goal, but keeping it activated so that it can be easily resumed; cf. Altmann & Trafton, 2002) and last but not least, they reduce the resumption lag. Thus, they probably reduce the probability of negative consequences of interruptions before they can occur.

The other mentioned resources will likely operate at a different (and later) point within the process. In chapter 5.4.5 two possible strategies of older or more experienced employees are suggested: prioritizing (cf. Baltes & Baltes, 1989) and affective skills or detachment. Prioritizing is focussed on the stressor interruption (or multitasking), but it is not assumed to optimize their accomplishment. According to Brixey et al. (2007), it is a handling strategy and happens within the interruption lag when a decision is made as to whether or not the interruption task should be accomplished. In the process of accumulating interruptions, prioritizing likely implies more decisions than whether or not to handle a single interruption. It might result in the decision to skip other non-relevant tasks which are not involved in the interruption situation and thus reduce the workload and time pressure. As a consequence, prioritizing can help to keep performance high without the investment of too much effort. Whereas prioritizing is a strategy to reduce stress, affective skills will probably help to reduce strain. Brose

et al. (2011) describe that older employees use emotion regulation strategies to improve their mood. Thus, the accomplishment or handling of the interruption will presumably stay the same. Also, resulting effects, such as increasing time pressure and workload and decreasing performance, should not differ from situations in which people do not use this strategy. They simply interpret the situation differently and show other emotions (Gross, 1998). In line with this, it has been found that a successful detachment dampens or severs the link between the stressor and the experience of strain in the evening (Sonnentag, 2012), but does not change the stressor and its direct effects.

Future studies need to identify which strategies or resources older employees successfully use in order to cope with interruptions (and multitasking demands). The general coping strategies suggested by Baltes and Baltes (1989), namely selection (of goals), optimization (of goal relevant means) and compensation (of a loss of goal relevant means) can be a useful starting point for identifying further specific coping strategies relevant for coping with interruptions. We already have examined the role of the goal-relevant means of attentional and working memory resources and discussed the role of the selection strategy of prioritizing and the compensation strategy of emotion regulation. The framework of Baltes and Baltes (1989) might help to identify further strategies. In addition, the knowledge/assumptions about the process of (accumulating) interruptions and a discrimination between the strategies according to their role within this process (like the suggested one: stress- and strain-oriented strategies) might help in designing an appropriate study to test possible strategies older employees might use (or might help establish hypotheses). If older employees use stress-oriented strategies like prioritizing, typical consequences of accumulating interruptions (e.g. time pressure, workload, failure, decrease of performance) might be reduced compared to employees who do not use these strategies. If they use strain-oriented strategies like emotion regulation or detachment, they will not differ from their colleagues in their perception of such consequences.

6.2 Limitations, strengths and suggestions for future research

The dissertation was able to answer questions about the mechanisms of work interruptions, however, new questions have also arisen. In the following chapter the strengths and limitations of this dissertation will be described along with further suggestions for future studies.

This dissertation was able to disclose the relationship between short term effects of interruptions found in laboratory studies and long-term effects of work interruptions found in field studies, by proposing a theoretical framework on the process of accumulating interruptions. Based on this novel theoretical framework, hypotheses were tested utilising daily diary studies during working time. To the author's knowledge, this is the first time that work interruptions have been examined across several days in the work context. This allowed the measurement of interruptions as they arise and the examination of the independent, dependent and moderating and (partly) mediating variables at separate points in time (except mood and the stressors). In both studies, the choice of variables had the advantage that specific stressors (which are particularly relevant in the examined occupation group) were matched with their adequate resources, mediating variables and consequences. In study 2, self-report data were further combined with performance testing (investigating cognitive abilities) and extended the actual research on age effects by considering both chronological age and cognitive abilities as one partial/particular indicator of functional age.

However, the studies have limitations which raise questions for future research. First of all, the chosen sample hampers generalizability. While an advantage of this sample is that the examined stressors are particularly relevant to this occupational group, they encounter them uncommonly frequently. Occupational groups in which these stressors are less prevalent may experience fewer effects as a result of working interruptions. Therefore, the investigation of context-specific stressors would be recommended rather than measuring atypical stressors of a

particular occupational group. Nevertheless, examining other occupations in which interruptions regularly appear would be advantageous to cross-validating the findings presented in this study.

Furthermore, although measuring interruptions three times within a shift can provide a good initial understanding of the process of interruptions during the work day, our theoretical framework ideally calls for different kind of investigation. Preferably, every occurring interruption and its characteristics within one working day should be investigated. In doing so, the greatest possible amount of information about the accumulation of interruptions could be gathered. A good opportunity for examining every interruption in a day, without the effort of engaging observers for every subject and the constraint of measuring just observable variables, would be the use of tallies. This could be done with a paper-and-pencil version, noticing every interruption, its length, complexity and the complexity of the interrupted task. Alternatively, an 'electronic tally' (kept by a handheld computer) could be carried out, in which the time point of the interruption is automatically recorded, which also allows conclusions about periods without interruptions. When using a tally, a limited number of characteristics (not more than five, three would be better) is recommendable to avoid the investigation being too intrusive (prolongs the interruption too much) and consequently the compliance rate could decline. Initial pilot studies conducted in our work group have confirmed the feasibility of this method.

Moreover, a next step in examining direct effects of work interruptions within or after the work day could be physiological data. The cited theory of Hockey (1989) leads to the assumption that potentially overloading conditions, like accumulating interruptions, could lead to physiological stress reactions like the allostatic load.

6.3 Résumé and implications for practice

In this dissertation, the daily processes of the work characteristic work interruptions were illuminated. To that end, a theoretical framework was developed, which integrated and extended present knowledge of laboratory and field studies and established new angles for applied research in the work context. Based on that, first assumptions about the underlying processes of work interruptions and potential coping resources were tested. Daily diary studies emerged as an appropriate method to examine processes in real work settings.

But what can be concluded from the results for organizational practice? In the two studies of this dissertation, relationships between interruptions (and multitasking) and mood, perceived quality of performance, forgetting of intentions and irritation were found, (partly) mediated by time pressure and mental demands and (partly) moderated by the interaction of age and mental abilities. There are four main opportunities therefore, which may prevent the identified negative effects of work interruptions.

First of all, the stressor, work interruptions, can be reduced. Therefore, unnecessary work interruptions could be defined and ideas to prevent them could be generated. For that purpose, health circles turned out to be a possible choice (Aust & Ducki, 2004; Baethge & Rigotti, 2013b). Health circles are a participative intervention which allows employees to find opportunities to reduce stressors like work interruptions (cf. chapter 4).

A second option would be to cut the link between interruptions and the mediating variables of time pressure and mental demands. The development of time pressure could be prevented by keeping the interruptions short. The author's own studies have shown that the experience of time pressure is positively related to the frequency of long lasting interruptions (Baethge, 2013, June). Further options would be to prioritise and to delay tasks which are not urgent or important (cf. chapter 6.4) or to schedule extra time for interruptions for each working day (Baethge & Rigotti, 2013c). Mental demands of interruptions mainly refer to

demands on the working memory and the attention. Working memory demands can be reduced by a proper use of the interruption lag (Boehm-Davis & Remington, 2009; Ho et al., 2004; Monk et al., 2004): the last or next steps of the primary task can be noted, the primary (sub) task can be finished. Finishing tasks will also be relevant at the end of the working day, to avoid rumination during leisure time (cf. chapter 2). The most severe attentional demands of interruptions are probably fast attention switches. These can be reduced by avoiding multitasking and interruptions in a fast pace. If many interruptions happen within a short time, it would be recommended to delay or delegate some of these (cf. Brixey et al., 2007).

A further possibility to prevent or reduce the negative effects of interruptions (or of time pressure/mental demands) is to cut the link between the stressors and well-being, performance and strain. Typical interventions to reduce the effect of stressors (which were already discussed in chapter 2 and 6.1.3) are breaks during working time or psychological detachment afterwards (Engelmann et al., 2011; Jonge, Spoor, Sonnentag, Dormann, & van den Tooren, 2012). In chapter 2, interruption free periods were also discussed as a potential moderator to prevent negative effects of accumulating interruptions.

Considering the second study, a fourth option to reduce strain should be considered. Younger employees can profit from the strategies and knowledge of older colleagues and from their own working memory and attentional abilities. The ability to solve attention and working memory tests can be trained (in samples of neurologic patients: Plohmann et al., 1998; Sturm et al., 2003; Sturm, Longoni, Fimm, et al., 2004; Sturm, Longoni, Weiss, et al., 2004), but whether such training would improve the ability to cope with work interruptions should be questioned. Zijlstra et al. (1999) found a training effect on the accomplishment of interruptions; people became faster when interrupted several times a day. According to our results older employees seem to have some kind of experience with the handling of interrup-

tions. Thus, it could be advantageous to share this knowledge or associated skills with other (younger) employees.

Finally, the results of the two empirical studies combined with the knowledge accumulated in the theoretical framework led to several concrete implications for practice. The knowledge of the process of interruptions as they appear in daily work is essential for finding effective intervention strategies to reduce stress at work caused by interruptions, one of the main stressors in the modern work environment (BAuA, 2012; Eurofound, 2012).

6.4 Conclusion

In this dissertation, the necessity and the benefit of examining interruptions in their daily work context became apparent. This approach helps us to understand the process of interruptions at work and possible reasons for their relationship with negative health outcomes. It was found that interruptions lead to performance declines and strain (a mid-term indicator of ill health) in the daily work life because they cause raised mental demands and time pressure. Further, it was demonstrated that younger employees profit from high attentional and working memory abilities to cope with the negative effects of interruptions on well-being and strain. In contrast, older employees seem to have alternative coping strategies.

These are initial steps to uncovering within- and between- subject effects of work interruptions- a ubiquitous stressor of modern work. To gain more profound knowledge of the process of work interruptions, further studies which capture interruptions as they appear in daily work are desirable.

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Appendices

Table of contents

List of tables

List of figures

Appendix A

Descriptive statistics and correlation matrix of the Dissertation variables

The descriptive statistics and the correlation matrix are based on a sample of 134 nurses (those who completed both the general and the diary survey) out of the 145 nurses examined in the general project.

Appendix A

Correlation matrix

Table A.1. Zero-Order Correlations of All Dissertation Variables.

	Variable	M[a]	SD[a]	M[b]	SD[b]	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Age	40.98	11.55			-														
2	Alertness[c]	275.47	73.39			.28**	-													
3	Working memory[c]	6.58	8.04			.23**	.05	-												
4	Interruptions	19.15	6.66	19.18	8.03	.10	.05	.07	-	.56***	.33***	.27***	.30***	.40***	-.03	-.17***	-.29***	.23***	-.14***	-.17***
5	Multitasking	3.15	0.60	3.15	0.75	-.10	.11	-.08	.57***	-	.57***	.54***	.52***	.62***	.00	-.20***	-.33***	.22***	-.08	-.17***
6	Time pressure (work shift)	11.18	3.11	11.19	3.72	-.12	.02	-.12	.29***	.57***	-	.75***	.51***	.48***	.02	-.18***	-.32***	.25***	-.18***	-.18***
7	Mental demands (work shift)	10.96	3.16	11.01	3.78	-.09	.05	-.12	.23**	.51***	.83***	-	.37***	.46***	.15***	-.03	-.20***	.23***	-.13**	-.15***
8	Time pressure (evening)	3.13	0.85	3.14	1.11	-.15	-.02	.03	.28**	.47***	.56***	.41***	-	.66***	-.12**	-.36***	-.45***	.38***	-.11**	-.27***
9	Mental demands (evening)	3.60	0.69	3.61	0.92	-.13	-.06	.05	.44***	.69***	.55***	.52***	.67***	-	-.05	-.23***	-.33***	.29***	-.12**	-.22***
10	Energetic arousal	5.21	0.96	5.21	1.11	.35***	.00	-.01	-.04	-.01	.05	.20*	-.12	-.06	-	.75***	.51***	-.26***	-.02	.22***
11	Valence	5.13	0.87	5.14	1.01	.29***	-.03	.00	-.18*	-.19*	-.16	.05	-.37***	-.21*	.80***	-	.80***	-.48***	.11*	.41***
12	Calmness	4.88	0.89	4.89	1.06	.22*	-.05	.06	-.28***	-.32***	-.31***	-.18*	-.46***	-.34***	.55***	.83***	-	-.48***	.16***	.43***
13	Irritation	2.39	0.88	2.39	1.08	-.04	.00	-.07	.30***	.17*	.26**	.21*	.38***	.31***	-.34***	-.58***	-.57***	-	-.20***	-.50***
14	Forgetting of intentions	.87	0.22	0.87	0.33	.11	.07	.03	.12	.01	.22*	.14	.19*	.20*	.01	.16	.24**	.26**	-	-.24***
15	Satisfaction with one's own performance	3.89	0.68	3.92	0.88	.14	.08	.17	-.19*	-.13	-.20*	-.15	-.31***	-.27**	.35***	.50***	.54***	-.59***	.37***	-

Note. Correlations below the diagonal are person-level correlations (N = 129-134). Correlations above the diagonal are day-level correlations (n = 570-633). Person-level correlations of $r > .10$ are significant at $p = .001$, those of $r > .13$ are significant at $p = .01$, and those of $r > .08$ are significant at $p = .05$. Day-level correlations of $r > .15$ are significant at $p = .001$. [a] Means and standard deviations at the person level. [b] Means and standard deviations at the day level. [c] High scores reflect worse cognitive functioning (alertness: reaction time; working memory: errors).

Age

Table A.2. Scale characteristics: Age.

Item	M	SD	Skew	Curtosis
Wie alt sind Sie?	40.98	11.55	-,23	-.99

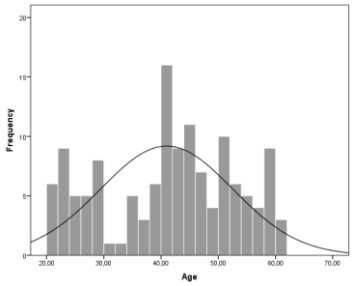

Figure A.1. Age.

Alertness, Working memory

Zimmermann & Fimm, 2002

Table A.3. Variable characteristics: Alertness, Working memory.

Name of the subtest/indicator	Measure	M	SD	Skew	Curtosis
Alertness/al_mdn5	Reaction time	275.46	73.39	3.73	19.06
Woking memory/wm3err0	Error	6.58	8.04	2.13	5.96

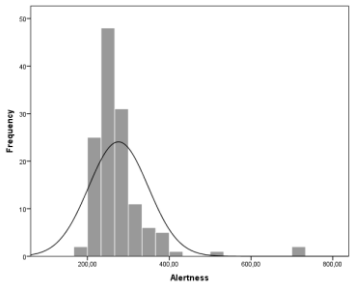

Figure A.2. Alertness.

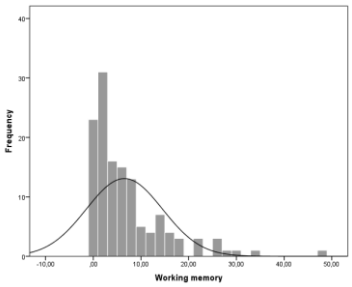

Figure A.3. Working memory.

Interruptions

Table A.4. Item and scale characteristics: Interruptions.

	Day 1				Day 2				Day 3				Day 4				Day 5			
Item	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu
Wie oft wurden Sie in der letzten halben Stunde unterbrochen durch...																				
Arzt/Ärztin?	2.67	1.78	2.70	9.05	2.73	1.29	1.25	2.51	2.89	1.53	2.05	7.78	2.78	1.39	1.35	2.50	2.78	1.47	1.46	2.25
Patient/in?	3.87	2.29	2.81	11.28	3.94	1.76	1.65	3.72	4.33	1.93	1.17	2.39	4.37	2.06	1.67	4.19	4.65	2.44	1.69	3.62
Pflegekraft?	3.57	2.00	2.93	15.38	3.49	1.36	0.55	-0.38	3.81	1.78	1.04	0.66	3.65	1.73	1.13	0.99	3.54	1.76	1.23	1.34
das Telefon?	3.77	2.50	1.86	5.57	3.87	2.01	1.15	1.80	4.03	2.34	1.46	2.38	3.84	2.16	1.43	3.69	3.77	2.38	1.83	4.86
anderes Personal?	2.60	1.54	3.06	17.25	2.78	1.34	1.80	6.11	3.00	1.70	1.19	1.09	2.82	1.53	1.27	1.52	2.66	1.54	1.47	2.36
fehlende Arbeitsmittel?	1.95	1.29	4.05	27.32	1.92	1.11	1.92	5.39	2.11	1.30	1.44	1.89	1.98	1.13	1.64	2.44	1.92	1.24	1.94	4.05
Scale	18.43	9.38	3.23	15.32	18.73	6.29	1.19	1.83	20.16	8.32	1.34	2.30	19.44	7.51	1.15	2.11	19.31	8.36	1.55	2.80

Note. Sk = Skew; Cu = Curtosis.

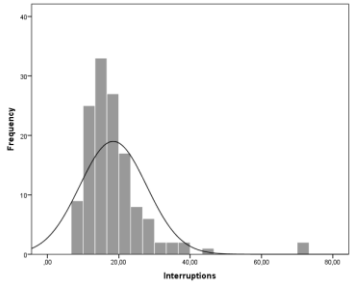

Figure A.4. Interruptions: Day 1.

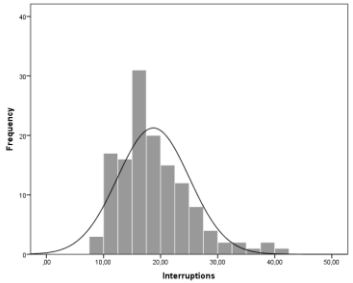

Figure A.5. Interruptions: Day 2.

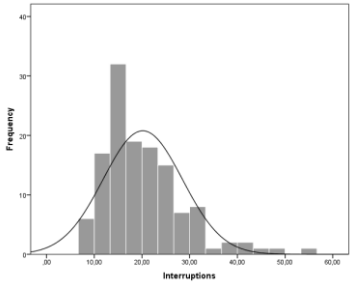

Figure A.6. Interruptions: Day 3.

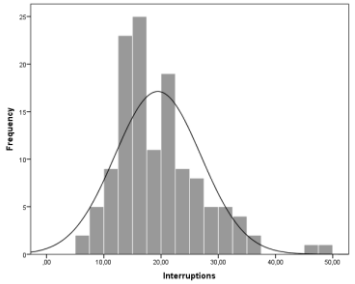

Figure A.7. Interruptions: Day 4.

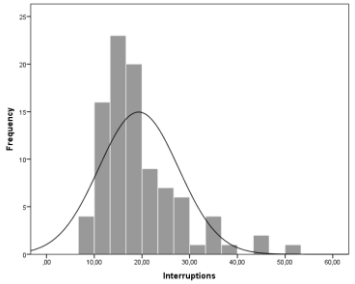

Figure A.8. Interruptions: Day 5.

Appendix A

Multitasking

Table A.5. Item and scale characteristics: Multitasking.

	Day 1				Day 2				Day 3				Day 4				Day 5			
Item	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu
Ich musste in der letzten halben Stunde viele Dinge gleichzeitig im Kopf haben.	3.32	0.84	-0.25	-0.38	3.33	0.81	-0.28	-0.70	3.58	0.79	-0.52	0.37	3.47	0.87	-0.45	0.15	3.41	0.89	0.13	-0.90
Ich erhielt in der letzten halben Stunde Anweisungen, die ich gleichzeitig bearbeiten musste.	2.58	0.87	-0.01	-0.95	2.83	0.80	0.03	-0.57	2.97	0.90	-0.16	-0.41	2.91	0.89	-0.02	-0.28	2.72	0.99	0.40	-0.45
Es gab in der letzten halben Stunde Momente, die für kurze Zeit höchste Konzentration erforderten.	3.01	0.95	-0.05	-0.67	3.21	0.87	-0.08	-0.52	3.34	0.84	-0.17	-0.46	3.31	0.90	-0.04	-0.55	3.18	0.89	0.32	-0.60
In der letzten halben Stunde kam es vor, dass mehrere Personen gleichzeitig etwas von mir wollten.	2.98	0.85	-0.24	-0.67	3.15	0.78	-0.26	-0.29	3.32	0.82	-0.52	0.04	3.26	0.84	-0.66	0.12	3.18	0.81	-0.03	-0.83
Scale	2.97	0.75	-0.08	-0.62	3.13	0.71	-0.16	-0.61	3.30	0.73	-0.36	0.23	3.24	0.77	-0.37	0.11	3.12	0.80	0.28	-0.54
			Alpha:	*.88*			*Alpha:*	*.90*			*Alpha:*	*.90*			*Alpha:*	*.90*			*Alpha:*	*.91*

Note. Sk = Skew; Cu = Curtosis.

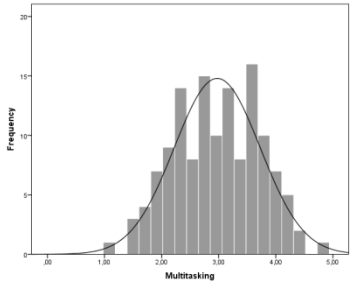

Figure A.9. Multitasking: Day 1.

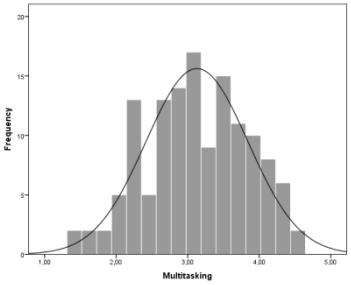

Figure A.10. Multitasking: Day 2.

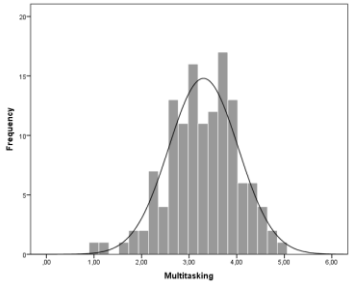

Figure A.11. Multitasking: Day 3.

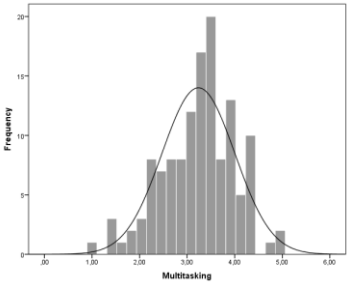

Figure A.12. Multitasking: Day 4.

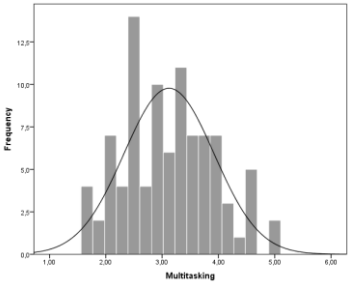

Figure A.13. Multitasking: Day 5.

Time pressure (work shift)

Hart & Staveland, 1988

Table A.6. Item and scale characteristics: Time pressure (work shift).

	Day 1				Day 2				Day 3				Day 4				Day 5			
Item	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu
Wie hoch war das Tempo, mit dem Sie die einzelnen Aufgaben in der letzten halben Stunde bewältigen mussten?	10.84	3.79	-0.21	-0.50	10.93	3.72	-0.07	-0.07	11.65	3.63	-0.44	0.20	11.45	3.79	-0.30	-0.05	11.23	3.63	-0.51	0.19

Note. Sk = Skew; Cu = Curtosis.

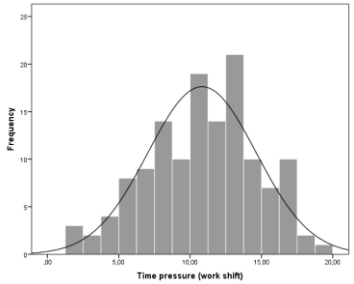

Figure A.14. Time pressure (shift): Day 1.

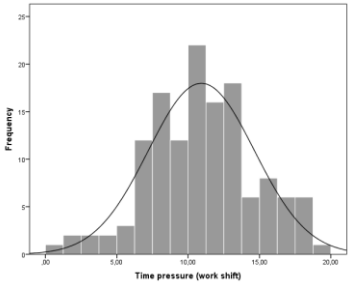

Figure A.15. Time pressure (shift): Day 2.

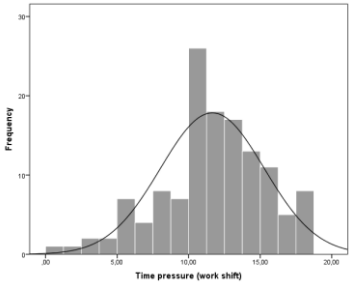

Figure A.16. Time pressure (shift): Day 3.

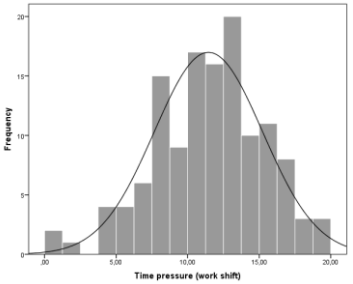

Figure A.17. Time pressure (shift): Day 4.

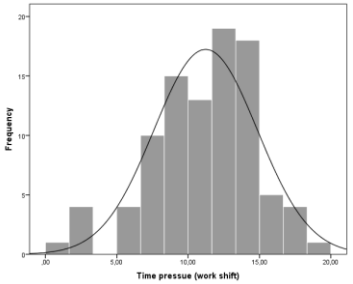

Figure A.18. Time pressure (shift): Day 5.

Mental demands (work shift)

Hart & Staveland, 1988

Table A.7. Item and scale characteristics: Mental demands (work shift).

	Day 1				Day 2				Day 3				Day 4				Day 5			
Item	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu
Wie hoch waren die geistigen Anforderungen in der letzten halben Stunde?	10.65	4.00	-0.21	-0.84	10.92	3.81	-0.13	-0.21	11.63	3.72	-0.40	0.29	11.05	3.72	-0.37	-0.02	10.58	3.63	-0.36	0.13

Note. Sk = Skew; Cu = Curtosis.

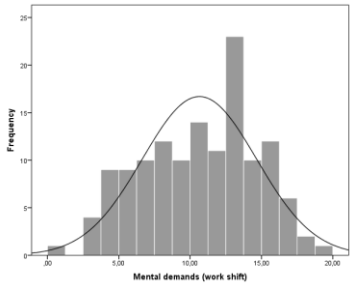

Figure A.19. Mental demands (shift): Day 1.

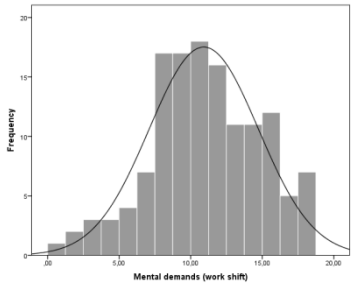

Figure A.20. Mental demands (shift): Day 2.

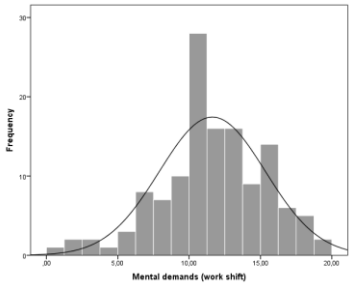

Figure A.21. Mental demands (shift): Day 3.

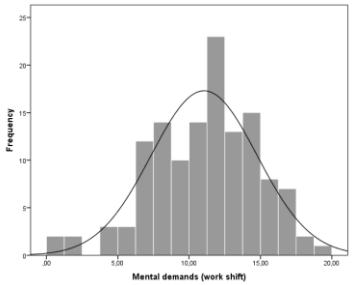

Figure A.22. Mental demands (shift): Day 4.

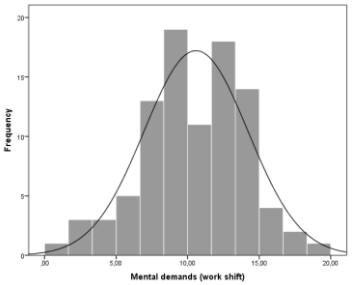

Figure A.23. Mental demands (shift): Day 5.

Time pressure (evening)

Semmer, Zapf, & Dunckel, 2007

Table A.8. Item and scale characteristics: Time pressure (evening).

	Day 1				Day 2				Day 3				Day 4				Day 5			
Item	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu
Ich stand heute unter Zeitdruck.	3.01	1.25	0.03	-0.97	3.29	1.11	-0.18	-0.74	3.55	1.07	-0.24	-0.90	3.47	1.16	-0.41	-0.66	3.46	1.20	-0.41	-0.80
Ich musste heute schneller arbeiten, als ich es normalerweise tue, um meine Arbeit zu schaffen.	2.43	1.16	0.56	-0.35	2.83	1.13	0.19	-0.78	3.24	1.16	0.00	-0.91	3.04	1.15	-0.05	-0.86	3.05	1.24	-0.02	-0.98
Bei meiner Arbeit wurde heute ein hohes Arbeitstempo verlangt.	2.74	1.28	0.21	-1.02	3.21	1.17	-0.13	-0.83	3.51	1.12	-0.39	-0.61	3.29	1.16	-0.15	-0.89	3.37	1.21	-0.30	-0.95
Scale	2.73	1.14	0.31	-0.75	3.11	1.05	0.01	-0.67	3.43	1.03	-0.14	-0.66	3.27	1.09	-0.20	-0.85	3.29	1.11	-0.16	-0.85
			Alpha:	*.92*			*Alpha:*	*.92*			*Alpha:*	*.91*			*Alpha:*	*.94*			*Alpha:*	*.90*

Note. Sk = Skew; Cu = Curtosis.

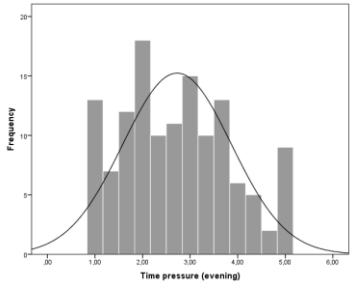

Figure A.24. Time pressure (evening): Day 1.

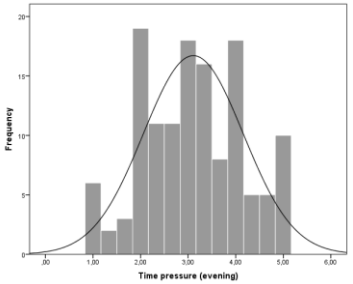

Figure A.25. Time pressure (evening): Day 2.

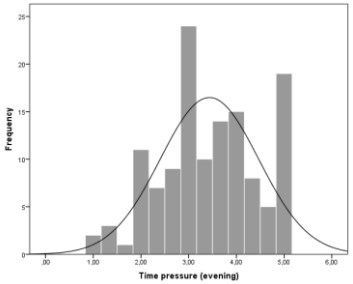

Figure A.26. Time pressure (evening): Day 3.

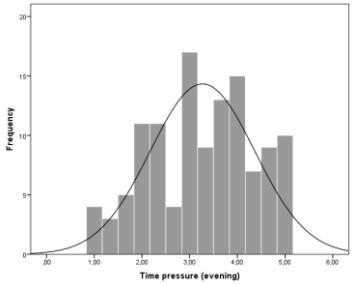

Figure A.27. Time pressure (evening): Day 4.

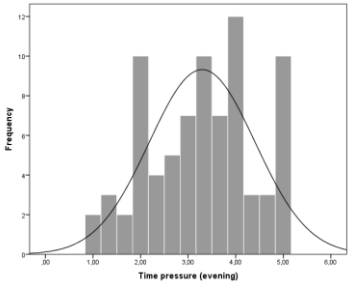

Figure A.28. Time pressure (evening): Day 5.

Mental demands (evening)

Semmer, Zapf, & Dunckel, 2007

Table A.9. Item and scale characteristics: Mental demands (evening).

	Day 1				Day 2				Day 3				Day 4				Day 5			
Item	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu
Ich musste bei meiner Arbeit heute viele Dinge gleichzeitig im Kopf haben.	3.57	1.06	-0.13	-0.89	3.68	1.02	-0.37	-0.60	3.91	0.93	-0.69	0.26	3.96	1.00	-0.86	0.20	3.73	0.98	-0.38	-0.42
Ich musste heute Informationen für kurze Zeit im Kopf behalten, die man sich schwer merken kann (z.B. Namen, Zahlen usw.).	3.00	1.24	0.00	-1.00	3.22	1.14	-0.25	-0.76	3.34	1.13	-0.21	-0.71	3.49	1.10	-0.57	-0.30	3.45	1.12	-0.40	-0.61
Es gab heute Momente bei meiner Arbeit, die für kurze Zeit höchste Konzentration erforderten.	3.60	1.18	-0.45	-0.75	3.79	1.00	-0.45	-0.61	3.85	0.99	-0.59	-0.20	3.85	0.98	-0.51	-0.49	3.73	1.09	-0.49	-0.55
Scale	3.39	0.98	-0.09	-0.67	3.56	0.88	-0.25	-0.75	3.70	0.85	-0.42	-0.05	3.77	0.90	-0.72	0.09	3.64	0.93	-0.35	-0.44
			Alpha:	*.80*			*Alpha:*	*.78*			*Alpha:*	*.79*			*Alpha:*	*.84*			*Alpha:*	*.84*

Note. Sk = Skew; Cu = Curtosis.

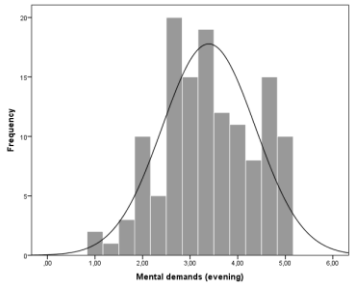

Figure A.29. Mental demands (evening): Day 1.

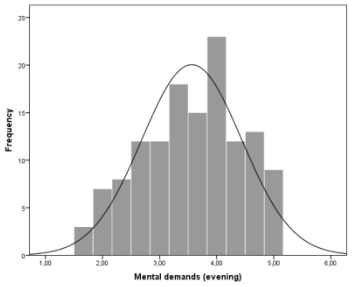

Figure A.30. Mental demands (evening): Day 2.

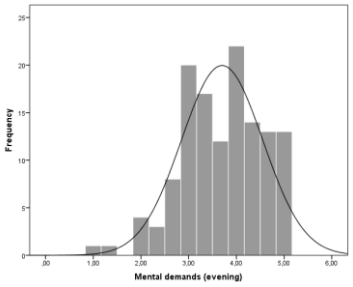

Figure A.31. Mental demands (evening): Day 3.

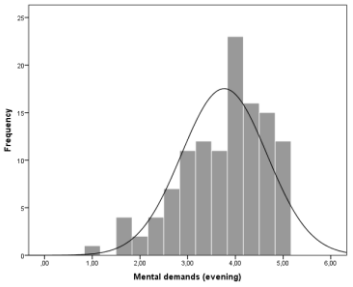

Figure A.32. Mental demands (evening): Day 4.

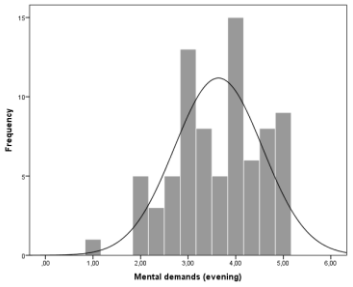

Figure A.33. Mental demands (evening): Day 5.

Appendix A

Mood: Energetic arousal

Wilhelm & Schoebi, 2007

Table A.10. Item and scale characteristics: Energetic arousal.

	Day 1				Day 2				Day 3				Day 4				Day 5			
Item	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu
In diesem Moment fühle ich mich..																				
sehr müde – sehr wach	5.46	1.21	-0.60	-0.34	5.41	1.19	-0.59	0.09	5.53	1.16	-0.49	-0.49	5.32	1.25	-0.49	-0.30	5.25	1.28	-0.21	-0.90
sehr energielos – sehr energiegeladen	5.09	1.09	-0.31	-0.54	5.10	1.14	-0.39	-0.09	5.05	1.15	-0.29	-0.24	4.95	1.12	-0.03	-0.81	4.92	1.06	-0.01	-0.30
Scale	5.27	1.08	-0.45	-0.36	5.25	1.12	-0.46	-0.13	5.29	1.11	-0.40	-0.45	5.13	1.14	-0.25	-0.66	5.09	1.13	-0.17	-0.54

Note. Sk = Skew; Cu = Curtosis.

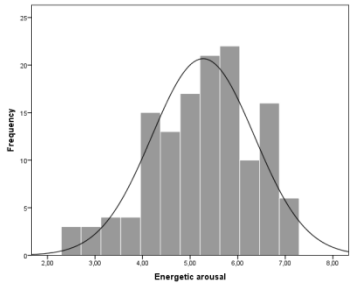

Figure A.34. Energetic arousal: Day 1.

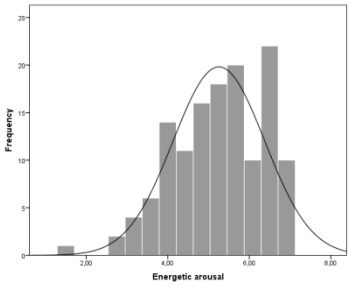

Figure A.35. Energetic arousal: Day 2.

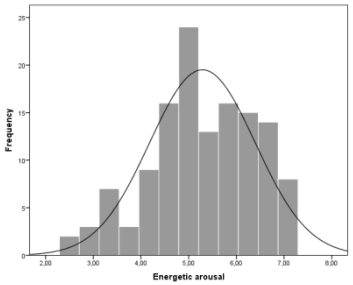

Figure A.36. Energetic arousal: Day 3.

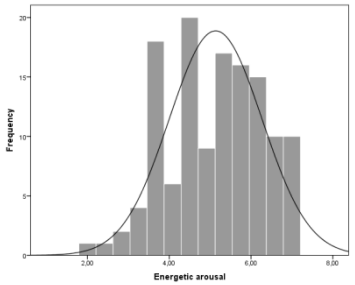

Figure A.37. Energetic arousal: Day 4.

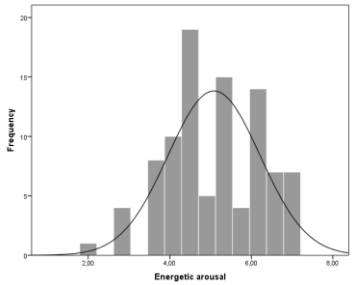

Figure A.38. Energetic arousal: Day 5.

Appendix A

Mood: Valence

Wilhelm & Schoebi, 2007

Table A.11. Item and scale characteristics: Valence.

	Day 1				Day 2				Day 3				Day 4				Day 5			
Item	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu
In diesem Moment fühle ich mich..																				
sehr unzufrieden – sehr zufrieden	5.29	1.01	-0.31	-0.57	5.17	1.11	-0.62	0.16	5.01	1.10	-0.33	0.03	5.04	1.08	-0.76	1.62	5.15	1.04	-0.40	0.36
sehr unwohl – sehr wohl	5.28	1.02	-0.40	-0.40	5.12	1.06	-0.40	-0.17	5.08	1.02	-0.42	0.58	5.07	1.06	-0.23	-0.05	5.09	1.03	-0.04	-0.01
Scale	5.29	0.98	-0.31	-0.52	5.15	1.05	-0.50	0.03	5.05	1.02	-0.28	0.14	5.06	1.02	-0.34	0.35	5.12	1.00	-0.23	0.23

Note. Sk = Skew; Cu = Curtosis.

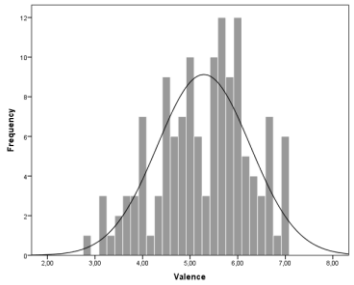

Figure A.39. Valence: Day 1.

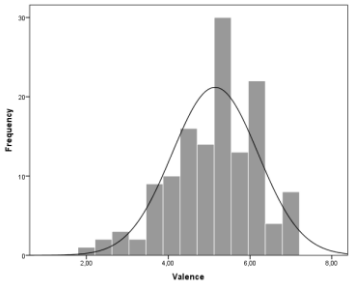

Figure A.40. Valence: Day 2.

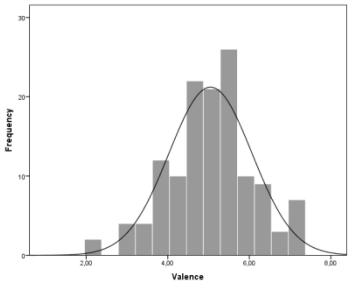

Figure A.41. Valence: Day 3.

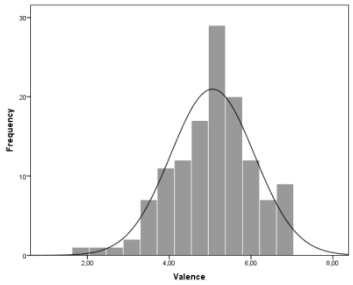

Figure A.42. Valence: Day 4.

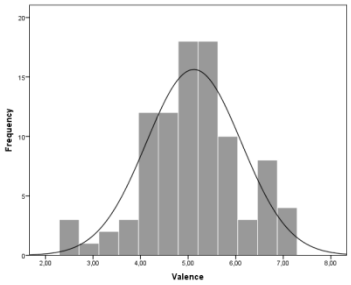

Figure A.43. Valence: Day 5.

Appendix A

Mood: Calmness

Wilhelm & Schoebi, 2007

Table A.12. Item and scale characteristics: Calmness.

	Day 1				Day 2				Day 3				Day 4				Day 5			
Item	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu
In diesem Moment fühle ich mich..																				
sehr unruhig – sehr ruhig	5.29	1.06	-0.38	-0.13	5.18	1.05	-0.48	0.27	4.99	1.11	-0.35	-0.13	5.09	0.99	-0.52	1.07	5.09	1.06	-0.15	-0.30
sehr angespannt – sehr entspannt	4.82	1.21	-0.45	0.03	4.65	1.18	-0.15	-0.39	4.53	1.22	-0.16	-0.51	4.54	1.18	-0.29	-0.04	4.65	1.05	-0.05	-0.26
Scale	5.05	1.05	-0.35	0.15	4.92	1.07	-0.31	-0.04	4.76	1.11	-0.19	-0.34	4.81	1.02	-0.22	0.20	4.87	1.00	-0.02	-0.29

Note. Sk = Skew; Cu = Curtosis.

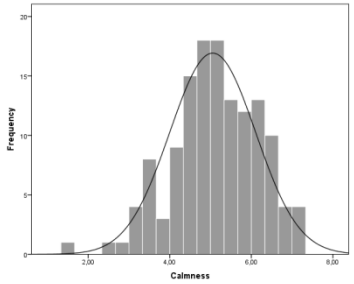

Figure A.44. Calmness: Day 1.

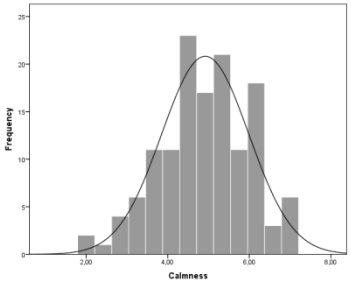

Figure A.45. Calmness: Day 2.

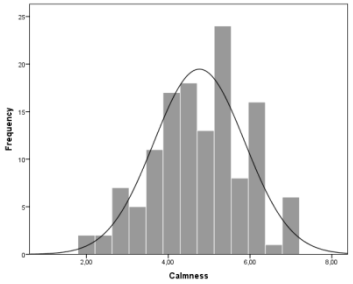

Figure A.46. Calmness: Day 3.

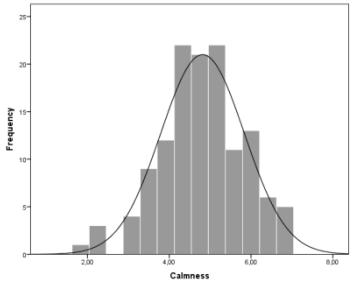

Figure A.47. Calmness: Day 4.

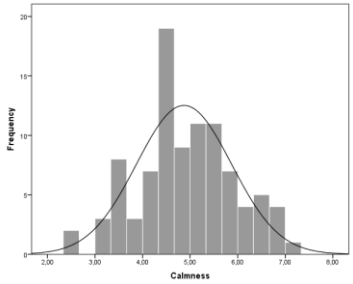

Figure A.48. Calmness: Day 5.

Irritation

Mohr, Rigotti, & Müller, 2005

Table A.13. Item and scale characteristics: Irritation.

	Day 1				Day 2				Day 3				Day 4				Day 5			
Item	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu
Es fiel mir heute schwer, nach der Arbeit abzuschalten.	2.90	1.74	0.66	-0.57	2.97	1.78	0.56	-0.76	3.41	1.82	0.22	-1.04	3.27	1.82	0.47	-0.72	2.91	1.71	0.48	-0.74
Ich musste auch zu Hause an Schwierigkeiten bei der Arbeit denken.	2.63	1.58	0.86	0.06	2.78	1.68	0.77	-0.45	2.99	1.75	0.45	-0.86	2.96	1.70	0.64	-0.54	2.51	1.48	0.75	-0.31
Wenn andere mich ansprachen, kam es vor, dass ich mürrisch reagierte.	1.79	1.13	1.58	2.04	1.95	1.26	1.34	0.99	2.25	1.49	1.03	-0.09	2.17	1.43	0.82	-0.79	2.04	1.25	1.06	0.43
Selbst im Urlaub müsste ich jetzt manchmal an Probleme bei der Arbeit denken.	2.28	1.46	1.10	0.39	2.08	1.37	1.40	1.51	1.97	1.33	1.35	0.97	2.03	1.31	1.34	1.53	1.96	1.22	1.17	0.71
Ich fühlte mich heute ab und zu wie jemand, den man als Nervenbündel bezeichnet.	1.88	1.22	1.33	0.90	2.02	1.35	1.45	1.46	2.27	1.57	1.01	-0.06	2.19	1.51	1.09	0.27	2.23	1.49	1.10	0.52
Ich war schnell verärgert.	1.94	1.22	1.31	0.94	2.16	1.43	1.12	0.12	2.34	1.48	1.01	0.17	2.23	1.44	1.02	0.05	2.08	1.23	0.94	0.10
Ich reagierte heute gereizt, obwohl ich es gar nicht wollte.	1.90	1.29	1.66	2.18	1.98	1.34	1.43	1.31	2.28	1.50	1.00	-0.20	2.36	1.70	0.97	-0.42	1.99	1.29	1.24	0.64
Als ich müde von der Arbeit nach Hause kam, fand ich durch nichts Erholung.	2.42	1.61	0.96	-0.08	2.87	1.86	0.65	-0.81	2.76	1.77	0.86	-0.27	2.82	1.67	0.85	-0.10	2.47	1.40	0.61	-0.73
Scale	2.22	0.98	0.93	0.78	2.35	1.08	0.91	0.17	2.53	1.16	0.63	-0.58	2.50	1.15	0.88	0.17	2.27	0.98	0.63	-0.15
			Alpha:	*.87*			*Alpha:*	*.88*			*Alpha:*	*.89*			*Alpha:*	*.89*			*Alpha:*	*.88*

Note. Sk = Skew; Cu = Curtosis.

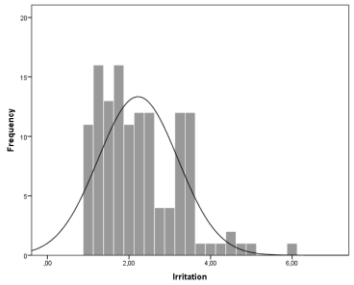

Figure A.49. Irritation: Day 1.

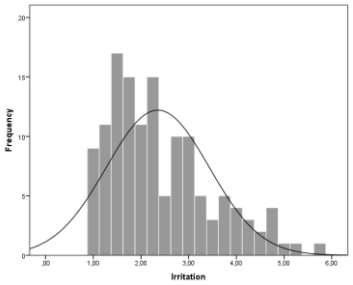

Figure A.50. Irritation: Day 2.

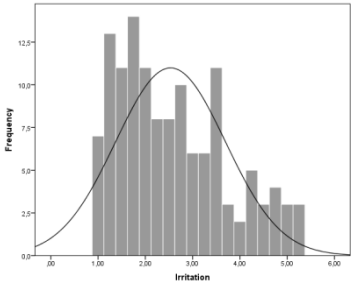

Figure A.51. Irritation: Day 3.

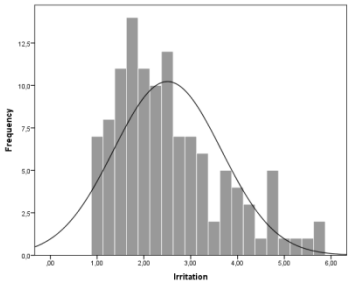

Figure A.52. Irritation: Day 4.

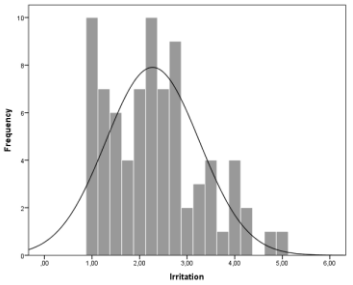

Figure A.53. Irritation: Day 5.

Forgetting of intentions

Table A.14. Frequency: Forgetting of intention.

Item		Day 1		Day 2		Day 3		Day 4		Day 5	
		Frequency	Valid Percent	Frequency	Valid Percent	Frequency	Valid Percent	Frequency	Valid Percent	Frequency	Valid Percent
Haben Sie heute bereits angefangene oder geplante Aufgaben vergessen zu erledigen?											
(0)	Nein	18	13,7	11	8,3	17	13,3	19	16,1	10	12,8
(1)	Ja	113	86,3	121	91,7	111	86,7	99	83,9	68	87,2

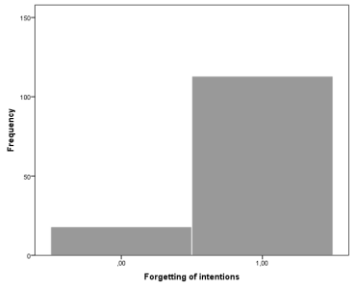

Figure A.54. Forgetting of intentions: Day 1.

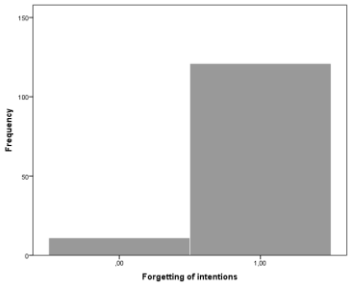

Figure A.55. Forgetting of intentions: Day 2.

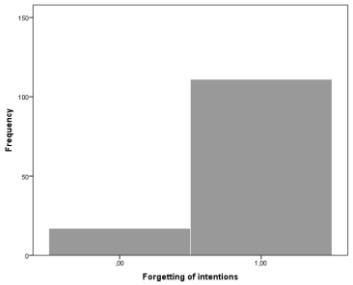

Figure A.56. Forgetting of intentions: Day 3.

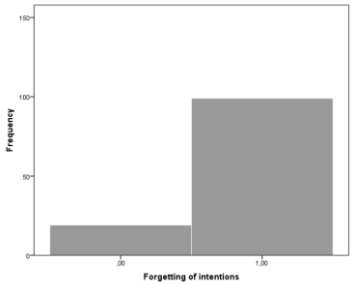

Figure A.57. Forgetting of intentions: Day 4.

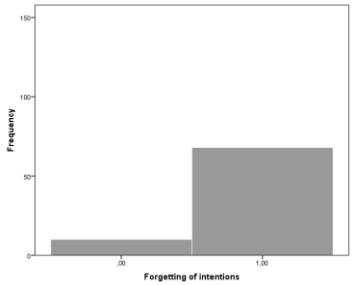

Figure A.58. Forgetting of intentions: Day 5.

Appendix A

Satisfaction with one's own performance

Table A.15. Item and scale characteristics: Satisfaction with one's own performance.

	Day 1				Day 2				Day 3				Day 4				Day 5			
Item	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu	M	SD	Sk	Cu
Heute konnte ich meinen persönlichen Anspruch an die Arbeit zufrieden stellen.	3.90	0.81	-0.60	0.59	3.88	0.86	-0.87	1.14	3.86	0.97	-1.03	1.01	3.93	0.93	-0.70	0.34	4.10	0.80	-0.66	0.09

Note. Sk = Skew; Cu = Curtosis.

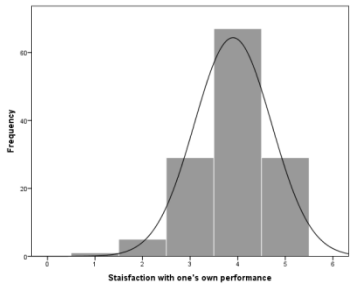

Figure A.59. Satisfaction with one's own performance: Day 1.

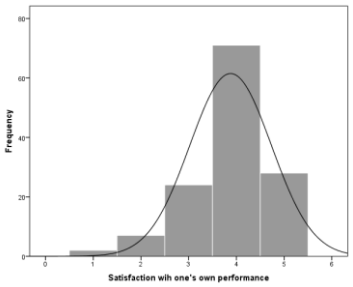

Figure A.60. Satisfaction with one's own performance: Day 2.

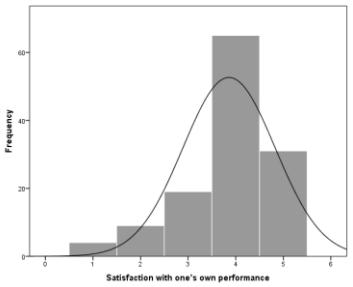

Figure A.61. Satisfaction with one's own performance: Day 3.

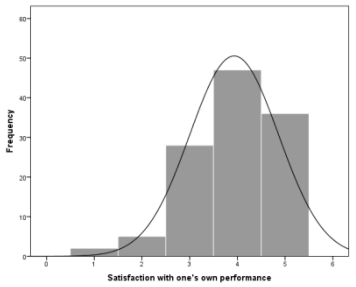

Figure A.62. Satisfaction with one's own performance: Day 4.

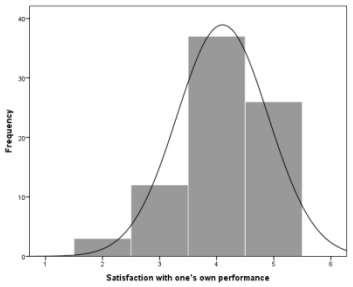

Figure A.63. Satisfaction with one's own performance: Day 5.

Appendix B

The general and the diary questionnaire

The general questionnaire

Sehr geehrte Teilnehmerin, sehr geehrter Teilnehmer,

Ihr Unternehmen hat sich bereit erklärt, unser Forschungsprojekt *Arbeitsunterbrechung und Multitasking in Informationsintensiven Berufen* zu unterstützen und eine Forschungsbefragung von MitarbeiterInnen in Ihrem Hause zu ermöglichen. Vielen Dank, dass Sie sich die Zeit nehmen, um diesen Fragebogen auszufüllen.

Mit diesem Forschungsprojekt wollen wir herausfinden, inwieweit Arbeitsunterbrechungen und Multitasking – Anforderungen Auswirkungen auf Sie als ArbeitnehmerIn haben.

Auf den kommenden Seiten stellen wir Ihnen Fragen zu Ihrem Arbeitserleben und Ihren Arbeitsbedingungen. Bitte setzen Sie Ihr **Kreuz <u>nicht</u> zwischen zwei Zahlen**. Beantworten Sie alle Fragen und lassen Sie keine Frage aus. Antworten Sie spontan und ohne lange nachzudenken! Vertrauen Sie Ihrem ersten Urteil. Die Beantwortung der Fragen nimmt ca. 45 Minuten in Anspruch.

Ihre persönlichen Daten und Antworten werden von uns selbstverständlich vertraulich behandelt und anonym ausgewertet. Eine Rückmeldung Ihrer Angaben oder der Ergebnisse an Ihr Unternehmen erfolgt über alle TeilnehmerInnen im Unternehmen hinweg, sodass keine Rückschlüsse auf einzelne Personen oder Teams/Abteilungen möglich sind. Für den Fall, dass Sie dennoch eine individuelle Rückmeldung wünschen, möchten wir Sie bitten, jetzt Ihren persönlichen Code zu erstellen.

erster. Buchstabe des Vornamens der Mutter	Letzter Buchstabe des Vornamens der Mutter	Anzahl der leiblichen Geschwister	2. Buchstabe des eigenen Geburtsortes	Letzter Buchstabe des eigenen Geburtsortes

Beispiel:
Name der Mutter: **S**iegri**d**,
Anzahl der leiblichen Geschwister: **2**
eigener Geburtsort: P**a**derbor**n**
Der Code würde dann folgendermaßen lauten: **SD2AN**

Bei Rückfragen können Sie sich jederzeit an einen Mitarbeiter unseres Projektteams wenden.

Vielen Dank für Ihre Unterstützung

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Angaben zu Ihrer Person und Ihrem beruflichen Werdegang

1.	Bitte geben Sie Ihr Geschlecht an.	□ männlich □ weiblich
2.	Wie alt sind Sie?	_____Jahre
3.	Wie ist Ihr Familienstand?	□ allein lebend □ in Partnerschaft lebend
4.	a) Haben Sie Kinder?	□ ja □ nein
	b) Wenn ja, wie viele?	_____Anzahl der Kinder
	c) Leben diese mit in Ihrem Haushalt?	□ ja □ nein
5.	Welchen höchsten allgemeinbildenden Schulabschluss haben Sie?	□ Schule beendet ohne Hauptschulabschluss □ Hauptschulabschluss bzw. POS 8. oder 9. Klasse □ Realschulabschluss bzw. POS 10. Klasse □ Fachhochschulreife □ Fachgebundene Hochschulreife □ Abitur □ Hochschulabschluss □ Ich habe einen anderen Schulabschluss und zwar: _____
6.	Wie lautet die Bezeichnung Ihres Berufsausbildungsabschlusses?	_____
7.	Was auf dieser Liste trifft auf Sie zu?	
	a)	□ Vollzeit- erwerbstätig (35 Stunden und mehr) □ Teilzeit erwerbstätig (15 bis 34 Stunden) □ Teilzeit- oder stundenweise erwerbstätig (unter 15 Stunden)
	b)	□ Unbefristetes Arbeitsverhältnis □ Befristetes Arbeitsverhältnis
8.	Wie lange sind Sie insgesamt schon berufstätig?	_____Jahre

9.	Seit wann sind Sie in ihrem jetzigen Unternehmen beschäftigt?	_____Jahre
10.	In welchem Bereich/welcher Abteilung sind Sie derzeit tätig?	_____
11.	In welcher Dienstform arbeiten Sie?	□ nur Frühdienst □ Wechsel Früh- und Spätdienst □ Wechsel Früh- und Nachtdienst □ Wechsel Spät- und Nachtdienst □ Wechsel Früh-, Spät- und Nachtdienst
12.	Für wie viele Patienten tragen Sie Verantwortung während des Frühdienstes?	_____Anzahl der Patienten
13.	a) Haben Sie eine besondere berufliche Position (Stationsschwester, Lehrbeauftragte, Gerätebeauftragte usw.) gerade inne? b) Wenn ja, welche?	□ ja □ nein _____
14.	Arbeiten Sie nebenbei in einem anderen Unternehmen zur Bestreitung Ihrer Lebenshaltungskosten?	□ ja □ nein
15.	Welchen Beitrag leisten Sie mit ihrem Gehalt zu ihren privaten Haushaltskosten? Sind Sie:	□ Alleinverdiener □ Zusatzverdiener □ zu _____% Hauptverdiener
16.	Wie viele Pflegekräfte arbeiten im Schnitt in einer Frühschicht auf Ihrer Station?	_____Anzahl der Pflegekräfte
17.	Wie viele Betten haben Sie auf Station?	_____Anzahl der Betten

Angaben zu Ihren Zielen und Einstellungen (bitte Zutreffendes ankreuzen)

	Bitte geben Sie an, inwiefern Sie den folgenden Aussagen zustimmen.	Stimme gar nicht zu ①	②	③	④	Stimme völlig zu ⑤
big_01	Ich bin eher zurückhaltend, reserviert	①	②	③	④	⑤
big_02	Ich schenke anderen leicht Vertrauen, glaube an das Gute im Menschen.	①	②	③	④	⑤
big_03	Ich bin bequem, neige zur Faulheit.	①	②	③	④	⑤
big_04	Ich bin entspannt, lasse mich durch Stress nicht aus der Ruhe bringen.	①	②	③	④	⑤
big_05	Ich habe nur wenig künstlerisches Interesse.	①	②	③	④	⑤
big_06	Ich gehe aus mir heraus, bin gesellig.	①	②	③	④	⑤
big_07	Ich neige dazu, andere zu kritisieren.	①	②	③	④	⑤
big_08	Ich erledige Aufgaben gründlich	①	②	③	④	⑤
big_09	Ich werde leicht nervös und unsicher	①	②	③	④	⑤
big_10	Ich habe eine aktive Vorstellungskraft, bin phantasievoll.	①	②	③	④	⑤
pol_01	Ich mag es, mehrere Aktivitäten unter einen Hut zu bringen.	①	②	③	④	⑤
pol_02	Mir ist es lieber, am Tag ein gesamtes Projekt zu Ende zu bringen, als verschiedene Teilaufgaben abzuschließen	①	②	③	④	⑤
pol_03	Ich finde, man sollte versuchen, mehrere Dinge auf einmal zu erledigen.	①	②	③	④	⑤
pol_04	Ich bevorzuge es, nur eine Sache zu einer bestimmten Zeit zu erledigen.	①	②	③	④	⑤
pol_05	Ich glaube, man leistet am meisten, wenn man mehrere Aufgaben auf einmal zu bearbeiten hat.	①	②	③	④	⑤
pol_06	Ich denke, es ist das Beste, erst eine Aufgabe zu Ende zu bringen, bevor man eine neue beginnt.	①	②	③	④	⑤

pol_07	Mir ist es lieber, am Tag verschiedene Teilaufgaben abzuschließen, als ein gesamtes Projekt zu Ende zu bringen.	①	②	③	④	⑤
pol_08	Es fällt mir schwer, etwas Neues zu beginnen, wenn es noch andere Dinge gibt, die ich noch nicht beendet habe.	①	②	③	④	⑤
pol_09	Wenn ich mehrere Sachen auf einmal zu tun habe, widme ich mich lieber jeder nur ein bisschen und springe zwischen ihnen hin und her.	①	②	③	④	⑤
pol_10	Ich finde es schwierig von einer Aufgabe zur anderen zu wechseln	①	②	③	④	⑤

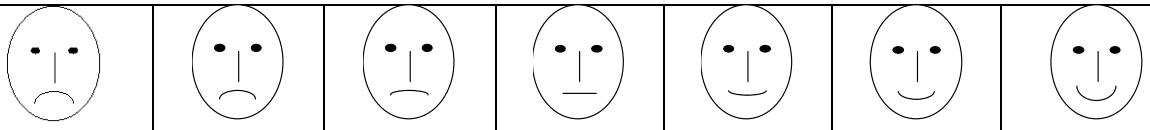
	Bitte geben Sie an, inwiefern Sie den folgenden Aussagen zustimmen. (Achtung, andere Antwortrichtung) →	stimmt überhaupt nicht					stimmt völlig
		①	②	③	④	⑤	⑥
swe_1	Beruflichen Schwierigkeiten sehe ich gelassen entgegen, weil ich mich immer auf meine Fähigkeiten verlassen kann.	①	②	③	④	⑤	⑥
swe_2	Wenn ich bei der Arbeit mit einem Problem konfrontiert werde, habe ich meist mehrere Ideen, wie ich damit fertig werde.	①	②	③	④	⑤	⑥
swe_3	Was auch immer in meinem Berufsleben passiert, ich werde schon klarkommen.	①	②	③	④	⑤	⑥
swe_4	Durch meine vergangenen beruflichen Erfahrungen bin ich gut auf meine berufliche Zukunft vorbereitet.	①	②	③	④	⑤	⑥
swe_5	Ich erreiche die beruflichen Ziele, die ich mir setze.	①	②	③	④	⑤	⑥
swe_6	Ich fühle mich den meisten beruflichen Anforderungen gewachsen.	①	②	③	④	⑤	⑥

		Diese Aussage trifft				
	Bitte geben Sie an, inwiefern Sie den folgenden Aussagen zustimmen.	Über-haupt nicht zu	Über - wiegend nicht zu	Teils/ teils zu	Über - wiegend zu	völlig zu
prob_1	Für mich sind Schwierigkeiten dazu da, dass ich sie überwinde.	①	②	③	④	⑤
prob_2	Wenn mir etwas nicht gelingt, sage ich mir: Jetzt erst recht!	①	②	③	④	⑤
prob_3	Misserfolge werfen mich nicht um, sondern veranlassen mich zu noch stärkerer Anstrengung.	①	②	③	④	⑤
prob_4	Ich bin mir sicher, dass ich auch die künftigen Anforderungen des Lebens gut bewältigen kann	①	②	③	④	⑤
prob_5	Ein Misserfolg kann bei mir neue Kräfte wecken.	①	②	③	④	⑤
prob_6	Wenn mir etwas nicht gelingt, bleibe ich hartnäckig und strenge mich umso mehr an.	①	②	③	④	⑤
wbi	Wenn es Veränderungen bei der Arbeit erfordern, bin ich gerne bereit, mich weiterzubilden.	①	②	③	④	⑤

	Bitte geben Sie an, inwiefern Sie den folgenden Aussagen zustimmen. (Achtung, andere Antwortrichtung) →	nein gar nicht ①	eher nein ②	teils, teils ③	eher ja ④	ja genau ⑤
sok_pfl_1	Bei meiner Arbeit erledige ich immer zuerst die wichtigsten Aufgaben.	①	②	③	④	⑤
sok_pfl_2	Auch in Stresssituationen bei der Arbeit, erledige ich immer erst eine Aufgabe, bevor ich mit der nächsten beginne.	①	②	③	④	⑤
sok_pfl_3	Ich konzentriere mich auf die Aufgaben, auf die es ankommt, um meine Arbeit gut zu machen.	①	②	③	④	⑤
sok_pfl_4	Ich halte mich fit, um die körperlichen Anforderungen in der Pflege gut zu schaffen.	①	②	③	④	⑤
sok_pfl_5	Ich informiere mich ständig über den aktuellen Stand des Fachwissens in der Pflege.	①	②	③	④	⑤

sok_pfl_6	Ich setze bewusst rückenschonende Hebe- und Tragetechniken ein.	①	②	③	④	⑤
sok_pfl_7	Bei schweren körperlichen Tätigkeiten hole ich mir Unterstützung von Kollegen.	①	②	③	④	⑤
sok_pfl_8	Bei schweren körperlichen Tätigkeiten nutze ich Hebe- oder Tragehilfen.	①	②	③	④	⑤
sok_pfl_9	Ich organisiere meine Arbeit so, dass ich einseitige körperliche Arbeitsbelastungen ausgleiche.	①	②	③	④	⑤

az_01 Wie zufrieden sind Sie im Allgemeinen mit Ihrer Arbeit?
Bitte kreuzen Sie an!



1	2	3	4	5	6	7
außerordentlich unzufrieden	sehr unzufrieden	ziemlich unzufrieden	teils-teils	ziemlich zufrieden	sehr zufrieden	außerordentlich zufrieden

		Diese Aussage trifft				
	Bitte geben Sie an, inwiefern Sie den folgenden Aussagen zustimmen.	Über-haupt nicht zu	Über - wiegend nicht zu	Teils/ teils zu	Über - wiegend zu	völlig zu
sBe_1	Die Arbeit ist für mich der wichtigste Lebensinhalt.	①	②	③	④	⑤
sBe_2	Die Arbeit ist mein Ein und Alles.	①	②	③	④	⑤
sBe_3	Ich könnte auch ohne meine Arbeit ganz glücklich sein.	①	②	③	④	⑤
sBe_4	Ich brauche die Arbeit wie die Luft zum Atmen.	①	②	③	④	⑤
sBe_5	Ich wüsste nicht, wie ich ohne Arbeit leben sollte.	①	②	③	④	⑤
sBe_6	Es gibt Wichtigeres im Leben als die Arbeit.	①	②	③	④	⑤

Angaben zu Ihren Arbeitsbedingungen und Arbeitserleben

	Gibt es Arbeitsaufgaben in Ihrem Arbeitsalltag, bei denen Sie sich fragen, ob ...	sehr selten/ nie	eher selten	ab und zu	eher häufig	sehr häufig
ill_1	... diese überhaupt gemacht werden müssen?	①	②	③	④	⑤
ill_2	... diese überhaupt Sinn machen?	①	②	③	④	⑤
ill_3	... diese nicht gemacht werden müssten (oder mit einem geringeren Arbeitsaufwand erledigt werden könnten), wenn es anders organisiert wäre?	①	②	③	④	⑤
ill_4	... diese nicht gemacht werden müssten (oder mit einem geringeren Arbeitsaufwand erledigt werden könnten), wenn andere Leute weniger Fehler machen würden?	①	②	③	④	⑤
ill_5	... diese nur existieren, weil andere es einfach so wollen?	①	②	③	④	⑤
ill_6	... diese jemand anderes machen sollte?	①	②	③	④	⑤
ill_7	... diese zu weit gehen, also eigentlich nicht von Ihnen erwartet werden können?	①	②	③	④	⑤
ill_8	... diese Sie in eine unmögliche Situation bringen?	①	②	③	④	⑤
ill_9	... es unfair ist, dass Sie diese machen müssen?	①	②	③	④	⑤
ill_10	... diese nicht Ihrem Berufsbild entsprechen?	①	②	③	④	⑤

Bitte kreuzen Sie an!

hs_1	Wenn Sie Ihre Tätigkeit insgesamt betrachten, inwieweit können Sie die **Reihenfolge der Arbeitsschritte** selbst festlegen?	① ② ③ ④ ⑤	sehr wenig ziemlich wenig etwas ziemlich viel sehr viel
hs_2	Wie viel **Einfluss** haben Sie darauf, welche Arbeit Ihnen **zugeteilt** wird?	① ② ③ ④ ⑤	sehr wenig ziemlich wenig etwas ziemlich viel sehr viel
hs_3	Wenn man Ihre Arbeit insgesamt betrachtet, wie viel **Möglichkeiten zu eigenen Entscheidungen** bietet ihnen Ihre Arbeit?	① ② ③ ④ ⑤	sehr wenig ziemlich wenig etwas ziemlich viel sehr viel
hs_4	Können Sie selbst bestimmen, **auf welche Art und Weise** Sie Ihre Arbeit erledigen?	① ② ③ ④ ⑤	sehr wenig ziemlich wenig etwas ziemlich viel sehr viel
hs_5	Inwieweit sind ausschließlich Sie selbst für die **Kontrolle** Ihres A**rbeitsergebnisses** zuständig?	① ② ③ ④ ⑤	**ich bin zuständig für die Kontrolle...** von allen Arbeitsergebnissen von den meisten Arbeitsergebnissen von einem Teil der Arbeitsergebnisse von wenigen Arbeitsergebnissen gar nicht
Var_allg_1	A hat Arbeitsaufgaben, die sich häufig wiederholen. B hat viele verschiedene Arbeitsaufgaben. Welcher der beiden Arbeitsplätze ist Ihrem Arbeitsplatz am ähnlichsten?	① ② ③ ④ ⑤	genau wie der von A ähnlich wie der von A zwischen A und B ähnlich wie der von B genau wie der von B

Var_allg_2	A muss bei seiner Arbeit mit vielen verschiedenen Arbeitsmitteln hantieren. B kommt mit sehr wenigen Arbeitsmitteln aus. Welcher der beiden Arbeitsplätze ist Ihrem Arbeitsplatz am ähnlichsten?	① ② ③ ④ ⑤	genau wie der von A ähnlich wie der von A zwischen A und B ähnlich wie der von B genau wie der von B
Var_allg_3	Die Arbeit von A erfordert nur zwei bis drei verschiedene Handgriffe, die immer wiederkommen. Die Arbeit von B umfasst viele verschiedene Handgriffe. Welcher der beiden Arbeitsplätze ist Ihrem Arbeitsplatz am ähnlichsten?	① ② ③ ④ ⑤	genau wie der von A ähnlich wie der von A zwischen A und B ähnlich wie der von B genau wie der von B
Var_allg_4	A muss sehr unterschiedliche Vorgänge oder Arbeitsmaterialien bearbeiten. B bearbeitet sehr ähnliche Arbeitsmaterialien oder Vorgänge. Welcher der beiden Arbeitsplätze ist Ihrem Arbeitsplatz am ähnlichsten?	① ② ③ ④ ⑤	genau wie der von A ähnlich wie der von A zwischen A und B ähnlich wie der von B genau wie der von B
Var_allg_5	A hat in seiner/ihrer Arbeit sehr viele Routineaufgaben zu tun. In der Arbeit von B wiederholen sich die Aufgaben nur wenig. Welcher der beiden Arbeitsplätze ist Ihrem Arbeitsplatz am ähnlichsten?	① ② ③ ④ ⑤	genau wie der von A ähnlich wie der von A zwischen A und B ähnlich wie der von B genau wie der von B
Z_allg_1	Wie lange können Sie während der Arbeitszeit Ihrem Arbeitsplatz verlassen?	① ② ③ ④ ⑤ ⑥	gar nicht bis zu 5 Minuten mehr als 5, bis zu 15 Minuten mehr als 15, bis zu 30 Minuten mehr als 30 Minuten, bis zu 1 Stunde mehr als 1 Stunde
Z_allg _2	Wie sehr können Sie Ihre Arbeitsgeschwindigkeit selbst bestimmen?	① ② ③ ④ ⑤	sehr wenig ziemlich wenig etwas ziemlich viel sehr viel
Z_allg _3	Wie lange können Sie sich von Ihrer Arbeit abwenden und irgendetwas	①	weniger als 5 Minuten am Tag mehr als 5, bis zu 10 Minuten am Tag

	anderes dazwischen schieben (z.B. eine Pause), ohne mit Ihrer eigentlichen Arbeitsaufgabe in Verzug zu geraten?	② ③ ④ ⑤ ⑥	mehr als 15, bis zu 30 Minuten am Tag mehr als 30 Minuten, bis zu 1 Stunde am Tag mehr als 1 Stunde, bis zu 2 Stunden am Tag mehr als 2 Stunden am Tag
Z_allg _4	In wieweit können Sie selbst bestimmen, wie lange Sie an einer Sache arbeiten?	① ② ③ ④ ⑤	sehr wenig ziemlich wenig etwas ziemlich viel sehr viel
Z_allg _5	Können Sie Ihren Arbeitstag selbständig einteilen?	① ② ③ ④ ⑤	sehr wenig ziemlich wenig etwas ziemlich viel sehr viel
komp_1	Kollege/in A muss bei seiner/ihrer Arbeit sehr komplizierte Entscheidungen treffen. Kollege/in B muss bei seiner/ihrer Arbeit nur sehr einfache Entscheidungen treffen. Welcher der beiden Arbeitsplätze ist Ihrem Arbeitsplatz am ähnlichsten?	① ② ③ ④ ⑤	genau wie der von A ähnlich wie der von A zwischen A und B ähnlich wie der von B genau wie der von B
komp _2	Wie oft erhalten Sie Aufträge, die besonders schwierig sind?	① ② ③ ④ ⑤	praktisch nie ein paar mal im Jahr etwa einmal im Monat etwa einmal in der Woche mehrmals in der Woche
komp _3	Können Sie bei Ihrer Arbeit Neues dazulernen?	① ② ③ ④ ⑤	sehr wenig ziemlich wenig etwas ziemlich viel sehr viel

komp_4	Kollege/in A bearbeitet Aufgaben, bei der er oder sie genau überlegen muss, was im Einzelnen zu tun ist. Kollege/in B bearbeitet Aufgaben, bei denen sofort klar ist, was zu tun ist. Welcher der zwei Arbeitsplätze ist Ihrem Arbeitsplatz am ähnlichsten?	① ② ③ ④ ⑤	genau wie der von A ähnlich wie der von A zwischen A und B ähnlich wie der von B genau wie der von B
komp_5	Kollege/in A bearbeitet Aufgaben, bei der er oder sie zuerst genau planen muss, um die Aufgaben ausführen zu können. Kollege/in B bearbeitet Aufgaben, bei denen keine Planung erforderlich ist. Welcher der zwei Arbeitsplätze ist Ihrem Arbeitsplatz am ähnlichsten?	① ② ③ ④ ⑤	genau wie der von A ähnlich wie der von A zwischen A und B ähnlich wie der von B genau wie der von B
au_1	Wie häufig werden Sie durchschnittlich bei Ihrer Arbeit von Ihrem/Ihrer Vorgesetzten unterbrochen (z.B. wegen einer Auskunft)?	① ② ③ ④ ⑤	sehr selten/nie selten (etwa 1 x pro Woche) gelegentlich (etwa 1 x pro Tag) oft (mehrmals pro Tag) sehr oft (mehrmals pro Stunde)
au_2	Wie häufig werden Sie durch andere Kollegen/Mitarbeiter bei Ihrer Arbeit unterbrochen?	① ② ③ ④ ⑤	sehr selten/nie selten (etwa 1 x pro Woche) gelegentlich (etwa 1 x pro Tag) oft (mehrmals pro Tag) sehr oft (mehrmals pro Stunde)
au_3	Wie häufig werden Sie durch Patienten bei Ihrer Arbeit unterbrochen?	① ② ③ ④ ⑤	sehr selten/nie selten (etwa 1 x pro Woche) gelegentlich (etwa 1 x pro Tag) oft (mehrmals pro Tag) sehr oft (mehrmals pro Stunde)
au_4	Kommt es vor, dass Sie aktuelle Arbeiten unterbrechen müssen, weil etwas Wichtiges dazwischen kommt?	① ② ③ ④ ⑤	sehr selten/nie selten (etwa 1 x pro Woche) gelegentlich (etwa 1 x pro Tag) oft (mehrmals pro Tag) sehr oft (mehrmals pro Stunde)
au_5	Wie häufig kommt es vor, dass Sie an mehreren Aufgaben gleichzeitig arbeiten müssen und zwischen den Arbeitsaufgaben hin und her springen?	① ② ③ ④ ⑤	sehr selten/nie selten (etwa 1 x pro Woche) gelegentlich (etwa 1 x pro Tag) oft (mehrmals pro Tag) sehr oft (mehrmals pro Stunde)

		Diese Aussage trifft				
	Es folgen nun einige Fragen zu Ihrer Arbeitssituation. Kreuzen Sie bitte bei jedem Satz die für Sie zutreffende Stufe an.	nie	selten	manchmal	teils/ teils	fast immer
vol_01	Bei dieser Arbeit macht man etwas Ganzes, Abgerundetes.	①	②	③	④	⑤
vol_02	Diese Arbeit ist zerstückelt, man erledigt nur kleine Teilaufgaben.	①	②	③	④	⑤
vol_03	Bei meiner Arbeit kann man eine Sache oder einen Auftrag von A bis Z herstellen bzw. ausführen.	①	②	③	④	⑤

		Diese Aussage trifft				
	Bitte geben Sie an, inwiefern Sie den folgenden Aussagen zustimmen.	Über-haupt nicht zu	Über - wiegend nicht zu	Teils/ teils zu	Über - wiegend zu	völlig zu
spiel_1	Auf dieser Station kann man selbst festlegen, wie man seine Arbeit erledigt.	①	②	③	④	⑤
spiel_2	Auf dieser Station kann man seinen Arbeitsablauf selbst festlegen.	①	②	③	④	⑤
spiel_3	Bei seiner Arbeit auf dieser Station kann man selbst auswählen, welche Hilfsmittel und Arbeitstechniken man einsetzt.	①	②	③	④	⑤
spiel_4	Man kann auf dieser Station selbst entscheiden, welche Aufgaben man zu erledigen hat.	①	②	③	④	⑤
spiel_5	Man kann auf dieser Station selbst über die Pflege der Patienten entscheiden (z.B. Pflegeziele festlegen, Pflegemaßnahmen bestimmen).	①	②	③	④	⑤
spie__6	Man kann auf dieser Station bei der Erledigung seiner Aufgaben eigene Vorstellungen umsetzen.	①	②	③	④	⑤
spiel_7	Man kann auf dieser Station bei der Durchführung seiner Aufgabe kreativ sein.	①	②	③	④	⑤

	Wie sehr können Sie sich auf folgende Personen verlassen, wenn es in der Arbeit schwierig wird?	gar nicht	wenig	ziemlich	völlig
Sozu1_VG	direkte(r) Vorgesetzte(r) (d.h. diejenige Person, die eine Stufe über Ihnen steht und Ihnen üblicherweise Anweisungen gibt)	①	②	③	④
Sozu1_MA	Kollegen	①	②	③	④
	Wie sehr sind die Personen bereit, Ihre Probleme im Zusammenhang mit der Arbeit anzuhören?				
Sozu2_VG	direkte(r) Vorgesetzte(r)	①	②	③	④
Sozu2_MA	Kollegen	①	②	③	④
	Wie sehr unterstützen diese Personen Sie, so dass Sie es in der Arbeit leichter haben?				
Sozu3_VG	direkte(r) Vorgesetzte(r)	①	②	③	④
Sozu3_MA	Kollegen	①	②	③	④

		Diese Aussage trifft				
	Bitte geben Sie an, inwiefern Sie den folgenden Aussagen zustimmen.	Über-haupt nicht zu	Über - wiegend nicht zu	Teils/ teils zu	Über - wiegend zu	völlig zu
afreu_1	Es gibt Tage, da freue ich mich über meine Arbeit.	①	②	③	④	⑤
afreu_2	Es gibt Tage, da bin ich stolz über das, was ich bei der Arbeit geschafft habe.	①	②	③	④	⑤
afreu_3	Meine Arbeit macht mir Spaß.	①	②	③	④	⑤
afreu_4	Ich habe das Gefühl, in meiner Arbeit etwas Sinnvolles zu tun.	①	②	③	④	⑤
afreu_5	Es gibt Tage, an denen ich beschwingt nach Hause gehe.	①	②	③	④	⑤

	Machen Sie sich Sorgen, dass ...	in sehr geringem Maß	in geringem Maß	in hohem Maß/zum Teil	in sehr hohem Maß
unsic_1	... Sie arbeitslos werden?	①	②	③	④
unsic_2	... neue Technologien Sie überflüssig machen?	①	②	③	④
unsic_3	... es schwierig für Sie wäre, eine neue Arbeit zu finden, wenn Sie arbeitslos würden?	①	②	③	④
unsic_4	... man Sie gegen Ihren Willen auf eine andere Arbeitsstelle versetzen könnte?	①	②	③	④

	Die nachfolgenden Fragen beziehen sich auf Ihren derzeitigen Beruf. Bitte geben Sie für jede der Fragen an, ob Sie voll zustimmen, zustimmen, nicht zustimmen oder gar nicht zustimmen.	stimme gar nicht zu	stimme nicht zu	stimme zu	stimme voll zu
grat_01	Aufgrund des hohen Arbeitsaufkommens besteht häufig großer Zeitdruck.	①	②	③	④
grat _02	Bei meiner Arbeit werde ich häufig unterbrochen und gestört.	①	②	③	④
grat _03	Im Laufe der letzten Jahre ist meine Arbeit immer mehr geworden.	①	②	③	④
grat _04	Ich erhalte von meinem Vorgesetzten bzw. einer entsprechenden wichtigen Person die Anerkennung, die ich verdiene.	①	②	③	④
grat _05	Die Aufstiegschancen in meinem Bereich sind schlecht.	①	②	③	④
grat _06	Ich erfahre - oder erwarte - eine Verschlechterung meiner Arbeitssituation.	①	②	③	④
grat _07	Mein eigener Arbeitsplatz ist gefährdet.	①	②	③	④
grat _08	Wenn ich an all die erbrachten Leistungen und Anstrengungen denke, halte ich die erfahrene Anerkennung für angemessen.	①	②	③	④
grat _09	Wenn ich an all die erbrachten Leistungen und Anstrengungen denke, halte ich meine persönlichen Chancen des beruflichen Fortkommens für angemessen.	①	②	③	④
grat _10	Wenn ich an all die erbrachten Leistungen denke, halte ich mein Gehalt / meinen Lohn für angemessen.	①	②	③	④

		Diese Aussage trifft				
	Im Folgenden geht es um die Einschätzung Ihrer unmittelbaren Vorgesetzten/ Ihres unmittelbaren Vorgesetzen. Bitte geben Sie an: Die Person, die ich einschätze,...	Über-haupt nicht zu	Über - wiegend nicht zu	Teils/ teils zu	Über - wiegend zu	völlig zu
mlq_01	äußert sich optimistisch über die Zukunft.	①	②	③	④	⑤
mlq_02	macht mich stolz darauf, mit ihr zu tun zu haben.	①	②	③	④	⑤
mlq_03	spricht mit Begeisterung über das, was erreicht werden soll.	①	②	③	④	⑤
mlq_04	verbringt Zeit mit Führung und damit, den Mitarbeitern etwas beizubringen.	①	②	③	④	⑤
mlq_05	stellt die eigenen Interessen zurück, wenn es um das Wohl der Gruppe geht.	①	②	③	④	⑤
mlq_06	berücksichtigt meine Individualität und behandelt mich nicht nur als irgendeinen Mitarbeiter unter vielen.	①	②	③	④	⑤
mlq_07	handelt in einer Weise, die bei mir Respekt erzeugt.	①	②	③	④	⑤
mlq_08	strahlt Stärke und Vertrauen aus.	①	②	③	④	⑤
mlq_09	formuliert eine überzeugende Zukunftsversion.	①	②	③	④	⑤
mlq_10	erkennt meine individuellen Bedürfnisse, Fähigkeiten und Ziele.	①	②	③	④	⑤
mlq_11	hilft mir, meine Stärken auszubauen.	①	②	③	④	⑤
mlq_12	hat großes Vertrauen, dass die gesteckten Ziele erreicht werden.	①	②	③	④	⑤

	Im Folgenden wollen wir wissen, wie viel Einfluss Sie auf Ihre Arbeitssituation haben.	ich habe keinerlei Einfluss-möglich-keiten	ich werde nur informiert	ich kann Vorschläge machen	ich werde bei der Ent-scheidung beteiligt	ich habe großen Einfluss auf die Ent-scheidung
part_01	bei der Aufstellung der Urlaubspläne	①	②	③	④	⑤
part _02	bei der Planung der Arbeitszeit (Schichten und Überstunden)	①	②	③	④	⑤
part _03	auf die Pausengestaltung	①	②	③	④	⑤
part _04	auf die Möglichkeiten zur Weiterbildung	①	②	③	④	⑤
part _05	bei der Einstellung neuer Kollegen/ Kolleginnen	①	②	③	④	⑤
part _06	bei der Anschaffung neuer Maschinen	①	②	③	④	⑤
part _07	auf die Ausgestaltung meines Arbeitsplatzes (z.B. Einrichtung des Arbeitszimmers)	①	②	③	④	⑤

	Kreuzen Sie bitte bei jedem Satz die für Sie zutreffende Stufe an.	trifft nicht zu	trifft eher nicht zu	trifft eher zu	trifft zu
ziel_1	Das Ziel meiner Arbeitsaufgabe wird durch andere Personen vorgegeben.	①	②	③	④
ziel_2	Das Ziel meiner Arbeit ist über einen kürzeren Zeitraum erreichbar.	①	②	③	④
ziel_3	Vorgegebene Arbeitsziele erscheinen mir sinnvoll.	①	②	③	④
ziel_4	Ich kann selbst bestimmen, wie ich das Ziel meiner Arbeit erreiche.	①	②	③	④
ziel_5	Ich muss das Ziel meiner Arbeitsaufgabe oft an neue Anforderungen anpassen.	①	②	③	④

		Diese Aussage trifft				
	In meinem Beruf/Bei meiner Tätigkeit ..	nicht im geringsten				immer notwendig
emo_01	... vermeide ich es, meine wahren Gefühle zu zeigen.	①	②	③	④	⑤
emo_02	. .. täusche ich Emotionen vor, die ich nicht wirklich habe.	①	②	③	④	⑤
emo_03	... verberge ich meine wahren Gefühle zu einer Situation.	①	②	③	④	⑤
emo_04	... gebe ich mir Mühe, die Gefühle tatsächlich zu fühlen, die ich anderen gegenüber zeigen muss.	①	②	③	④	⑤
emo_05	... versuche ich die Gefühle, die ich zeigen muss, tatsächlich zu empfinden.	①	②	③	④	⑤
emo_06	... versuche ich die Emotionen, die ich als Teil meiner Tätigkeit zeigen muss, tatsächlich zu fühlen.	①	②	③	④	⑤

Angaben zu Ihrem Befinden (bitte Zutreffendes ankreuzen)

	Nutzen Sie die folgenden Antwortmöglichkeiten, um anzugeben, wie sehr Sie den folgenden Aussagen zustimmen oder wie sehr Sie diese ablehnen.	nie	sehr selten	selten	ge-legent-lich	oft	sehr oft	immer
Ir_allg_01	Es fällt mir schwer, nach der Arbeit abzuschalten.	①	②	③	④	⑤	⑥	⑦
Ir_allg _02	Ich muss auch zu Hause an Schwierigkeiten bei der Arbeit denken.	①	②	③	④	⑤	⑥	⑦
Ir_allg _03	Wenn andere mich ansprechen, kommt es vor, dass ich mürrisch reagiere.	①	②	③	④	⑤	⑥	⑦
Ir_allg _04	Selbst im Urlaub muss ich manchmal an Probleme bei der Arbeit denken.	①	②	③	④	⑤	⑥	⑦
Ir_allg _05	Ich fühle mich ab und zu wie jemand, den man als Nervenbündel bezeichnet.	①	②	③	④	⑤	⑥	⑦
Ir_allg _06	Ich bin schnell verärgert.	①	②	③	④	⑤	⑥	⑦
Ir_allg _07	Ich reagiere gereizt, obwohl ich es gar nicht will.	①	②	③	④	⑤	⑥	⑦

Ir_allg _08	Wenn ich müde von der Arbeit nach Hause komme, finde ich durch nichts Erholung.	①	②	③	④	⑤	⑥	⑦
depr_01	Ich muss mich sehr dazu antreiben, etwas zu tun.	①	②	③	④	⑤	⑥	⑦
depr _02	Vieles erscheint mir sinnlos.	①	②	③	④	⑤	⑥	⑦
depr _03	Mich bedrücken Schuldgefühle.	①	②	③	④	⑤	⑥	⑦
depr _04	Ich fühle mich einsam, selbst wenn ich mit anderen Menschen zusammen bin.	①	②	③	④	⑤	⑥	⑦
depr _05	Ich habe traurige Stimmungen.	①	②	③	④	⑤	⑥	⑦
depr _06	Ich finde es schwer, Entscheidungen zu treffen.	①	②	③	④	⑤	⑥	⑦
depr _07	Am Anfang des Tages fühle ich mich am schlechtesten.	①	②	③	④	⑤	⑥	⑦
depr_ 08	Ich sehe ohne Hoffnung in die Zukunft.	①	②	③	④	⑤	⑥	⑦

Bitte geben Sie an:

PSQI_allg_01	Während des letzten Monats, wann gingen Sie üblicherweise am Abend (vor einer Frühschicht) ins Bett?	_____Uhr
PSQI_allg _02	Während des letzten Monats, wie lange (in Minuten) hat es pro Nacht üblicherweise gedauert, bis Sie eingeschlafen sind?	_____Minuten/ Stunden (zutreffende Maßeinheit bitte unterstreichen)
PSQI_allg _03	Während des letzten Monats, wann sind Sie üblicherweise (zur Frühschicht) aufgestanden? (Uhrzeit)	_____Uhr
PSQI_allg _04	Während des letzten Monats, wie viele Stunden haben Sie in der Nacht tatsächlich geschlafen? (Das kann von der Anzahl der im Bett verbrachten Stunden abweichen.)	_____Stunden

Bitte wählen Sie die passendste Antwort für die verbleibenden Fragen.

PSQI_allg_05	Während des letzten Monats, wie oft hatten Sie Schlafprobleme weil Sie…	□ nicht innerhalb von 30 Minuten einschlafen konnten □ mitten in der Nacht oder am frühen Morgen aufgewacht sind □ aufstehen mussten um auf die Toilette zu gehen □ nicht angenehm atmen konnten □ laut gehustet oder geschnarcht haben □ es Ihnen zu kühl war □ es Ihnen zu heiß war □ schlecht geträumt haben □ Schmerzen hatten □ andere Gründe
PSQI_allg_06	Wie häufig?	□ nicht während des letzten Monats □ weniger als einmal in der Woche □ ein- oder zweimal in der Woche □ dreimal oder öfter in der Woche
PSQI_allg_07	Während des letzten Monats, wie würden Sie Ihre Schlafqualität im Allgemeinen einschätzen?	□ sehr gut □ eher gut □ eher schlecht □ sehr schlecht
PSQI_allg_08	Während des letzten Monats, wie oft haben Sie Medikamente eingenommen (verschreibungspflichtig oder nicht) um besser schlafen zu können?	□ nie □ selten □ manchmal □ oft □ sehr oft
PSQI_allg_09	Während des letzten Monats, wie oft hatten Sie Schwierigkeiten während des Fahrens, Essens oder der Beteiligung an sozialen Aktivitäten wach zu bleiben?	□ nie □ selten □ manchmal □ oft □ sehr oft
PSQI_allg_10	Während des letzten Monats, wie oft war es schwierig für Sie genug Energie aufzubringen um Ihre Angelegenheiten zu erledigen?	□ nie □ selten □ manchmal □ oft □ sehr oft

rueck_01	Während des letzen Jahres, wie oft hatten Sie Rückenschmerzen (Schmerz, Stechen, Steifheit, Taubheitsgefühl)?	□ gar nicht □ 1 – 7 Tage □ 8 – 30 Tage □ mehr als 30 Tage

Angaben zur Erholung und zum Freizeitverhalten (bitte Zutreffendes

		Diese Aussage trifft				
	Bitte geben Sie an, inwiefern Sie den folgenden Aussagen zustimmen.	Über-haupt nicht zu	Über - wiegend nicht zu	Teils/ teils zu	Über - wiegend zu	völlig zu
nfr_01	Ich finde es schwer mich am Ende eines Arbeitstages zu erholen.	①	②	③	④	⑤
nfr_02	Am Ende eines Arbeitstages fühle ich mich richtig fertig/erschöpft	①	②	③	④	⑤
nfr_03	Aufgrund meiner Arbeit fühle ich mich am Ende eines Arbeitstages ziemlich erschöpft	①	②	③	④	⑤
nfr_04	Nach dem Abendessen fühle ich mich normalerweise fit	①	②	③	④	⑤
nfr_05	Normalerweise fange ich erst am 2.Nicht-Arbeitstag an, mich entspannt zu fühlen	①	②	③	④	⑤
nfr_06	Ich finde es schwer, mich nach der Arbeit auf meine Freizeit zu konzentrieren	①	②	③	④	⑤
nfr_07	Es fällt mir schwer, Interesse an anderen Leuten zu zeigen, wenn ich gerade erst nach Hause gekommen bin.	①	②	③	④	⑤
nfr_08	Ich brauche im Allgemeinen mehr als eine Stunde, um mich vollständig nach der Arbeit zu erholen.	①	②	③	④	⑤
nfr_09	Nach der Arbeit möchte ich eine Weile in Ruhe gelassen werden.	①	②	③	④	⑤
nfr_10	Nachdem ich den ganzen Tag gearbeitet habe, fühle ich mich oftmals so müde, dass ich mich an keinen anderen Aktivitäten beteiligen kann.	①	②	③	④	⑤

nfr_11	Ein Gefühl von Müdigkeit hindert mich daran, meine Arbeit so durchzuführen, wie ich sie normalerweise während der letzten Hälfte meines Arbeitstages durchführen würde.	①	②	③	④	⑤

		Diese Aussage trifft				
	Bitte geben Sie an, inwiefern Sie den folgenden Aussagen zustimmen.	trifft wenig zu	trifft eher nicht zu	trifft mittel-mäßig zu	trifft zu	trifft völlig zu
req_allg_01	Nach der Arbeit kann ich abschalten und entspannen.	①	②	③	④	⑤
req_allg_02	Nach der Arbeit kann ich entspannende Dinge tun.	①	②	③	④	⑤
req_allg_03	Nach der Arbeit nutze ich die Zeit zur Entspannung.	①	②	③	④	⑤
req_allg_04	Nach der Arbeit gönne ich mir Freizeit/nutze ich die Zeit für Erholung.	①	②	③	④	⑤
req_allg_05	Nach der Arbeit lerne ich neue Dinge.	①	②	③	④	⑤
req_allg_06	Nach der Arbeit suche ich nach intellektuellen Herausforderungen.	①	②	③	④	⑤
req_allg_07	Nach der Arbeit tue ich Dinge, die mich herausfordern.	①	②	③	④	⑤
req_allg_08	Nach der Arbeit tue ich etwas, um meinen Horizont zu erweitern.	①	②	③	④	⑤

wai_01

Derzeitige Arbeitsfähigkeit im Vergleich zu der besten, je erreichten Arbeitsfähigkeit

Wenn Sie Ihre beste, je erreichte Arbeitsfähigkeit mit 10 Punkten bewerten: Wie viele Punkte würden Sie dann für Ihre derzeitige Arbeitsfähigkeit geben? (0 bedeutet, dass Sie derzeit arbeitsunfähig sind)

O_0	O_1	O_2	O_3	O_4	O_5	O_6	O_7	O_8	O_9	O_{10}

völlig arbeitsunfähig — derzeit die beste Arbeitsfähigkeit

		Diese Aussage trifft				
	Aussagen zu Arbeitsfähigkeit in Bezug auf die Arbeitsanforderungen	sehr schlecht	eher schlecht	mittelmäßig	eher gut	sehr gut
wai_02	Wie schätzen Sie Ihre derzeitige Arbeitsfähigkeit in Bezug auf die körperlichen Arbeitsanforderungen ein?	①	②	③	④	⑤
wai_03	Wie schätzen Sie Ihre derzeitige Arbeitsfähigkeit in Bezug auf die psychischen Arbeitsanforderungen ein?	①	②	③	④	⑤
wai_04	Behindert Sie derzeit eine Erkrankung oder Verletzung bei der Arbeit? Falls nötig, kreuzen Sie bitte mehr als eine Antwort-Möglichkeit an.	□ Keine Beeinträchtigung / Ich habe keine Erkrankung. □ Ich kann meine Arbeit ausführen, habe aber Beschwerden. □ Ich bin manchmal gezwungen, langsamer zu arbeiten oder meine Arbeitsmethoden zu ändern. □ Wegen meiner Krankheit bin ich nur in der Lage Teilzeitarbeit zu verrichten. □ Meiner Meinung nach bin ich völlig arbeitsunfähig.				
wai_05	Wie viele ganze Tage blieben Sie auf Grund eines gesundheitlichen Problems (Krankheit, Gesundheitsvorsorge oder Untersuchung) im letzten Jahr (12 Monate) der Arbeit fern?	□ überhaupt keinen □ höchstens 9 Tage □ 10-24 Tage □ 25 – 99 Tage □ 100-365 Tage				
wai_06	Glauben Sie, dass Sie, ausgehend von Ihrem jetzigen Gesundheitszustand, Ihre derzeitige Arbeit auch in den nächsten zwei Jahren ausüben können?	□ unwahrscheinlich □ nicht sicher □ ziemlich sicher				
wai_07	Haben Sie in der letzten Zeit Ihre täglichen Aufgaben mit Freude erledigt?	□ häufig □ eher häufig □ manchmal □ eher selten □ niemals				
wai_08	Waren Sie in letzter Zeit aktiv und rege?	□ immer □ eher häufig □ manchmal				

		□ eher selten □ niemals
wai_09	Waren Sie in der letzten Zeit zuversichtlich, was die Zukunft betrifft?	□ ständig □ eher häufig □ manchmal □ eher selten □ niemals

		Diese Aussage trifft				
	Wir haben im Folgenden einige Aufgaben aufgelistet. Wie gut haben Sie (Ihrem eigenen Urteil nach) in der <u>letzten Arbeitswoche</u> die folgenden Aufgaben erfüllt?	sehr schlecht	eher schlecht	weder gut, noch schlecht	eher gut	sehr gut
perf_allg_01	Entscheidungen getroffen?	①	②	③	④	⑤
perf_allg_02	Fehlerfrei gearbeitet?	①	②	③	④	⑤
perf_allg_03	Sich mit vollem Einsatz Ihrer Arbeit gewidmet?	①	②	③	④	⑤
perf_allg_04	Ihre Aufgaben erfüllt?	①	②	③	④	⑤
perf_allg_05	Die Initiative ergriffen?	①	②	③	④	⑤
perf_allg_06	Verantwortung übernommen?	①	②	③	④	⑤

Sie haben nun alle Fragen des Fragebogens beantwortet. Bitte prüfen Sie noch einmal auf Seite 1, ob Sie den Code eingegeben haben.

Vielen Dank für Ihre Mitarbeit!

The diary questionnaire

Table B.1. Items of the diary questionnaire (morning).

Items	Response format
	Mood
In diesem Moment fühle ich mich..	Check boxes; 7-point scale with the extreme points: (1) sehr müde – (7) sehr wach (1) sehr unzufrieden – (7) sehr zufrieden (1) sehr unruhig – (7) sehr ruhig (1) sehr energielos – (7) sehr energiegeladen (1) sehr unwohl – (7) sehr wohl (1) sehr angespannt – (7) sehr entspannt
	Recovery
Heute morgen fühle ich mich ausgeschlafen. Heute morgen fühle ich mich körperlich erholt. Heute morgen fühle ich mich geistig erholt. Heute morgen bin ich voll neuer Energie.	Drop down list: trifft… gar nicht zu wenig zu mittel-mäßig zu zu völlig zu
	Sleep quality
Wie viele Stunden haben Sie tatsächlich geschlafen? (Dies kann von der Zeit, die Sie im Bett verbracht haben abweichen.)	Radio buttons: > 7 Stunden 6-7 Stunden 5-6 Stunden < 5 Stunden
Wie würden Sie Ihren Schlaf in der letzten Nacht bewerten?	Drop down list: sehr schelcht eher schlecht eher gut gut
Wie viele Minuten hat es in etwa gedauert, bis Sie eingeschlafen sind?	Radio buttons: <=15 Minuten 16-30 Minuten 31-60 Minuten > 60 Minuten
Sind Sie in der Nacht aufgewacht?	Radio buttons: Nein. Ja, ein Mal. Ja, zwei Mal. Ja, drei Mal. Ja, mehr als drei Mal .
	Antizipation of the day
Wenn Sie an die bevorstehende Schicht denken, haben Sie das Gefühl, dass Ihnen die Arbeit heute … von der Hand gehen wird?	Radio buttons: leicht eher leicht mittelmäißig eher schwer schwer

Table B.2. Items of the diary questionnaire (shift).

Items	Response format
Mood	
In diesem Moment fühle ich mich..	Check boxes; 7-point scale with the extreme points: (1) sehr müde – (7) sehr wach (1) sehr unzufrieden – (7) sehr zufrieden (1) sehr unruhig – (7) sehr ruhig (1) sehr energielos – (7) sehr energiegeladen (1) sehr unwohl – (7) sehr wohl (1) sehr angespannt – (7) sehr entspannt
Breaks	
Haben Sie in der letzten halben Stunde eine größere Arbeitspause gemacht? Wenn ja, bitte beziehen Sie sich in folgenden Fragen auf die halbe Stunde vor der Pause.	Radio buttons: Ja. Nein.
Work interruptions	
Wie oft wurden Sie in der letzten halben Stunde unterbrochen durch .. ..den Arzt/die Ärztin/Stationsleitung? .. eine Pflegekraft? .. eine/n Patientin/en? .. das Telefon? .. anderes Personal? .. fehlende Arbeitsmittel?	Drop down list: 0 Mal – 0> 15 Mal
Unplanned Events	
Wie oft kam es seit Schichtbeginn/dem letzten Piepston zu außerplanmäßigen Vorfällen? (unangekündigte Ops, Zugänge; Notfälle)	Drop down list: 0 Mal – 0> 15 Mal
Multitasking	
Ich musste in der letzten halben Stunde viele Dinge gleichzeitig im Kopf haben. Ich erhielt in der letzten halben Stunde Anweisungen, die ich gleichzeitig bearbeiten musste. Es gab in der letzten halben Stunde Momente, die für kurze Zeit höchste Konzentration erforderten. In der letzten halben Stunde kam es vor, dass mehrere Personen gleichzeitig etwas von mir wollten.	Drop down list: nie selten manchmal häufig immer
Task load index	
Geistige Anforderungen Wie hoch waren die geistigen Anforderungen in der letzten halben Stunde?	Scroll bar from 1 to 20: sehr niedrig-sehr hoch
Körperliche Anforderungen Wie hoch waren die körperlichen Anforderungen in der letzten halben Stunde?	sehr gering -sehr hoch
Zeitliche Anforderungen Wie hoch war das Tempo, mit dem Sie die einzelnen Aufgaben in der letzten halben Stunde bewältigen mussten?	sehr niedrig – sehr hoch

Table B.2. Items of the diary questionnaire (shift) (continued).

Items	Response format
Leistung Wie erfolgreich haben Sie Ihre Aufgaben in der letzten halben Stunde Ihrer Meinung nach durchgeführt?	perfekter Erfolg – Misserfolg
Anstrengung Wie sehr mussten Sie sich anstrengen, um ihre Leistung zu erreichen?	sehr wenig – sehr stark
Frustration Wie verunsichert entmutigt, gereizt und verärgert waren Sie in der letzten halben Stunde?	sehr wenig – sehr stark
Stress Wie gestresst fühlten Sie sich in der letzten halben Stunde?	sehr wenig – sehr stark

Table B.3. Items of the diary questionnaire (evening).

Items	Response format
Mood	
In diesem Moment fühle ich mich..	Check boxes; 7-point scale with the extreme points: (1) sehr müde – (7) sehr wach (1) sehr unzufrieden – (7) sehr zufrieden (1) sehr unruhig – (7) sehr ruhig (1) sehr energielos – (7) sehr energiegeladen (1) sehr unwohl – (7) sehr wohl (1) sehr angespannt – (7) sehr entspannt
Fatigue	
Nach der Arbeit fühlte ich mich sehr erschöpft.	Drop down list: trifft… gar nicht zu wenig zu mittelmäßig zu zu vollständig zu
Interruptions (evening measure)	
Wenn Sie an den heutigen Arbeitstag denken: Gab es… … Unterbrechungen als sonst?	Radio buttons: …weniger… …genauso viele… …mehr…
Break (evening measure)	
Konnten Sie heute während der Arbeit in vollem Umfang Ihre Pause nehmen?	Radio buttons: Ja. Nein.
Irritation	
Es fiel mir heute schwer, nach der Arbeit abzuschalten. Ich musste auch zu Hause an Schwierigkeiten bei der Arbeit denken. Wenn andere mich ansprachen, kam es vor, dass ich mürrisch reagierte. Selbst im Urlaub müsste ich jetzt manchmal an Probleme bei der Arbeit denken. Ich fühlte mich heute ab und zu wie jemand, den man als Nervenbündel bezeichnet. Ich war schnell verärgert. Ich reagierte heute gereizt, obwohl ich es gar nicht wollte. Als ich müde von der Arbeit nach Hause kam, fand ich durch nichts Erholung.	Drop down list: trifft… überhaupt nicht zu größtenteils nicht zu wenig zu mittelmäßig zu etwas zu größtenteils zu fast völlig zu
Forgetting of intentions	
Haben Sie heute bereits angefangene oder geplante Aufgaben vergessen zu erledigen?	Radio buttons: Ja. Nein.

Table B.3. Items of the diary questionnaire (evening) (continued).

Items	Response format
Satisfaction with one's own performance	
Heute konnte ich meinen persönlichen Anspruch an die Arbeit zufrieden stellen.	Drop down list: trifft… wenig zu eher nicht zu mittelmäßig zu zu völlig zu
Extra-role behaviour	
Ich habe heute mehr geleistet, als eigentlich von mir gefordert wurde.	Drop down list: trifft… überhaupt nicht zu größtenteils nicht zu wenig zu mittelmäßig zu etwas zu größtenteils zu fast völlig zu
Time pressure (evening measure)	
Inwiefern stimmen Sie den folgenden Aussagen zu?	Check boxes; 7-point scale with the extreme points:
Ich stand heute unter Zeitdruck.	(1) trifft gar nicht zu
Ich musste heute schneller arbeiten, als ich es normalerweise tue, um meine Arbeit zu schaffen.	(5) trifft vollständig zu
Bei meiner Arbeit wurde heute ein hohes Arbeitstempo verlangt.	
Mental demands (evening measure)	
Inwiefern stimmen Sie den folgenden Aussagen zu?	Check boxes; 7-point scale with the extreme points:
Ich musste bei meiner Arbeit heute viele Dinge gleichzeitig im Kopf haben.	(1) trifft gar nicht zu (5) trifft vollständig zu
Ich musste heute Informationen für kurze Zeit im Kopf behalten, die man sich schwer merken kann (z.B. Namen, Zahlen usw.).	
Es gab heute Momente bei meiner Arbeit, die für kurze Zeit höchste Konzentration erforderten.	
Uncertainty	
Inwiefern stimmen Sie den folgenden Aussagen zu?	Check boxes; 7-point scale with the extreme points:
Ich erhielt heute unklare Anweisungen.	(1) trifft gar nicht zu
Ich erhielt heute von verschiedenen Vorgesetzten widersprüchliche Anweisungen.	(5) trifft vollständig zu
Ich musste Entscheidungen fällen, ohne dass ausreichende Informationen zur Verfügung standen.	
Staff	
Die Station war heute in Bezug auf das Arbeitspensum…	Radio buttons: unterbesetzt. gut besetzt. überbesetzt.

Table B.3. Items of the diary questionnaire (evening) (continued).

Items	Response format
Recovery	
Inwiefern stimmen Sie folgenden Aussagen zu?	Drop down list: trifft… gar nicht zu / wenig zu / mittelmäßig zu / zu / völlig zu
Nach der Arbeit habe ich abgeschalten und mich entspannt.	
Nach der Arbeit habe ich entspannende Dinge getan.	
Nach der Arbeit nutzte ich die Zeit zur Entspannung.	
Nach der Arbeit gönnte ich mir Freizeit/nutze ich die Zeit für Erholung.	
Nach der Arbeit lernte ich neue Dinge.	
Nach der Arbeit suchte ich nach intellektuellen Herausforderungen.	
Nach der Arbeit tat ich Dinge, die mich herausfordern.	
Nach der Arbeit tat ich etwas um meinen Horizont zu erweitern.	
Leisure	
Tätigkeiten im Haushalt (z.B. einkaufen, Wäsche waschen, Kinder betreuen)	Drop down list: weniger als 1 Stunden / 1-2 Stunden / 2-3 Stunden / 3-4 Stunden / mehr als 4 Stunden
Wenig anstrengenden Tätigkeiten (z.B. Fernsehen, PC Spiele, Lesen, Nichtstun)	
Körperlichen Tätigkeiten (Z.B. Laufen, Radfahren, Ballsportarten)	
Tätigkeiten mit sozialen Kontakten (z.B. zu Hause mit Partner unterhalten, Ausgehen ins Kino, jemanden besuchen)	
Dispute	
Gab es heute in Ihrer Freizeit besonders stressvolle Ereignisse, die Sie belastet haben? Zum Beispiel ein Streit mit dem Partner oder schlechte Neuigkeiten?	Radio buttons: Ja. / Nein.

Examples of PDA screens with different widgets:

Figure B.1. Check box.

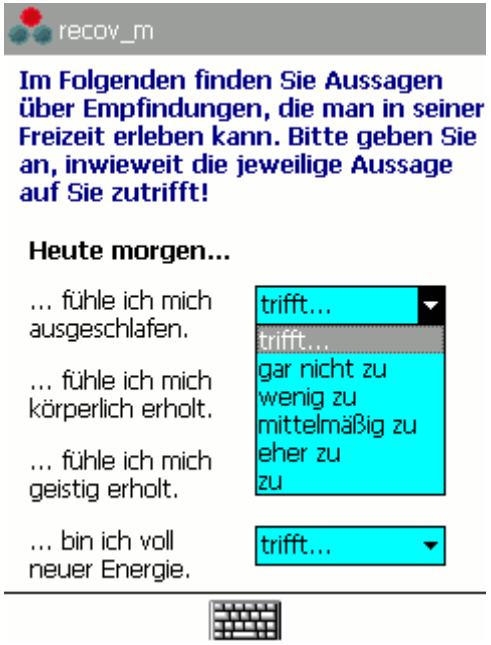


Figure B.2. Drop down list.

Figure B.3. Radio button.

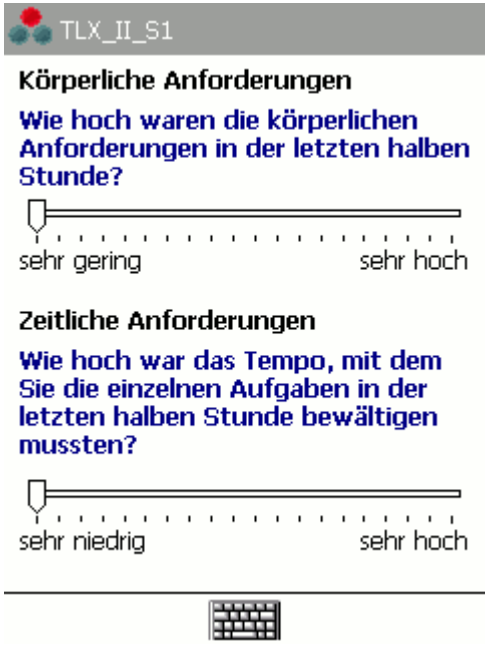


Figure B.4. Slider.

Zusammenfassung

Diese Dissertation basiert auf einem theoretischen Artikel und zwei empirischen Studien.

Der theoretische Artikel: Es wird ein theoretisches Rahmenmodell postuliert, welches die Kumulierung von Arbeitsunterbrechung und deren Effekte untersucht. Die meisten bisherigen Studien haben Unterbrechungen als isoliertes Phänomen betrachtet und dabei unberücksichtigt gelassen, dass während eines typischen Arbeitstages mehrere Unterbrechungen gleichzeitig (oder aufeinanderfolgend) auftreten. In der vorliegenden Dissertation wird diese Lücke gefüllt, indem der Prozess der kumulierenden Unterbrechungen untersucht wird. Es wird beschrieben, inwieweit die Kumulation von Unterbrechungen zu einer neuen Qualität von (negativen) Effekten führt. Das Zusammenspiel und die gegenseitige Verstärkung einzelner Effekte werden dargestellt und moderierende und mediierende Faktoren aufgezeigt. Auf diese Weise ist es möglich, eine Verbindung zwischen kurzfristigen Effekten einzelner Unterbrechungen und Gesundheitsbeeinträchtigungen durch die Arbeitsbedingung ‚Unterbrechungen' herzustellen.

Studie 1: In dieser Studie wurde untersucht, inwieweit Unterbrechungen Leistung und Wohlbefinden einer Person innerhalb eines Arbeitstages beeinflussen. Es wurde postuliert, dass das Auftreten von Unterbrechungen die Zufriedenheit mit der eigenen Leistung vermindert und das Vergessen von Intentionen und das Irritationserleben verstärkt. Geistige Anforderung und Zeitdruck galten hierbei als Mediatoren. Um dies zu testen, wurden 133 Pflegekräften über 5 Tage hinweg mittels Smartphones befragt. Mehrebenenanalysen konnten die Haupteffekte bestätigen. Die vermuteten Mediationseffekte wurden für Irritation und (teilweise) für Zufriedenheit mit der Leistung bestätigt, nicht jedoch für Vergessen von Intentionen. Unterbrechungen führen demzufolge (u.a.) zu negativen Effekten, da sie kognitiv anspruchsvoll sind und Zeit beanspruchen.

Studie 2: In dieser Studie wurden Zusammenhänge zwischen kognitiven Stressoren (Arbeitsunterbrechungen und Multitasking) und Beanspruchungsfolgen (Stimmung und Irritation) innerhalb eines Arbeitstages gemessen. Es wurde angenommen, dass diese Zusammenhänge durch chronologisches Alter und Indikatoren funktionalen Alters (Arbeitsgedächtniskapazität und Aufmerksamkeit) moderiert wird. Ältere mit schlechteren Aufmerksamkeits- und Arbeitsgedächtnisleistungen sollten am stärksten durch die untersuchten Stressoren beeinträchtigt werden. Es wurde eine Tagebuchstudie (siehe Studie 1) und computergestützte kognitive Leistungstests durchgeführt. Mehrebenenanalysen konnten die Haupteffekte für die abhängigen Variablen Stimmung (Valenz und Wachheit) und Irritation bestätigen, nicht jedoch für Erregung (Stimmung). Dreifachinteraktionen wurden nicht in der postulierten Richtung gefunden. Jüngere, nicht Ältere profitierten von einem hohen basalen kognitiven Leistungsvermögen. Ältere scheinen Copingstrategien zu besitzen, die mögliche kognitive Verluste ausgleichen.

Im Allgemeinen konnten die (getesteten) Annahmen des theoretischen Rahmenmodells bestätigt werden. Prinzipiell scheint es möglich, Ergebnisse der Laborforschung auf die Feldforschung zu übertragen, jedoch ist es notwendig die Besonderheiten des Feldes zu berücksichtigen. Die postulieren Mediationseffekte (Studie 1) wurden (teilweise) bestätigt. Die Ergebnisse weisen jedoch darauf hin, dass der volle Arbeitstag untersucht werden muss und dass sehr spezifische abhängige Variablen auch spezifischere Mediatoren benötigen. Des Weiteren konnte in Studie 2 bestätigt werden, dass die kognitive Kapazität eine bedeutsame Ressource im Umgang mit Unterbrechungen ist, im Arbeitskontext jedoch auch andere Ressourcen wirken.