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Investigating the Relationships Between Job Characteristics, Physical Activity, and Well-Being: A Mixed Methods Approach

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Abstract

This dissertation is devoted to a detailed evaluation of the relationships between job characteristics, leisure-time physical activity (LTPA), and well-being drawing on the assumptions of the recently introduced *physical-activity mediated Demand-Control* (*pamDC*) *model* by Häusser and Mojzisch (2017). The two key concerns were to *i)* evaluate the effects of job demands (via self-regulation) and job control (via self-determination) on LTPA within varying time frames (ranging from short-term effects within days to time-lagged effects over weeks), and *ii)* test for a mediating effect of LTPA for the effects of job demands and job control on well-being for the first time.

To address these questions, five empirical studies were conducted that differ in their scope (*Study 1* aimed to test the central assumptions of the pamDC model for the first time, whereas S*tudies 2* to *5* focused on the relationships between job characteristics and LTPA) and methodological approach. While *Studies 1* and *5* were based on longitudinal designs with a working sample, *Studies 2* to *4* employed experimental designs to increase confidence with regard to causal directions of the assumed processes.

Overall, I found general support for the effects of job demands on LTPA (as three out of four studies found an effect) although this effect does not seem to be mediated through self-control and mainly unfolded in a short time frame. There was no support for direct effects of job control on LTPA as none of the studies that tested these relationships revealed significant effects. However, there was an indirect effect of job control on LTPA through self-determination in *Study 4*. With regard to the proposed mediation of LTPA for the effects of job characteristics on well-being, I found partial support as daily LTPA could be identified as a mediator for the effects of daily job demands but not for the effects of daily job control on well-being.

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Chapter 1: Introduction

"If we could give every individual the right amount of nourishment and exercise, not too little and not too much, we would have found the safest way to health."

— Hippocrates (460–377 BC)

As soon as the end of the workday rolls around, people sometimes face difficulties with engagement in physical activity although they had intentions to do so. In the face of high obligations at work, it can be challenging to shift attention to exercising although physical activity can relieve feelings of work-related strain and helps to sustain general health and well-being as indicated by a wealth of research (cf. Penedo & Dahn, 2005; Calderwood et al., 2016). Preserving health and well-being is one of the most important – or even the most important – values for every individual (Ganten & Kickbusch, 2018) and is, furthermore, crucial to the attainment of other intrinsic goals (cf. Kasser & Ryan, 2001).

Another line of research, with a similar goal but that is broadly unconnected, has been greatly concerned with the identification of job characteristics that impact health and well-being. As one of the most prominent job stress models the *Job Demand-Control model* (*JDC*; Karasek, 1979; Karasek & Theorell, 1990) proposes that job demands and job control are two crucial job conditions that influence health and well-being in employees. Only more recently has theorizing started to emphasize the importance of understanding *how* job characteristics are linked to well-being thus proposing work-to-leisure spillover in the form of leisure-time physical activity (LTPA) as one of the mechanisms for these relationships. In their *physical activity-mediated Demand-Control* (*pamDC*) *model*, Häusser and Mojzisch (2017) extended the basic assumptions of Karasek's JDC model (1979) to LTPA as a partial mediator for the effects of job demands

and job control on health and well-being. Identifying variables that serve as mediators for the effects of work on well-being is important as it can help to further develop theorizing in occupational health psychology and provides implications for practitioners aiming to support employee well-being and health.

This dissertation focuses on the relationships between job characteristics, LTPA, and subjective well-being and consists of three parts.

Part I (Chapter 1) describes the theoretical foundations for the dissertation and introduces the central assumptions and previous empirical research in more detail. In a nutshell, the central components of the JDC model (Karasek, 1979; Karasek & Theorell, 1990) are proposed to also be applicable to predict LTPA as job demands should negatively affect LTPA, whereas job control should be positively related to it. LTPA, in turn, is expected to positively influence health and well-being. Consequently, LTPA is assumed to convey the effects of job demands and job control on well-being through their inhibitive and/or promoting effects on LTPA (Häusser & Mojzisch, 2017).

Part II (Chapter 2 to 5) describes the empirical studies that were conducted to test the assumptions. Five studies will be described that differ *i)* in their focus and *ii)* methodological approach. While *Study 1* aims to test the proposed mediation of LTPA for the relationships between job demands, job control and well-being for the first time, *Studies 3* to *6* are mainly concerned with the relationships between job characteristics and LTPA. While past research provides a wealth of evidence for the relationships between LTPA and well-being, the relationships between job characteristics and LTPA have received less attention but are essential to establish the idea of a mediation effect (cf. Yzerbyt et al., 2018). Regarding the methodological approaches, *Study 1* (Chapter 2) and *Study 5* (Chapter 6) are based on longitudinal field data ranging from two waves of measurement over weeks to multiple continued measurements within and over days.

To increase confidence with regard to internal validity, *Studies 2* to *4* focus on an experimental approach to test the propositions.

Finally, Part III will summarize the findings of the empirical studies and draw conclusions and implications with regards to the basic propositions of the pamDC model (Häusser & Mojzisch, 2017) and further lines of research.

Leisure-Time Physical Activity

In this dissertation, leisure-time physical activity mostly refers to moderate-to-vigorous intensity aerobic activities as well as muscle-strengthening activities such as brisk walking, skipping, or jogging that involve an energy expenditure of at least 3 METs (metabolic equivalent, which is a ratio for the metabolic rate and reflects the amount of energy expenditure in adults compared to a resting state; Schmitz et al., 2000) and are conducted outside work (Dunstan et al., 2012; Evenson & Wen, 2010). To achieve substantial health benefits, the World Health Organization (WHO, 2016) advises adults to engage in moderate-to-vigorous intensity physical activities (MVPA) on at least five days every week for 30 minutes or vigorous intensity activities on at least three days every week for 20 minutes.

The idea that physical activity is a promoter of health and well-being has almost become common sense. The human body has evolved in such a way that most of its systems, for instance, musculoskeletal, metabolic, and cardiovascular, do not function in an optimal way unless they are frequently stimulated by physical activity (Booth et al., 2008). This is reflected by a plethora of studies that link physical activity to a number of health benefits (for an overview, see Warburton & Bredin, 2017). For example, physical *in*activity is associated with a higher risk for many physical diseases, like type 2 diabetes, coronary heart diseases, some types of cancer, and above that, an increase in all-

cause mortality (e.g., Bouchard et al., 2012; Lee et al., 2012). Furthermore, physical activity has been found to be a source of mental health recreation as it is positively related to detachment from work (van Hooff et al., 2019), lower emotional exhaustion (Janurek et al., 2018), and lower levels of stress and improved mood (e.g., Feuerhahn et al., 2014; Nägel et al., 2015; Sonnentag, 2001). In a daily diary study, Sonnentag (2001) demonstrated that employees' situational well-being in the evening was higher on days with more physical activity compared to days where physical activity levels were low. Amongst other factors, the positive effects of LTPA on well-being are due to the creation of psychological resilience (Cohn et al., 2009) and its ability to act as an emotion regulation strategy after work (Bernstein & McNally, 2017). Furthermore, physical activity produces relatively stable effects on self-perceptions, like increased self-esteem (Fox, 2000), and self-efficacy (McAuley et al., 2000) which spill over to well-being (Bakker et al., 2013; Calderwood et al., 2016).

However, research shows that individuals often compromise health and well-being by spending too much time in (more) sedentary activities compared to physical activities. Worldwide, more than a third of adults are physically inactive (Hallal et al., 2012). Moreover, physical activity rates have tended to decrease during the past decades in Western countries (Guthold et al., 2018).

The physical activity-mediated Demand-Control (pamDC) model

The central idea of the pamDC model (Häusser & Mojzisch, 2017) is to integrate previous findings about LTPA into the assumptions of the seminal JDC model (Karasek, 1979; Karasek & Theorell, 1990). The two key concerns of the pamDC model are to *i)* apply the basic assumptions of the JDC model to predict LTPA (cf. Fransson et al., 2012), and *ii)* establish LTPA as a partial mediator for the effects of job demands and job control on health and well-being (Häusser & Mojzisch, 2017).

According to the JDC model (Karasek, 1979; Karasek & Theorell, 1990), job demands are negatively related to health and well-being while job control shows positive relationships (for an overview, see Häusser et al., 2010; van der Doef & Maes, 1999). Typically, job demands refer to quantitative demands at work, like time pressure (e.g., meeting the requirements of a job within a limited time frame), emotional demands (e.g., having to stay polite during customer interactions), and physical demands (e.g., heavy lifting; Karasek et al., 1998) that require sustained mental and/or physical effort and are therefore associated with certain psychological and/or physiological costs (Demerouti & Bakker, 2011). Job control is defined as "the degree to which the job provides substantial freedom, independence, and discretion to the individual in scheduling the work and in determining the procedures to be used in carrying it out" (Hackman & Oldham, 1976, p. 258).

Amongst its effects on health and well-being, job demands are also expected to negatively influence LTPA, whereas job control is expected to positively influence it (Häusser & Mojzisch, 2017). LTPA, in turn, should be positively related to health and well-being. To explain how job demands and job control are related to LTPA, the pamDC model argues that job demands should negatively impact LTPA through impairing self-regulation, whereas job control should unfold its positive effects on LTPA through increasing self-determination. These assumptions are based on the notion that the human body is made for movement and therefore needs physical activity to stay well and healthy (Booth et al., 2011). When in energetic *homeostasis* – that is external demands, and external as well as personal resources are in balance – individuals feel vital and motivated to be (physically) active (Ganster et al., 2001). On the one hand, unfavorable job conditions like too high job demands might result in an energetic imbalance and feelings of fatigue (i.e., through hampering self-regulatory capacities), thereby inhibiting the natural desire to be (physically) active (Bakker et al., 2004). Consequently,

by negatively impacting LTPA, job demands are becoming a risk factor for health and well-being. On the other hand, job control should be able to provide the individual with feelings of motivation and vitality thereby leading to higher physical activity (i.e., through the satisfaction of basic psychological needs; Deci & Ryan, 2008), and hence helping to sustain health and well-being.

All assumptions of the pamDC model that are within the scope of this dissertation are presented in Figure 1.1. In the next sections, I will describe the theoretical rationale and previous research on the relationships between job demands, job control, and LTPA in more detail.

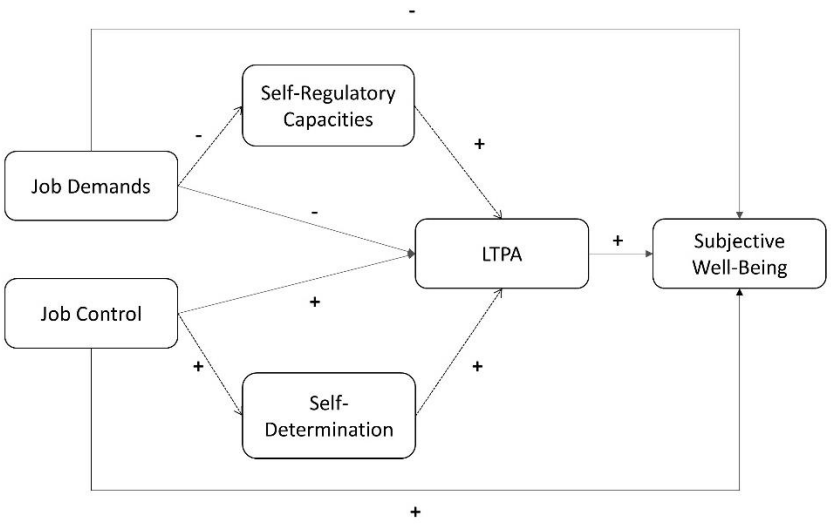

Figure 1.1 Conceptual model for the dissertation enterprise. LTPA= leisure-time physical activity

Job Demands, Self-Regulatory Capacities and LTPA

Besides its numerous effects for health and well-being (for reviews, see Häusser et al., 2010, and van der Doef & Maes, 1999) job demands are assumed to decrease LTPA.

This assumption is preliminarily supported by previous studies that tested and found these relationships although most of them applied a cross-sectional design (e.g., Burton & Turrell, 2000; Kirk & Rhodes, 2012; Mutz et al., 2020; Ng & Jeffery, 2003). This is an issue as research based on correlational data is not able to draw conclusions about causality and to exclude alternative explanations like confounding variables that might cause spurious relationships (Taris, 2000; Zapf et al., 1996). For instance, reversed causality might be due to the fact that physical activity leads to psychological and physiological changes that are related to positive experiences of job characteristics (I will come back to this issue in the research outline; Calderwood et al., 2016). Fewer studies, like a study by Johansson et al. (1991), used a longitudinal design to test the proposed relationships between job demands and LTPA. In this study, they found that high occupational stress is related to lower sports activities during leisure-time. Similarly, Payne et al. (2002) found in a longitudinal study that job demands undermined employees' physical activity intentions after work. Although studies based on longitudinal data are more conclusive about causality, they are still not able to provide clear evidence for causal effects (van der Laan & Petersen, 2004). Furthermore, as all of the aforementioned studies on the relationships between job demands and LTPA are based on self-report measures they carry the risk of common-method bias (Podsakoff et al., 2012; Podsakoff et al., 2003) as well as other reporting biases such as over-reporting physical activity because of social desirability (Patterson et al., 1993). For instance, Adams et al. (2005) found that social desirability was associated with an over-reporting of 4.15 – 11.30 minutes of physical activity per day on average. Hence, previous studies are able to provide first evidence for the existence of a relationship between job demands and LTPA but are lacking with regard to internal validity (Flanders et al., 1992).

As an underlying psychological mechanism for the effects of job demands on LTPA, the pamDC model suggests self-regulatory processes (Häusser & Mojzisch,

2017). Self-regulation in general describes the ability to alter one's own behavioral responses, such as by overriding internal or external, mental or physical impulses to act in line with long-term goals and standards (Baumeister & Heatherton, 1996). It plays a crucial role in updating and monitoring relevant information, inhibitory behavioral control, interference control, planning, scheduling, and cognitive flexibility (for a review, see Diamond, 2013). Hence, it enables the individual to maintain goals across prolonged periods of time and to adjust behavioral control to an upcoming conflict or a discrepancy between conflicting motivations stemming from long-term goals versus short-term desires (Botvinick et al., 2001; Buckley et al., 2014). Individuals show varying levels of self-regulatory abilities that lead to time and situation specific differences in the amount of self-control an individual can exhibit (Baumeister et al., 2007). These inter- and intra-individual differences in self-control over time are called self-regulatory capacities (cf. Meier & Gross, 2015). Although contradictory perspectives on the foundations of self-regulation exist, most prominent theories regarding self-control (e.g., strength model of self-control by Baumeister et al., 1998; "Central Governor" framework by Evans et al., 2016; motivational attentional process-model of ego-depletion by Inzlicht & Schmeichel, 2012; opportunity cost model by Kurzban et al., 2013; conflict-monitoring theory by Botvinick et al., 2001) posit that expending self-control in a preceding task has negative effects on self-regulatory performance in a subsequent task.

One factor that consumes self-regulatory capacities can be the confrontation with job demands (Gombert et al., 2020; Prem et al., 2016). To deal with high demands at work, employees have to invest self-regulatory capacities to alter their thinking, emotions, and behavior (Schaufeli & Bakker, 2004). For instance, employees often have to *i)* control their emotional responses to stay polite (e.g., while dealing with unfriendly customers at work), *ii)* overcome inner resistances to fulfill tasks that are unfavorable,

and *iii)* resist external temptations to meet the requirements of a task (Schmidt & Neubach, 2007).

The reduction of self-regulatory capacities due to high job demands might lead to a self-regulatory conflict in an upcoming situation, where self-regulatory capacities might be needed as well. This might be the case when it comes to the engagement and execution of LTPA as previous research shows that exercising represents a classic self-regulatory goal (Wills et al., 2007). Although there might be differences in the amount of self-control needed to invest depending on the kind of physical activity (Rouse et al., 2013), individuals with greater self-regulatory capacities are more successful at implementing their intentions to be physically active (de Bruin et al., 2012). Instead of choosing a more pleasurable sedentary activity after work, individuals that want to accomplish a long-term goal (e.g., sustain health and well-being) often need to curb their short-term desires by actively choosing physical activity (Rhodes et al., 2016). A study by Sonnentag and Jelden (2009) provides first evidence for the assumption that daily job demands are negatively related to daily LTPA through self-regulatory capacities as they found vigor (which can be seen as a proxy for self-control; cf. Saunders & Inzlicht, 2016) to mediate the effects of job demands on LTPA in police employees.

Consequently, people might fail to engage in moderate-to-vigorous physical activities when self-regulatory capacities are temporarily impaired due to high demands at work (Rouse et al., 2013). Job demands should be negatively related to self-regulatory capacities, which, in turn, are positively related to LTPA.

Job Control, Self-Determination and LTPA

With regard to job control, it has been suggested that control over one's own work should be positively related to LTPA and there is also first empirical evidence for this assumption (e.g., Bennett et al., 2006; Choi et al., 2010; Hellerstedt & Jeffery, 1997; Johansson et al., 1991; Kouvonen et al., 2005; Tsutsumi et al., 2003). For instance, a study

by Kouvonen et al. (2005) found among a large sample of over 46,000 Finnish public sector employees that job control is significantly positively related to LTPA. Hence, positive effects of job control are assumed to generalize into leisure time. The idea that job control is positively related to LTPA is based on the notion that there is rather a similarity than a contrast between work and non-work characteristics: Motivation that arises from high control at work should spill-over into leisure-time health behavior such as LTPA ("spill-over hypothesis" versus "compensation hypothesis"; cf. Choi et al., 2010). However, as already mentioned above, issues concerning causal inferences, possible influences of third variables, and reporting biases in LTPA also have to be raised with regard to previous research on job control and LTPA since almost all of the previous studies are based on cross-sectional data and self-reported LTPA (Bennett et al., 2006; Hellerstedt & Jeffery, 1997; Kouvonen et al., 2005; Tsutsumi et al., 2003).

One explanation for the positive spill-over of job control on LTPA is grounded in Self-Determination Theory (SDT; Deci & Ryan, 1985). SDT is a macro-theory of motivation that seeks to explain why individuals show certain types of behavior (Vansteenkiste et al., 2010). Generally spoken, SDT hypothesizes that greater relative autonomy is associated with higher quality behavior (i.e., improved performance) and greater persistence (Deci & Ryan, 2000; Ryan & Deci, 2017). As proposed by the basic psychological needs satisfaction approach – which is one of the five mini-theories of SDT (Deci & Ryan, 2000) – every individual has basic psychological needs, such as the need for autonomy, that have to be satisfied to function in an optimal way. Need satisfaction increases motivation and active behavior by providing vitality that can be turned into action (Deci & Ryan, 2008).

In the work domain, job control turned out to be an important promoter of need satisfaction (Trépanier et al., 2015). Through the ability to make own decisions and to use own skills, employees should fulfil their basic need for autonomy thereby experiencing

increased feelings of motivation (Deci et al., 1994; Gagné et al., 1997). In contrast to high job control, when choice of action is suppressed by the spatial, temporal, and functional constraints of the work process, employees' basic needs remain unmet, causing decreased general motivation, lower feelings of mastery and confidence, while feelings of frustration increase (Gagné & Deci, 2005).

With regard to LTPA, previous research highlights the crucial importance of psychological need satisfaction (Edmunds et al., 2006). Drive and motivation that arise from need satisfaction are central preconditions for the initiation and execution of LTPA (Standage et al., 2003, 2005). Most kinds of LTPA must be actively chosen, for example, for reasons of health, or to enhance sports performance (e.g., Frederick & Ryan, 1993; Ryan et al., 1997) and therefore need a certain investment of skill and ability (Duda & Tappe, 1988). These drives should be undermined by frustration and low competence due to low autonomy satisfaction (Gunnell et al., 2013). Therefore, autonomy satisfaction should explain how job control is linked to leisure-time health behavior such as LTPA. Previous theorizing (Sheldon et al., 1996) and empirical research (Bagøien et al., 2010) supports the idea that general feelings of self-determination (in the form of need satisfaction) can explain the spill-over of job control into leisure. For example, Englert and Bertrams (2014) found that participants in their study showed increased performances during a sports task when experiencing an autonomy-supportive environment in an unrelated preceding self-control task compared to a controlling environment.

Hence, job control is assumed to increase the satisfaction of autonomy needs, which in turn positively affects LTPA.

Research Goals and Contributions

This dissertation makes four key contributions to the literature. First of all, I aimed to extensively test whether the central components of the JDC model (Karasek, 1979) – that is, job demands and job control – can be also applied to predict LTPA. Moreover, this dissertation adds to the theoretical knowledge about drivers for the effects of job characteristics on LTPA as it aims to test self-regulation and self-determination as factors that explain how job demands and job control are extending its effects on LTPA.

Second, I aim to empirically evaluate the idea that LTPA mediates the effects of job demands and job control on well-being. As there have been no previous studies that tested these assumptions in an integrated framework, this is the first attempt to do so. Although many studies have already tested the relationships between job characteristics and well-being, only a few studies have focused on underlying variables that mediate these relationships. However, identifying factors that serve as mediators seems crucial as a deeper understanding of how job characteristics are linked to well-being is vital for further theory development and, moreover, bears implications for the prevention of health threatening effects of work on well-being.

Third, this dissertation project applies *i)* advanced study designs and *ii)* more objective measures of LTPA to test the proposed relationships. I employed a mixed methods approach to increase the internal validity of the findings while still keeping external validity high (Tashakkori & Teddlie, 2003; Turner et al., 2017). Especially the combination of field studies with a working sample and experimental lab studies seems to be a fruitful endeavor, as field studies offer important insights into the relationships within a natural environment, although they are not able to rule out concerns regarding causality and third-variable influences. When it comes to researching the relationships between job characteristics and LTPA in field studies, there is always the possibility of reversed causality (van der Laan & Petersen, 2004; Zapf et al., 1996). For instance, LTPA might

have psychological and/or physiological effects such as increasing psychological resilience (Cohn et al., 2009) or influencing endocrinological responses like endorphin secretion (Paluska & Schwenk, 2000). These changes may alter experiences of job characteristics in a more positive manner (Calderwood et al., 2016). Consequently, inferences regarding causality can and should be supplemented by experimental studies that are able to control for reversed causality and third-variable influences (Highhouse, 2009). Furthermore, a central aim of this dissertation is to increase the credibility of the findings by using more objective measures of physical activity such as accelerometry (i.e., activity monitors). Using self-reports poses a convenient way to measure behavior alongside inner processes but is limited in terms of validity since actual and reported behavior often differ to a high degree (West & Brown, 1975). Reasons for the lack of validity with regard to self-reports of human behavior are, for example, over-reporting due to social desirability (cf. Adams et al., 2005). Therefore, whenever it is possible, the measurement of LTPA in the presented studies is based on more objective methods like accelerometry (*Study 1*) or physical activity tasks (*Studies 2* to *4*).

Fourth, this dissertation aims to advance knowledge about the temporal dynamics of the proposed effects. This is a fruitful endeavor as adding a time perspective to the assumptions informs us about how the effects of job demands and job control on LTPA may unfold. While the daily diary study (*Study 1*) in Chapter 2 and the experimental studies (*Studies 3 and 4*) in Chapter 4 allow us to make inferences about short-term processes with regard to the effects of job characteristics on LTPA, the longitudinal study (*Study 5*) about the relationships between job characteristics and physical activity during vacations reported in Chapter 5 is able to draw conclusions about time-lagged effects of job characteristics on physical activity outside of work.

Dissertation Outline

The dissertation is composed of five empirical studies that examine the relationships between job characteristics, LTPA, and well-being. The empirical studies are presented in the next part of this dissertation (Chapters 2 to 5). Several studies are in press or under review in different scientific journals, which is indicated in more detail in a footnote for each chapter. Each chapter includes a theoretical introduction and a discussion section in addition to the reports of methods and results. Therefore, each study can be read independently which sometimes might lead to overlaps of repeated explanations due to common theoretical foundations. In the empirical part of the dissertation I refer to *we* to acknowledge the role of all contributors (which will be indicated in a foot note for each study separately). Table 1.1 presents an overview of the empirical part of the dissertation.

In Chapter 2, I report a daily diary study (*Study 1*) to test the central assumptions of the pamDC framework within one statistical model. A special emphasis was placed on the test of the mediation of LTPA for the effects of job characteristics on well-being for the first time. Therefore, I employed an ambulatory assessment approach with participants answering online surveys three times a day and continuous accelerometry over two weeks to objectively measure LTPA.

To tie in with the limited internal validity of field studies, Chapter 3 (*Study 2*) describes the development and evaluation of a workplace simulation that can be used to assess the effects of job characteristics on LTPA. Hence, this pilot study builds the foundation for the methodological approach that should be employed to experimentally test the effects of job characteristics on LTPA.

In Chapter 4 (*Studies 3 and 4*), I report two studies that aimed to investigate the assumptions with a focus on the effects of job characteristics on LTPA under more controlled experimental conditions. Specifically, I conducted workplace simulations with

manipulations of job demands (*Study 3 and 4*) and job control (*Study 4*) and a post-work physical activity task in which participants had to engage physically on a bicycle ergometer.

As there have been no previous studies that tested for time-lagged effects of job characteristics on off-work physical activity, Chapter 5 (*Study 5)* reports the empirical investigation of the role of job characteristics for physical activity during vacation. With this study, I aimed to test whether job characteristics are able to predict LTPA over extended periods of time and wanted to find out whether the assumptions of the pamDC model with regard to the prediction of LTPA can be applied to different types of leisure.

Finally, Chapter 6 summarizes and integrates the main findings of the empirical studies presented in Chapters 2 to 5 and provides implications and future directions for studies on the relationships between job characteristics, LTPA, and well-being.

Table 1.1*: Overview of the empirical part of the dissertation*

	Scope	Methods	Main Findings
Chapter 2 (Study 1)	- Testing the mediating role of LTPA for the effects of job characteristics on well-being on a day-level (within-person)	- Ambulatory assessment study with three surveys a day (morning, after-work, evening) over the course of 14 days - Assessment of job characteristics, self-regulation, self-determination, well-being, as well as continuous accelerometry	- Job demands were negatively related to LTPA (but no indirect effect through self-regulation). Effects of job demands on well-being were (partially) mediated through LTPA - Job control showed neither direct, nor indirect effects (through self-determination) on LTPA, and was not indirectly related to well-being through LTPA
Chapter 3 (Study 2)	- Development and evaluation of a work simulation than can be used to test for the effects of job factors on physical activity (PA)	- Answering pre-recorded customer inquiries (work simulation) with manipulations of job demands - Subsequently, presentation of questions about perceived demands and completion of a PA-task	- Participants in the high demands condition reported higher perceived job demands compared to the low demands condition - PA did not differ between experimental conditions
Chapter 4 (Studies 3 & 4)	- Testing the effects of job demands and job control on PA in an (controlled) experimental setting	- Work simulation consisting of customer-inquiries and mental arithmetic tasks; manipulations of job demands (Studies 3 & 4) and job control (Study 4) - Afterwards, participants completed a PA-task	- Job demands had negative effects on PA (although this effect was not mediated by self-regulation) - Job control showed no direct but indirect effects on PA (through self-determination)
Chapter 5 (Study 5)	- Testing the relationships between job characteristics and PA during vacation	- Two-wave study (before and after vacation) with self-reports of job conditions and PA	- Neither job demands, nor job control showed time-lagged relationships with PA during vacation

Chapter 2

Day-level Relationships Between Work, Physical Activity, and Well-Being: An Ambulatory Assessment Study[1]

According to the *Job Demand-Control model* (JDC; Karasek, 1979; Karasek & Theorell, 1990), two major job dimensions – job demands and job control – explain considerable variance in workers' health and psychological well-being. Job demands refer to cognitive (e.g., time pressure), physical (e.g., heavy lifting), and emotional stressors (e.g., unfriendly customers) encountered at work (Karasek & Theorell, 1990). Job control refers to the degree of skill discretion and decision latitude of the jobholder. To date, hundreds of studies have confirmed the notion that job demands are negatively related to well-being, while job control has positive effects (for reviews see, e.g., Häusser et al., 2010; van der Doef & Maes, 1999).

In line with Karasek's notion of the JDC model to be a "…stress-management model of strain which is environmentally based" (Karasek, 1979, p. 287), previous research on the JDC model focused on identifying specific environmental job stressors, but put only weak emphasis on the identification of underlying psychological or behavioural mechanisms that link job demands and job control to well-being. However, this seems crucial as a deeper understanding of such underlying mechanisms provides important insights as to how workers can alleviate negative consequences resulting from unfavourable work characteristics. In this vein, recent theorizing by Häusser and Mojzisch (2017) suggests that work-to-leisure spillover in the domain of leisure-time physical activity (LTPA) is an important underlying mechanism for the relationship between job characteristics and well-being. Past research revealed LTPA to

[1] This study was conducted together with A. Mojzisch, S. Krumm, & J. A. Häusser and is currently under revision at *Work & Stress* (revise and resubmit request).

be a substantial promoter of well-being as LTPA has shown to facilitate recovery processes by supporting mental detachment from work-related strain (e.g., Feuerhahn et al., 2014; van Hooff et al., 2019). Although LTPA is unlikely to be the only variable mediating the effects of job characteristics on well-being, previous research addressing the relationship between job characteristics and LTPA on the one hand, and the relationship between LTPA and well-being on the other hand, encourages the idea that LTPA might be essential in understanding the relationship between job characteristics and well-being (Häusser & Mojzisch, 2017).

In the present study, we investigate day-level work-to-leisure spillover as a partial mediator for the effects of job characteristics on well-being. Specifically, we propose that day-to-day dynamics in LTPA after work act as an underlying mechanism linking job characteristics with well-being. We hypothesize that day-specific job demands are negatively related to daily LTPA, which, in turn, has positive effects on well-being before bedtime. Also, we hypothesize that day-level job control is positively related to daily LTPA, which, in turn, has positive effects on well-being before bedtime. Finally, we predict that the effects of daily job demands and job control on LTPA are mediated by two distinct psychological processes. First, we predict that the effects of day-specific job demands on LTPA after work are mediated by momentary self-regulatory capacities after work. Second, we predict that the effects of day-specific job control on LTPA after work are mediated by feelings of self-determination after work. Figure 2.1 illustrates our conceptual model.

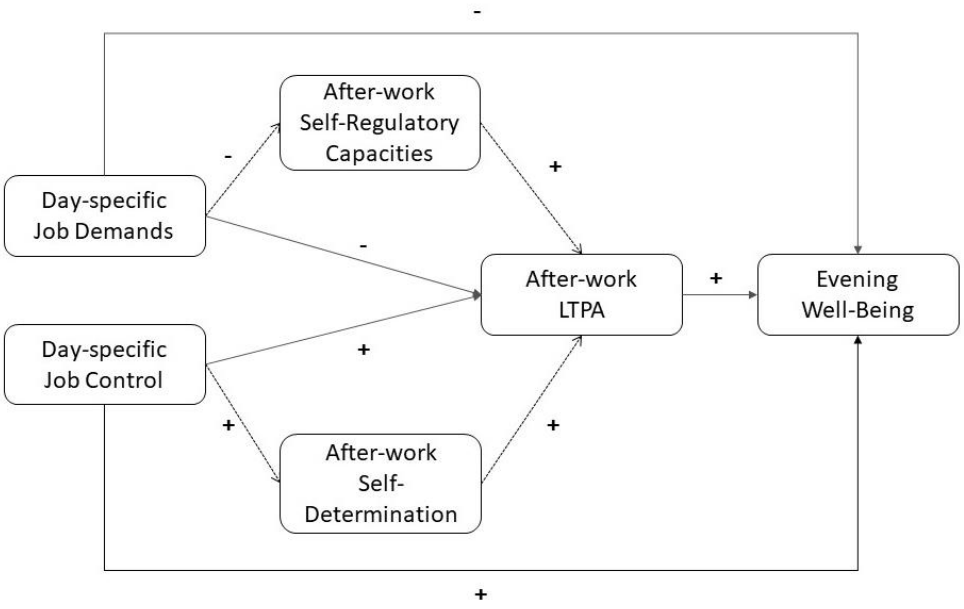

Figure 2.1 Conceptual model of our study. LTPA= leisure-time physical activity. Note that our analytical approach included respective morning well-being variables (Level 1) as covariates to predict (evening) well-being variables.

The present research advances our understanding of occupational health in three important ways. First, by testing the proposed pathways, we contribute to a deeper understanding of the mechanisms linking job characteristics and well-being. With a special emphasis on the relevance of LTPA for this relationship, our study is the first to test the assumptions within an integrated framework. Although some previous studies already found evidence for single pathways (as, for example, Feuerhahn et al., 2014, and van Hooff et al., 2019, already found evidence for the positive effects of LTPA on well-being, and Choi et al., 2010, and Payne et al., 2002, already showed a relationship between job characteristics and LTPA) this does not necessarily imply mediation.

Second, we focus on within-person effects to examine the proposed relationships. Specifically, we conducted a two-week ambulatory assessment study with a sample of employees working in sedentary jobs. Given the dynamic nature of the constructs tested herein, it is most

adequate to analyze the relationships on a daily basis. In particular, previous research showed that psychological well-being is considered to vary strongly on a daily basis (e.g., Daniels et al., 2006; Totterdell et al., 2006; Wilhelm & Schoebi, 2007). Similarly, demands and control (or at least the perception of these job characteristics) fluctuate within individuals over short periods of time, even days (e.g., Butler et al., 2005; Jones et al., 2007; Prem et al., 2016; Sonnentag, 2003). Likewise, research also indicates that substantial day-to-day fluctuations are evident for LTPA, suggesting that transitory situational factors are important to explain LTPA (e.g., Jaeschke et al., 2018; Jones et al., 2007). Surprisingly, however, cross-sectional and between-subject approaches have clearly dominated past research addressing the JDC model (for a review, see Häusser et al., 2010), thereby neglecting potential day-to-day variability in job characteristics.

Third, instead of using self-report measures, as has been the common practice in previous research, we used accelerometry to measure LTPA after work. Accelerometers are devices attached to the body designed to monitor spatial movements. To the best of our knowledge, all previous studies examining the effects of job demands and job control on LTPA used self-report measures of LTPA (e.g., Choi et al., 2010; Payne et al., 2002; Sonnentag & Jelden, 2009). However, social desirability, memory biases or difficulties in monitoring movement behaviour in everyday life are likely to lead to inaccurate estimates of the duration and the intensity of physical activity (Canning et al., 2014; Donaldson & Grant-Vallone, 2002).

Leisure-Time Physical Activity

Past research provides robust evidence that LTPA reduces negative affective states, subjective feelings of stress, and emotional exhaustion (e.g., Hogan et al., 2015; Janurek et al., 2018; Sonnentag, 2001; Taylor et al., 2007), and boosts daily recovery processes (Feuerhahn et al., 2014; van Hooff et al., 2019). Consequently, LTPA can be seen as an important resource replenishing activity as, for instance, increased levels of mood are important sources of psychological resilience (Cohn et al., 2009). Following the common physical activity

guidelines for health, adults should engage in moderate-to-vigorous physical activity (MVPA), including activities like cycling, brisk walking, and exercising, at least five times per week, for a minimum of 30 minutes each day (Haskell et al., 2007; World Health Organization, 2010, 2016). However, even though most people are aware of its positive effects, they frequently fail to engage in physical activity (Guthold et al., 2018). According to a study by Hallal et al. (2012) more than 31% of adults worldwide are physically inactive suggesting that approximately one out of three individuals does not reach physical activity recommendations.

With regard to the crucial importance of LTPA for health and psychological well-being, a mounting number of studies examined facilitators of LTPA. Notwithstanding the role of stable inter-individual factors, like personality (Rhodes & Smith, 2006), environmental factors (Cerin et al., 2010) or socio-economic factors (Brown & Siahpush, 2006) in predicting LTPA, previous research point to the idea that job characteristics have a substantial impact on LTPA (for an overview, see Fransson et al., 2012).

Day-Specific Job Demands, Momentary Self-Regulatory Capacities, and Daily Physical Activity After Work

With respect to job demands, some previous cross-sectional studies suggest a negative relationship with LTPA (e.g., Hellerstedt & Jeffery, 1997; Johansson et al., 1991; Payne et al., 2002). Here, we argue that self-regulation might be a key reason for the reduced willingness to engage in physical activity after work. Previous research suggests that dealing with high job demands drains self-regulatory capacities, which, in turn, are usually needed to initiate and maintain physical activity (Rouse et al., 2013; Sonnentag & Jelden, 2009). The term self-regulatory capacities, thereby, refers to the intra- and interindividual variation in the ability to exert (top-down) control over behaviours and impulses (Meier & Gross, 2015). Dealing with job demands forces employees to invest self-regulatory effort as most of today's job demands cannot be met by automated patterns of behaviour (Schmidt & Neubach, 2010). For example,

employees are often required to (i) shield themselves against surrounding distractions (e.g., environmental or social disruptions), (ii) overcome inner resistances (e.g., to get started with unpleasant tasks), and (iii) fulfill the requirements of their jobs. Consequently, self-regulatory capacities after work might be temporarily hampered. However, LTPA after work typically taps on self-regulation as previous research shows that individuals with greater self-regulatory capacities are more successful in the execution of LTPA (de Bruin et al., 2012). Preliminary evidence for a negative indirect effect of job demands on LTPA through self-regulation comes from a study by Sonnentag and Jelden (2009). They found that the negative effect of situational constraints encountered at work on exercise activities after work was mediated by vigor, which could be seen as a proxy to measure self-regulatory capacities. Building on previous theorizing and empirical evidence, we predict that day-level LTPA after work is substantially influenced by day-specific job demands and, furthermore, acts as a mediator of the day-level relationship between demands and well-being in the evening:

H1: Day-specific job demands are negatively related to psychological well-being in the evening.

H2: Day-specific job demands are negatively related to LTPA after work.

H3: The negative effect of day-specific job demands on well-being in the evening is mediated through LTPA after work.

H4: The negative effect of day-specific job demands on well-being in the evening is sequentially mediated through momentary self-regulatory capacities and LTPA after work.

Day-Specific Job Control, Momentary Self-Determination, and Daily Physical Activity After Work

In contrast to job demands, research suggests that experiencing control at work is positively related to LTPA (Choi et al., 2010; Hellerstedt & Jeffery, 1997; Johansson et al., 1991). These findings are in line with Self-Determination Theory (SDT; Deci & Ryan, 1985),

which argues that a state of self-determination is beneficial for motivation and effective behaviour (e.g., at work) and that it is, furthermore, important for the execution of physical activity (Ryan & Deci, 2007; see Teixeira et al., 2012 for a meta-analysis). According to the basic need satisfaction approach as proposed by SDT, the satisfaction of basic psychological needs, for instance, the need for autonomy, is crucial to experience self-determination (Deci & Ryan, 2000). Need for autonomy might best be described as a basic desire to experience psychological ownership of one's own behavior (Van den Broeck et al., 2008). A satisfied need for autonomy poses a central pre-condition for motivated behaviour as it provides the foundation for self-actualization and to maintenance growth, integrity, and health (Deci & Ryan, 2000). On days with high job control, individuals can experience a satisfied need for autonomy, and thereby, develop increased feelings of vigour and dedication (i.e., high levels of engagement and feelings of pride; Deci et al., 1994; Gagné et al., 1997; Nix et al., 1999). By contrast, on days with low job control, individuals might feel a thwarting of their basic psychological needs, and thereby experience decreased levels of motivation and psychological functioning (Bartholomew et al., 2011). Importantly, previous studies emphasized that self-determination should not only be seen as being bound to a specific task but also as existing in a more generalized form (Sheldon et al., 1996). In line with this notion, Englert and Bertrams (2014) found that an autonomy-supportive environment during a transcription task led to increased performance in a subsequent sports task compared to executing the identical task in a controlling environment. Hence, we predict spill-over effects from daily work-related motivation (arising from increased need satisfaction due to high job control) to motivation for LTPA after work. Similar to job demands, we predict that the day-level relationship between job control and well-being is mediated by day-level LTPA:

H5: Day-specific job control is positively related to psychological well-being in the evening.

H6: Day-specific job control is positively related to LTPA after work.

H7: The positive effect of job control on well-being in the evening is mediated through LTPA after work.

H8: The positive effect of day-specific job control on well-being in the evening is sequentially mediated through momentary self-determination and LTPA after work.

Method

Participants

We recruited 207 employees (76 % female, mean age = 36.39 years, *SD* = 11.29, mean BMI = 24.51, *SD* = 5.17) via mailing lists of different local organizations and postings in local social media groups. Inclusion criteria were (i) ongoing employment of at least 50% of a full-time office job (i.e., at least 19.5 hours per week), (ii) not being a competitive athlete, and (iii) not exercising more than eight hours per week on a regular basis. The last two exclusion criteria were used to avoid outliers and ceiling effects in LTPA. All participants received €50 (approximately $61 US) for participation in the study. Of the 207 participants, 203 participants met the a-priori criteria for eligibility and were included in the main analyses. One participant was excluded as he completed less than 20% of the survey's questions (cf. McCabe et al., 2012) and three participants were identified as outliers with respect to LTPA data (> 3 *SD*s above average), hence, they violated our a-priori inclusion criteria (moreover, measurement errors are very likely to have occurred in these cases).

Participants mainly worked in public sector jobs (i.e., administrative jobs) characterized by sedentary activities (self-reported mean proportion of seated activities = 85.59%, *SD* = 10.87). Mean working hours per week was 36.37 (*SD* = 8.24) and mean job tenure was 6.3 years (*SD* = 7.45). Adherence to the daily diary protocol was very good, with participants completing more than 39 of the 42 possible daily diaries on average (93% adherence). The study was approved by the local ethics committee.

Procedure

The study procedure comprises a core ambulatory assessment phase and a pre-ambulatory assessment session.

Pre-Ambulatory Assessment Session

Prior to ambulatory assessment, participants received information about the aim of the study, the procedure, and gave written informed consent. Participants received accelerometers along with instructions on how to answer the daily surveys on their smartphones. At the pre-ambulatory assessment, participants completed a general survey, including age, gender, height, weight, and working hours per week. Height and weight were used to calculate Body Mass Index (BMI).[2]

Ambulatory Assessment

Participants wore an accelerometer for 14 consecutive days and completed three daily surveys on their smartphones: after waking up in the morning, immediately after finishing work, and before going to sleep in the evening. At each of the three daily assessments, we gauged participants' situational states of mood, fatigue, and subjective stress (see below). Immediately after work, we additionally measured day-specific job characteristics, as well as momentary self-regulatory capacities, and momentary need for autonomy satisfaction. All daily assessments were conducted via SoSci Survey (Leiner, 2016). SoSci Survey provides online tools for the creation and distribution of online surveys. Participants had to start the survey by using a time-specific link which they received at the pre-ambulatory assessment session.

[2] Some additional constructs were measured that are beyond the scope of this paper and were included mainly for educational purposes. At Level-2 burnout (Maslach Burnout Inventory; Büssing & Glaser, 1999), trait self-control (Self-Control Scale; Bertrams & Dickhäuser, 2009), implicit theories about willpower (Job et al., 2010), general job demands, job control, and social support (Copenhagen Psychosocial Questionnaire; Nübling et al., 2005), and information about commuting and physical activity routines were measured. At Level-1 subjective sleep quality (Pittsburgh Sleep Quality Index; Buysse et al., 1989) and self-reported sleep duration were measured.

Measures

Subjective Well-Being

We assessed situational states of subjective stress, fatigue, and emotional valence as indicators of subjective well-being at each time of the three daily surveys. All items assessed subjective well-being of the current situation (i.e., state subjective well-being). Subjective stress and fatigue were measured using visual analogue scales (Aitken, 1969) ranging from 0 to 100, with high values reflecting high levels of stress (i.e., "How stressed do you feel at the moment?") and high levels of fatigue (i.e., "How tired do you feel at the moment?"). Using single-item measures offers a concise and valid opportunity to measure well-being in daily diaries, thereby sustaining the likelihood of good compliance (van Hooff et al., 2007). To measure emotional valence, we used the valence subscale of the German short version of the multidimensional mood questionnaire (MDMQ; Wilhelm & Schoebi, 2007) with two bipolar items (sample item: "At this moment I feel: unwell - well") on a seven-point rating scale ranging from 0 to 6.[3] The MDMQ is a parsimonious and validated questionnaire to capture mood in ambulatory assessment studies (Wilhelm & Schoebi, 2007).

Day-Specific Job Characteristics

Within the daily afternoon survey, we assessed day-specific job demands and job control with items adapted from the German version of the Copenhagen Psychosocial Questionnaire (COPSOQ; Nübling et al., 2005). All items were adapted to refer to the day-level. We assessed day-specific job demands (sample item: "Did you have to work very fast today?") with four items. Day-specific job control was assessed with three items (sample item: "Did you have an influence on what you did at work today?"). Participants responded on five-point rating scales ranging from 0 (= never) to 4 (= always).

[3] Beyond that, we measured the other two subscales (i.e., energetic arousal and calmness) of the MDMQ (Wilhelm & Schoebi, 2007), each with two items. As entering these items into the model did not reveal an acceptable model fit, we proceeded without them.

Momentary Self-Regulatory Capacities

Within the daily afternoon survey, we assessed momentary self-regulatory capacities after work. We used five items from the German version of the situational self-control capacity scale (sample item: "I feel increasingly unable to focus on anything") developed by Bertrams et al. (2011) as used before by Rivkin et al. (2015). Participants were informed that all items related to their current self-control capacities. Items were answered on a seven-point Likert scale ranging from 1 (= not at all) to 7 (= very much). As all items measure the depletion of self-regulatory capacities, they were reverse coded before our analyses.

Momentary Need for Autonomy Satisfaction

Within the daily afternoon survey, we assessed momentary self-determination after work according to the basic psychological need satisfaction approach (Deci & Ryan, 2000).[4] We used a German translation of three adapted items of the basic need satisfaction scale (version "in general"; BNS-G; subscale autonomy; sample items: "I feel like I am free to make decisions for myself") developed by Deci and Ryan (2000). Participants were informed that all items would capture their current feelings of self-determination. Items were answered on a seven-point Likert scale ranging from 1 (= not at all true) to 7 (= very true).

Leisure-Time Physical Activity

We assessed LTPA with accelerometers (Actigraph wGT3X-BT) which constantly measured physical activity (sampling rate 30 Hz). Accelerometers were attached to the hip since this provides the most reliable measurement of physical activity (Rosenberger et al., 2013). Accelerometer data were processed with ActiLife 6.13.3 (ActiGraph LLC, 2012). LTPA was operationalized by calculating a measure for moderate-to-vigorous physical activity (MVPA), which refers to the amount of time (in minutes) a subject spends above a "moderate" cut

[4] We focused on need for autonomy as this represents the most basic desire in individuals to be the origin of one's own actions (Cerasoli et al., 2016; de Charms, 1968) and particularly draws from the notion of locus of causality (Van den Broeck et al., 2008).

point activity level (ActiGraph LLC, 2018a). We used a standard algorithm by Freedson et al. (1998) with 1,952 counts per minute or higher indicating MVPA. Counts result from the post-processing of raw acceleration data and can be used as an indicator of movement behaviour (ActiGraph LLC, 2018b). Considering the Choi wear time validation (Choi et al., 2011) and recommendations of Katapally and Muhajarine (2014), no data sets had to be excluded due to violations of wear time, indicating very good compliance with the protocol. To obtain a measure for LTPA after work, data were aggregated for the period after filling out the after-work survey and before answering the questions of the bedtime survey (i.e., physical activity data only referred to the period after work).

Factor Structure

We tested the factorial structure of our measures by using a set of multilevel confirmatory factor analyses (MCFAs) with two levels (daily observations nested in persons) in Mplus 8 (Muthén & Muthén, 1998-2017). To estimate the overall latent factor structure we included all predictors and all well-being variables in our models. As two of the three well-being variables were single-item measures (i.e., subjective stress and fatigue), we used the different times of measurement (after waking up, after work, and before bedtime) as latent variable indicators for these measures. Note that we only aggregated measures from different time points to examine the factorial structure of our measures. In the main analyses (see below), these measures were not averaged across time points.[5]

A seven-factor model including (i) job demands, (ii) job control, (iii) self-regulatory capacities, (iv) need for autonomy satisfaction, and the well-being indicators (v) emotional valence, (vi) subjective stress, and (vii) fatigue showed a good fit, $\chi^2 = 499.048$, $df = 223$, $p < .001$, root mean square error of approximation (RMSEA) = .028, scale correction factor (SCF) = 1.2478, comparative fit index (CFI) = .96, standardized root mean square residual

[5] We also conducted all MFCAs by using pseudo-latent factors based on the single-item measures as indicators of stress and fatigue (Brown, 2015). These analyses led to similar results.

$(SRMR)_{within}$ = .046. We tested several alternative models. A model with six-factors included (i) job characteristics (aggregated demands and control), (ii) self-regulatory capacities, (iii) need for autonomy satisfaction, as well as (iv) emotional valence, (v) stress, and (vi) fatigue, χ^2 = 1408.910, *df* = 230, *p* < .001, RMSEA = .056, SCF = 1.2849, CFI = .84, $SRMR_{within}$ = .067. An additional five-factor model that tested the distinctiveness of all well-being indicators included (i) demands, (ii) control, (iii) self-regulatory capacities, (iv) need for autonomy satisfaction, and (v) general well-being, χ^2 = 1268.686, *df* = 235, *p* < .001, RMSEA = .052, SCF = 1.2961, CFI = .86, $SRMR_{within}$ = .067. We finally also examined a one-factorial model (χ^2 = 4831.090, *df* = 255, *p* < .001, RMSEA = .106, SCF = 1.3303, CFI = .38, $SRMR_{within}$ = .117). Thus, the seven-factor model was superior to all alternative models, as evidenced by significant χ^2 -difference tests (all Satorra-Bentler $\Delta\chi^2$ > 465, *p* < .001*)*. We, therefore, concluded that the seven factors included in our final factorial model were sufficiently distinct to be used as separate constructs in our main analyses.

Analytic Approach

We conducted multilevel structural equation analyses with random intercepts to account for daily observations (Level 1) being nested in persons (Level 2) in Mplus 8 (Muthén & Muthén, 1998-2017). We specified one two-level model with days nested within persons including all predictor variables simultaneously on day-level (Level 1). All day-level predictor variables were person-mean centered. Since person-mean centering day-level variables remove between-person variation, the relationships can be interpreted more accurately within-person (Enders, 2013; Enders & Tofighi, 2007). We refrained from entering the averaged continuous Level-1 predictors as indicators for between-person effects since we were interested in the temporal dynamics of the proposed relationships (Bolger & Laurenceau, 2013). Hence, all analyses focus on the within-person level. Additionally, we entered subjective well-being in the morning as Level-1 covariates to control for daily baseline well-being states. In order to test the contingencies as proposed, we calculated a sequence of indirect

effects as described by Preacher et al. (2010). All hypotheses were tested at $p < .05$ (two-tailed). We report unstandardized coefficients.

Results

Means, standard deviations, internal consistencies (alpha), and zero-order correlations of the main study variables are shown in Table 2.1. A substantial amount of variance of the study variables was accounted for on the intra-individual level (Level 1). Specifically, intra-class correlations (ICCs) revealed that intra-individual variability accounted for 53% to 60% of variance in job characteristics, respectively. Similar results were found for LTPA (85%), momentary self-regulatory capacities (44%), and momentary need for autonomy satisfaction (46%), as well as for well-being variables (subjective stress, fatigue, and emotional valence), ranging from 57% to 76%. In sum, all ICCs suggest that a substantial portion of the total variance can be explained by within-person variations.

Hypotheses Tests

To test our hypotheses, we fitted a two-level structural equation model including day-specific job characteristics (Level 1), momentary self-regulatory capacities after work (Level 1), momentary need for autonomy satisfaction after work (Level 1), LTPA after work (Level 1) and all evening well-being variables (Level 1) in a simultaneous model. For all Level-1 well-being indicators, we included the respective morning well-being variables to control for baseline levels of well-being. Our overall model, including all day-level variables, had a good fit, $\chi^2 = 624.099$, $df = 224$, $p < .001$, RMSEA = .033, CFI = .95, $SRMR_{within} = .058$.

Table 2.1
Means, Standard Deviations, and Zero-order Correlations

Variable	M_{within}	SD_{within}	$M_{between}$	$SD_{between}$	1	2	3	4	5	6	7	9
1. Demands	2.17	0.86	2.16	0.63	(0.80)	-0.40**	-0.23**	-0.47**	-0.10**	0.10**	0.35**	-0.17*
2. Control	3.67	0.96	3.70	0.69	-0.24**	(0.77)	0.25**	0.30**	0.08*	-0.07*	-0.22**	0.12**
3. Regulatory Capacities	3.28	1.43	3.28	1.15	-0.25**	-0.12**	(0.91)	0.52**	0.01	-0.18**	-0.43**	0.44**
4. Autonomy Satisfaction	4.54	0.69	4.54	0.53	-0.40**	0.11**	0.46**	(0.80)	-0.03*	-0.14**	-0.50**	0.45**
5. LTPA	27.72	27.45	29.49	15.15	-0.08**	-0.03	0.04	0.01	-	-0.06*	-0.01	0.08**
6. Fatigue	65.87	23.77	63.67	15.63	0.05*	-0.03	-0.08**	-0.08**	0.01	-	0.10**	-0.31**
7. Stress	21.55	18.10	21.66	12.67	0.27**	-0.07**	-0.28**	-0.35**	-0.03	0.06**	-	-0.70**
8. Emotional Valence	4.69	0.98	4.65	0.65	-0.17**	0.09**	0.31**	0.31**	0.05**	-0.30**	-0.62**	(0.86)

Note. Within = estimates displayed on Level-1 (within-person), between = estimates displayed on Level-2 (between-person). LTPA = leisure-time physical activity after work (in minutes). All well-being variables relate to (state) well-being in the evening. Correlations below the diagonal are within-person correlations ($N_{Level\text{-}1}$ = 1690). Correlations above the diagonal are between-person correlations ($N_{Level\text{-}1}$ = 203). Internal consistency reliabilities (alpha) are displayed on the diagonal. Stress and fatigue were single item measures, therefore no internal consistency could be calculated. * = $p < .05$, **= $p < .01$.

Day-Specific Job Demands, Job Control, and Well-Being in the Evening

In Table 2.2, results are shown for the relationships between job demands (Level 1) and job control (Level 1) as predictors, and subjective stress, fatigue, and emotional valence as outcomes. We found a positive relationship between job demands (Level 1) and subjective stress in the evening (B = 8.23, SE = 3.44, p = .017) and a negative relationship between job demands (Level 1) and emotional valence in the evening (B = -0.33, SE = 0.15, p = .032), but not between job demands (Level 1) and fatigue in the evening (B = 0.55, SE = 3.01, p = .855). In other words, on days with high job demands employees showed higher levels of subjective stress and more negative emotional valence in the evening. Thus, Hypothesis 1 was partially supported by our data. Against Hypothesis 5, day-specific job control was not associated with subjective stress (B = -0.33, SE = 2.67, p = .902), fatigue (B = -0.14, SE = 2.37, p = .953), or with emotional valence (B = 0.13, SE = 0.12, p = .285) in the evening.

Day-Specific Job Demands, Job Control, and Daily LTPA

Analyses revealed that participants showed lower levels of daily LTPA after work on days with high job demands (B = -8.63, SE = 2.69, p = .001), supporting Hypothesis 2. Day-specific job control was not associated with daily after-work LTPA, B = -5.02, SE = 3.06, p =.101 (rejecting Hypothesis 6). All results for the relationship between demands, control, and LTPA are shown in Table 2.3.

Table 2.2

Unstandardized Coefficients from Multilevel SEM Predicting Evening Well-Being

	Criterion					
	Subjective Stress		Emotional Valence		Mental Fatigue	
Level-1 Predictors	Estimate (*S.E.*)	95 % CI	Estimate (*S.E.*)	95 % CI	Estimate (*S.E.*)	95 % CI
Job Demands	8.23 (3.44)*	[1.50, 14.97]	-0.33 (0.15)*	[-0.62, -0.03]	0.55 (3.01)	[-5.35, 6.45]
Job Control	-0.33 (2.67)	[-5.57, 4.91]	0.13 (0.12)	[-0.11, 0.37]	-0.14 (2.37)	[-4.79, 4.51]
LTPA	-0.06 (0.02)**	[-0.10, -0.02]	0.004 (0.001)***	[0.002, 0.006]	0.01 (0.03)	[-0.04, 0.07]
Morning Well-Being	0.05 (0.03)†	[0.01, 0.10]	0.12 (0.04)***	[0.05, 0.19]	0.10 (0.03)***	[0.04, 0.16]
Level-1 residual variance	205.76 (17.01)***	[172.41, 239.11]	0.46 (0.07)***	[0.32, 0.61]	284.83 (15.53)***	[254.38, 324.83]

Note. $N_{\text{Level-1}}$ = 1657, $N_{\text{Level-1}}$ = 203. All outcome well-being variables relate to (state) well-being before bedtime. The respective well-being variables in the morning were entered to the model to control for baseline well-being states. LTPA = leisure-time physical activity after work (in minutes). Two-tailed regression analyses; † = $p < .10$, * = $p < .05$, ** = $p < .01$, *** = $p < .001$.

Table 2.3
Unstandardized Coefficients from Multilevel SEM Predicting LTPA After Work

Level-1 Predictors	Estimate	*S.E.*	95 % CI
Job Demands	-8.63**	2.69	[-13.91, -3.36]
Job Control	-5.02	3.06	[-11.00, 0.97]
Self-Regulatory Capacities	0.25	0.78	[-1.29, 1.78]
Autonomy satisfaction	0.61	2.02	[-3.35, 3.94]
Level-1 residual variance	281.46***	29.40	[223.66, 339.26]

Note. $N_{\text{Level-1}}$ = 1657, $N_{\text{Level-2}}$ = 203. LTPA = leisure-time physical activity after work. Two-tailed regression analyses; ** = $p < .01$, *** = $p < .001$.

Daily LTPA and Well-Being in the Evening

As expected, we found a negative relationship between LTPA after work (Level 1) and subjective stress in the evening (B = -0.06, SE = 0.02, p = .006). Furthermore, LTPA after work was positively related to Level-1 emotional valence in the evening (B = 0.004, SE = 0.001, $p < .001$). Contrary to predictions, fatigue in the evening (Level 1) was unrelated to after-work LTPA, B = 0.01, SE = 0.03, p = .608. Table 2.2 shows the results for the outcomes subjective stress, fatigue, and emotional valence.

Mediation Analyses

Finally, we tested for the proposed mediating effects (Figure 2.1 depicts the full conceptual model). We expected that LTPA after work partially mediates the relationship between day-specific job demands and well-being in the evening (Hypothesis 3). Moreover, we predicted that the relationship between day-specific job demands and LTPA after work is driven by decreased momentary self-regulatory capacities after work. This should manifest in a two-step serial mediation as described in Hypothesis 3. As we did not find the predicted effects of job control (Level 1) on LTPA after work (Level 1), we refrained from testing mediation analyses with these variables but tested the mediations for job demands only. As can be seen in Figure 2.2, analyses revealed that the relationship between day-specific job demands and subjective stress in the evening (*indirect effect* = 0.498, p = .038, CI_{95} [0.027, 0.968]) as well

as emotional valence in the evening (*indirect effect* = -0.032, *p* = .032, CI_{95} [-0.062, -0.003]) was mediated by daily LTPA after work. No significant indirect effect was found for fatigue in the evening (*indirect effect* = -0.131, *p*= .614, CI_{95} [-0.642, 0.379]). Hence, Hypothesis 3 was supported for two out of three well-being indicators. However, we found no support for Hypothesis 4, suggesting that the relationship between job demands (Level 1) and subjective stress (*indirect effect* = 0.013, *p* = .751, CI_{95} [-0.065, 0.090]), emotional valence (*indirect effect* = -0.001, *p* = .755, CI_{95} [-0.006, 0.004]), and fatigue (*indirect effect* = -0.003, *p* = .782, CI_{95} [-0.027, 0.020]) was mediated through momentary self-regulatory capacities (Level 1) and LTPA (Level 1). This might be mainly due to the missing link between after-work self-regulatory capacities and LTPA (*B* = 0.25, *SE* = 0.78, *p* = .751), as we found a negative relationship between job demands and self-regulatory capacities after work (*B* = -0.88, *SE* = 0.13, *p* < .001). In conclusion, our results reveal that high day-specific job demands at work decrease LTPA after work and this, in turn, leads to impaired well-being in the evening.

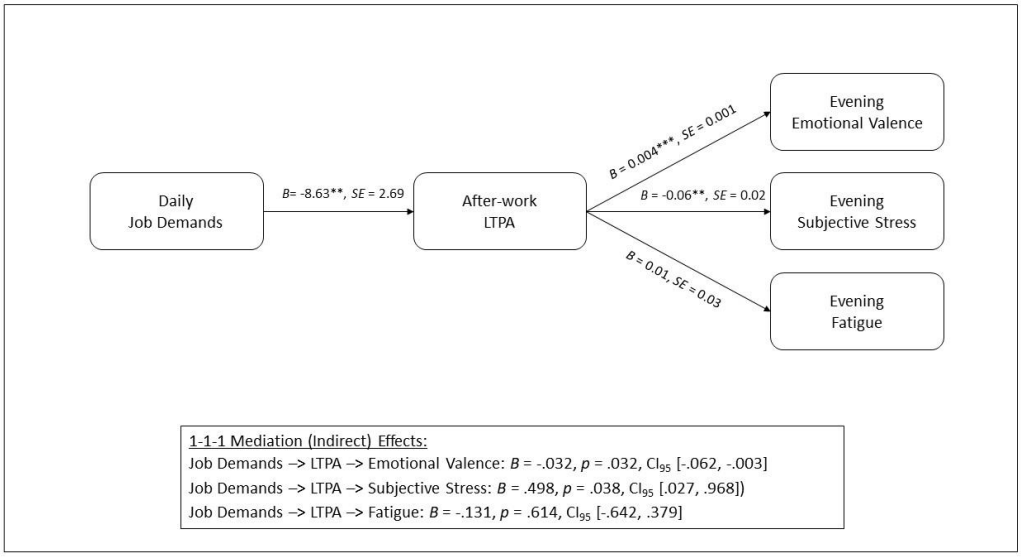

Figure 2.2 Level-1 mediations of leisure-time physical activity (LTPA) for the relationships of daily job demands and well-being. Unstandardized estimates are reported. * = *p* < .05, ** = *p* < .01.

Discussion

It is common sense that taking a walk or a jog after work improves health and psychological well-being. But what is it that determines whether we engage in physical activity after work? In this paper, we argue that job demands and job control affect LTPA after work which, in turn, improves psychological well-being in the evening. To test this idea, we conducted a 14-day ambulatory assessment study using accelerometry as an objective measure of LTPA.

The key assumption of our study was that the effects of day-specific job characteristics on psychological well-being in the evening are mediated by LTPA after work. Furthermore, we predicted that momentary self-regulatory capacities and momentary self-determination after work are the underlying psychological mechanisms of the relationship between day-specific job characteristics and LTPA after work.

In a two-week ambulatory assessment study using accelerometry, the proposed relationship between job characteristics and LTPA was found for day-specific job demands and LTPA after work. By contrast, LTPA after work was not predicted by day-specific job control. Furthermore, we found that LTPA after work mediated the relationship between day-specific job demands and well-being (i.e., stress and mood) in the evening. To summarize, our results show that on days with high job demands, employees are less likely to engage in physical activity, and in turn, report impaired well-being.

Theoretical Implications

Our study provides insights into the highly dynamic interplay between job characteristics, LTPA, and well-being. Specifically, it advances research on the effects of day-specific job demands and job control on daily well-being by delineating some of the underlying mechanisms linking job characteristics to well-being. Although hundreds of studies have confirmed

that job demands and job control affect well-being (cf. Häusser et al., 2010), little is known about the pathways through which demands and control unfold their effects.

As predicted, day-specific job demands were negatively related to LTPA after work on that specific day. Hence, our study reveals that the negative effects of high job demands at work on well-being can be partially explained by LTPA as a health-related off-job behaviour.

However, we did not find a mediating effect of self-reported self-regulatory capacities. One reason why the proposed relationship was not found might be that other factors are more important to explain these relationships. For example, job demands might trigger after-work cognitive processes such as affective ruminative thinking, thereby leading to a lack of detachment from work (Cropley & Millward Purvis, 2003). This, in turn, may predict decreased physical activity (or other active recovery) during leisure time. This idea is in line with a study by Keune et al. (2012) who showed that ruminative thinking is positively related to behavioural inhibition, and, thereby, negatively affects human motivation. Consequently, the emotional-cognitive spill-over from working time into leisure time and a lack of detachment from work (see Sonnentag & Bayer, 2005) might account for the negative effects of job demands on LTPA, in addition to the self-regulatory processes that we predicted and examined. Testing this idea is a promising avenue for future research.

With respect to job control, we hypothesized that day-specific job control is positively related to LTPA after work, and that this effect is mediated by increased feelings of self-determination. Contrary to our predictions, we found no relationship between job control and LTPA. One post-hoc explanation could be that job control is a diverse construct, consisting of different facets and consequences (e.g., Schmidt & Diestel, 2011; Sundin et al., 2008). In particular, it might be worthwhile to study different types of job control or alternative psychological mechanisms potentially linking job control to physical activity. For example, control over *when* to work (scheduling control) might have different effects on LTPA than control over *how* to work (decision latitude).

Practical Implications

Our findings have practical implications for the prevention of negative influences of job demands on well-being. In particular, they point to the importance of LTPA as an underlying behavioural mechanism for the relationship between job characteristics and well-being. Motivating employees to be physically active after work offers opportunities for organizations to alleviate the negative impact of work on employee well-being. However, it should be carefully considered how wellness programs that address exercising activities during non-work times (e.g., offering membership discounts at local gyms or health classes, initiating exercising group activities, like running groups) can be designed effectively. Although many organizations have started to acknowledge the positive effects of physical activity (Stoltzfus, 2006), past research point to the limited effectiveness of many worksite physical activity interventions (e.g., Abraham & Graham-Rowe, 2009; Dishman et al., 1998; Marshall, 2004). Somewhat ironically, our results suggest that employees who are at risk of suffering from high job demands at work might be less willing to take part in such programs, even though they could benefit most from them. Hence, tailoring physical activity interventions to meet the needs of employees who are most in need of such programs is important in order to make these programs more effective.

Limitations

Our results should be considered in light of some limitations. First, due to the correlational nature of our study, we cannot completely rule out the possibility of reversed causation (Da Silva et al., 2012) and the effects of variables confounded with job demands and job control. However, as we used data with lagged time points (with measurement of predictors preceding measurement of outcomes), we have good reasons to assume that our findings reflect causal pathways as described in our model.

Second, even though we used a more objective measure of LTPA (as compared to self-report measures), we still had to rely on self-report data for the measurement of job characteristics, momentary self-regulatory capacities, momentary need for autonomy satisfaction, and psychological well-being. As a result, we cannot fully eliminate common-method bias (Podsakoff et al., 2012). Therefore, we recommend that future studies use additional objective outcome measures, such as cortisol levels, as a biomarker of stress.

Finally, we are aware that our decision to exclude individuals from our sample who exercised very intensely reduces the generalizability of our findings to some degree. However, we deem this exclusion to be reasonable for two reasons. One reason is that it is particularly the difference between no (or very little) and moderate physical activity that produces strong effects on health and well-being (Moore et al., 2012). In other words, LTPA is most important for occasionally active individuals. The second reason is that the day-level relationships between work and LTPA for intensely exercising individuals might be somewhat different as compared to occasionally physically active individuals. To illustrate if an individual has a tight routine to exercise every Tuesday and Thursday in his or her sports club, day-level job characteristics on these days might play a minor role (as the routine or obligation to go is the crucial factor).

Conclusion

We found first-time evidence for the hypothesis that the effects of day-specific job demands on psychological well-being in the evening are mediated by LTPA after work. In conclusion, our results show that considering LTPA in occupational health psychology is a fruiful endeavor.

Chapter 3

Development and Critical Evaluation of a Workplace Simulation to Test for Effects of Work on Physical Activity[6]

Previous theorizing by Häusser and Mojzisch (2017) and some empirical studies (e.g., Burton & Turrell, 2000; Kirk & Rhodes, 2012; Mutz et al., 2020; Ng & Jeffery, 2003; Payne et al., 2002; Sonnentag & Jelden, 2009) suggest that job characteristics have an impact on physical activity after work. However, most of the previous research that analyzed the relationships between job characteristics, such as job demands, and physical activity, has primarily focused on correlational data stemming from cross-sectional designs (e.g., Burton & Turrell, 2000; Kirk & Rhodes, 2012; Mutz et al., 2020; Ng & Jeffery, 2003) while even fewer studies applied longitudinal designs (Payne et al., 2002; Sonnentag & Jelden, 2009). Therefore, past research contains the risk of low internal validity due to the possibility of reversed causation and influences of confounding variables (cf. Zapf et al., 1996). For instance, there might be the risk of reversed effects as physical activity might alter perceptions of job demands. Physical activity might increase positive affectivity which in turn is related to positive attitudes towards job conditions (Heller et al., 2002; Mazzetti et al., 2016). Furthermore, physical activity may also improve psychological resilience that in turn positively affects job attitudes (Cohn et al., 2009). Apart from that, confounding variables that can lead to false conclusions with regards to the relationships between job demands and physical activity off-work may be self-efficacy as it can affect perceptions of job demands (Pajares et al., 2000; Skaalvik, 1997) and physical activity (e.g., McAuley et al., 2000) simultaneously and therefore lead to spurious relationships between these variables (MacKinnon et al., 2000).

[6] This study was conducted together with A. Mojzisch & J. A. Häusser.

To rule out the possibility of alternative explanations for the effects of job characteristics on physical activity off-work, we developed an experimental workplace simulation that can be used to test the relationships under more controlled conditions. With this pilot study, we sought to test the work simulation for its feasibility and effectiveness. An effective workplace simulation can help to further develop theorizing on the relationships between work and well-being as experimental studies are the only way to come to valid conclusions regarding causal relationships between two variables (Mitchell, 2012). Hence, experimental studies are crucial as a supplement to previous correlational field studies (e.g., Burton & Turrell, 2000; Kirk & Rhodes, 2012; Ng & Jeffery, 2003; Popham & Mitchell, 2007; Sonnentag & Jelden, 2009). We took an already existing call center simulation by Wegge et al. (2007) and adapted it with regard to decreasing the resources that have to be invested (e.g., monetary resources) while sustaining high power (cf. Lakens, 2014). Our workplace simulation can be conducted by only one experimenter as all customer interactions are based on pre-recorded voice mail requests that should evoke impulse control requirements when recording the answer to the requests. Furthermore, we developed a physical activity measure that should be sufficiently high in ecological validity but also reliable in measuring physical activity off-work in a laboratory environment.

Research Questions

In a nutshell, the central concern of this study was to develop an experimental workplace simulation, and to test whether it is an effective tool to manipulate perceptions of job demands (*Research Question #1*). Furthermore, we wanted to develop a physical activity task that is able to measure off-work physical activity and to check its feasibility within a lab experiment (*Research Question #2*). In a more explorative manner, we also tested whether experimentally manipulated job demands affect physical activity off-work (*Research Question #3*).

Method

Participants

The study sample consisted of 98 (64 female, 34 male) undergraduate students (12 psychology students, 86 other students). The age of participants ranged from 18 to 36 years (M_{age} = 24.06, *SD* = 3.16). Mean Body-mass index (BMI) was 22.65 (*SD* = 3.57). Exclusion criteria for all participants were i) being a competitive athlete, ii) more than eight hours of physical exercise per week, and iii) physical constraints that impair moderate-to-vigorous physical activity on a bicycle ergometer. As a reward, participants received 12€ or course credit.

Design and Procedure

Participants were randomly assigned to the experimental conditions of a one-factorial (demands: high vs. low) between-subjects design. Gender was stratified. Analyses for homogeneity of demographic characteristics (i.e., gender, age, and BMI) across the different conditions showed no significant differences (all *p*s > .30), suggesting that stratified randomization was effective.

Participants were told that the purpose of the study was to develop a call-center training for future call-center agents and that it consisted of two parts: the main-work phase and an after-work phase. Two rooms were set up prior to the arrival of participants. Room 1 was prepared as a call-center workplace where participants had to carry out the workplace simulation. Room 2 was prepared as a break room with a bicycle ergometer and a table with a range of magazines (e.g., film magazines, boulevard magazines). This was to offer an appealing low-effort alternative activity. As a crucial feature of self-control is to withstand temptations by redirecting desires (Hofmann et al., 2012), the availability of an attractive low-effort activity should increase the self-regulatory effort needed to maintain physical activity. Participants started in room one where they completed the workplace simulation. They were asked to consider themselves as a service employee in a call-center of the company ‘PHONIAK’. Before

the start of the work simulation, they were required to indicate their sociodemographic details and other baseline measures were collected[7]. After completion of the workplace simulation, participants were escorted to Room 2 to do a physical activity task on the bicycle ergometer. The experimenter left the room for the physical activity task. Participants could freely choose how long they wanted to ride the bicycle ergometer. After finishing the physical activity task, they had the opportunity to choose a magazine and to read it in a convenient sedentary position. After 10 minutes, the experimenter returned to end the experimental session. The experimental procedure was approved by the local ethics committee.

Development of a Work Simulation

We implemented a work simulation that consisted of simulated call-center interactions in SoSci Survey (Leiner, 2016). During the work simulation, participants had to answer different mailbox messages, which were related to smartphones. They had to answer ten pre-recorded customer inquiries by recording their response as a mailbox message. Customers had three different types of requests: information requests, complaints regarding a product, or product orders. To answer the requests, all participants were provided with a manual containing all the information needed to answer the inquiries. Participants had no time constraints but were told to work as quickly as possible since a lot of customers were in the waiting line. The customer inquiries were based on Wegge et al.'s (2007) analysis of customer-induced stress in call center work.

Experimental Task Demands Manipulation

Task demands were manipulated with regard to friendliness of the customers. Participants in the high demands condition were confronted with unfriendly customers, while participants in the low demands condition were confronted with friendly customers. We evaluated

[7] Some additional measures were assesssed that are beyond the scope of this research. We also captured dispositional self-control (SCS-K-D; Bertrams & Dickhäuser, 2009), implicit theories about willpower (Job et al., 2010), momentary self-control (Bertrams et al., 2011), mood (PANAS; Krohne et al., 1996), subjective stress, and mental fatigue (Visual Analogue Scales; Aitken, 1969).

the customer inquiries in advance in terms of friendliness and valence (the pre-test is described in more detail in Chapter 4). Furthermore, participants in the high demands condition were instructed to be very friendly throughout the complete task and "serve with a smile".

Measures

Physical Activity After Work

To measure physical activity after work we developed a physical activity task that should be sensitive to detect effects of job characteristics on physical activity engagement after work. Therefore, we captured time spent on a bicycle ergometer in seconds. Participants were seated on a bicycle ergometer (Christopeit® Blue T1) and received the instruction to ride the bicycle ergometer for as long as they wanted. Participants were asked to choose a resistance level and could freely decide on how long they wanted to engage physically, but the maximum time was 10 minutes.

Perceived Job Demands

To check whether the manipulation of task demands was successful, we used two items (sample item: "I had to force myself to be friendly while talking to the customers") on a seven-point Likert scale ranging from 1 (= not at all) to 7 (= very much). The item scores of the two items were aggregated to form an overall measure (r = .68). Additionally, we used an adapted version of the self-control demands measure (subscale impulse control demands) developed by Schmidt and Neubach (2007) consisting of six items (sample item: "The task requires that I never lose my temper") that were answered on a five-point Likert scale ranging from 1 (= not at all) to 5 (= a great deal). Internal consistency (alpha) for the self-control demands scale was .90.

Demographics

Age, gender, self-reported BMI, and field of study were captured in advance to the experimental procedure.

Results

To analyze the effectiveness of the workplace simulation we calculated independent samples *t*-tests to test for differences between the experimental conditions (high vs. low demands) with regards to perceived task demands and impulse control demands. Next, we used an independent samples *t*-test to analyze differences in time spent on the bicycle ergometer between the two experimental conditions. This aimed to test, for the first time, whether the developed operationalization of physical activity after work is sensitive to detect effects of job characteristics. Means and standard deviations are displayed in Table 3.1.

Table 3.1
Means, Standard Deviations, and Zero-order Correlations for Study 1

Variable	*M*	*SD*	1	2	3	4	5	6
Study variables								
(1) Demands Manipulation [a]	–	–	–					
(2) Perceived Demands	3.11	1.9	.88***	–				
(3) Impulse Control Demands	3.79	1.00	.25*	.26*				
(4) Physical Activity [b]	260.61	150.04	.13	.03	.05			
Controls								
(5) BMI	22.74	2.60	-.14	-.01	.11	-.24*	–	
(6) Age	24.26	3.48	.19	.16	.02	-.06	.19	
(7) Gender [c]	–	–	.09	.08	.09	.16	-.18	-.28**

Note. $N = 98$. [a] 1 = low Demands and 2 = high Demands. [b] Physical activity indicates time spent on the bicycle ergometer (in seconds). [c] 1= male and 2 = female. *** = $p < .001$, ** = $p < .01$, * = $p < .05$.

Effects of the Demands Manipulation on Perceptions of Job Demands

An independent samples *t*-test with experimental conditions (high vs. low demands) as the independent variable and participants' perceptions of demands as the dependent variable revealed a significant effect of task demands on perceptions of demands, $t(76.17) = 18.55$, $p < .001$, $d = 3.75$, indicating that participants in the high demands condition perceived the demands to be higher ($M = 4.86$, $SD = 1.14$) than participants in the low demands condition

(M = 1.38, SD = 0.65). Similarly, a second independent samples t-test with impulse control demands as the dependent variable revealed a significant effect of task demands on impulse control demands, $t(96) = 2.51$, $p = .014$, $d = 0.51$. Participants in the high demands conditions (M = 4.03, SD = 0.92) perceived impulse control demands to be higher compared to participants in the low demands condition (M = 3.54, SD = 4.03).

Effects of the Experimental Manipulation on Physical Activity After Work

Furthermore, to test whether the manipulation was able to impact physical activity after work, we performed a third independent samples t-test. This analysis revealed that the physical activity of individuals in the high demands condition (M = 273.59 seconds, SD = 144.26) was not significantly different than the physical activity of individuals in the low demands condition (M = 236.16 seconds, SD = 145.10), $t(96) = 1.27$, $p = .206$, $d = 0.26$.

Discussion

With this pilot study we wanted to develop and test the effectiveness of a workplace simulation with an experimental manipulation of job demands. The workplace simulation was built to manipulate job characteristics such as job demands in an economical but effective way. It is based on various different mailbox messages that were recorded in advance, with participants being required to react to the voicemails by also recording their answers.

Results show that the experimental manipulation was able to affect perceptions of job demands as participants in the high demands condition perceived the service requests as more unfriendly and demanding and had to control their impulses more strongly than participants in the low demands condition. However, the experimental manipulation had no influence on the physical activity task.

Potential Problems with Operationalisations and Approaches to Solve Them

There might be different reasons as to why the workplace simulation did not impact physical activity although previous cross-sectional studies found relationships between job

demands and physical activity (e.g., Burton & Turrell, 2000; Kirk & Rhodes, 2012; Mutz et al., 2020; Ng & Jeffery, 2003; Payne et al., 2002) and it was able to affect perceptions of job demands. First of all, it is possible that relationships found in earlier correlational studies are mostly due to reversed causation as physical activity might rather alter perceptions of job demands than vice versa (Tomaka et al., 1997). Consequently, the relationships found in earlier studies might be not replicable under highly controlled experimental conditions. However, it is also possible that the operationalization of physical activity was not sensitive enough to detect meaningful effects. The basic idea of the development of a laboratory physical activity task was to create a task that requires self-control without being too physically exhausting. Participants were asked to adjust the workload on the bicycle ergometer through choosing a threshold (i.e., resistance level). However, we did not determine a minimum resistance level which might have led to the fact that self-control requirements of the task were rather low. Hence, the physical activity task might have not reflected actual levels of self-control that are needed when engaging in physical activity outside a lab (cf. Wills et al., 2007). Consequently, the physical activity task seems promising but some important adaptions should be taken in advance to applying it in future studies as a tool to measure physical activity outside of work. Most importantly, it should be re-evaluated with regards to self-control demands to increase its validity in terms of measuring physical activity off-work. Therefore, it seems crucial to find a way to determine an individual resistance level that requires participants to invest self-control without physically exhausting participants too soon (cf. Baumeister et al., 1998).

Conclusions

Overall, it can be concluded that the workplace simulation seems promising to test for effects of job characteristics on physical activity off-work under highly controlled conditions thereby helping to pursue further knowledge with regard to the causal relationships between these variables. The workplace simulation was able to affect perceptions of job demands.

However, this study also implies that some adaptions should be taken in advance to applying similar designs for hypotheses testing. Most importantly, the physical activity task should be adapted in terms of self-control demands to get a more valid measure of physical activity off-work in future lab studies.

Chapter 4

Experimental Evidence for the Effects of Job Characteristics on Physical Activity After Work[8]

Suppose you had a hard day at work. You had to handle many rude customer complaints over the phone, having to stay polite all day long. Moreover, you had to complete many complex tasks in a timely manner. Finally, the work day is over. Would you prefer riding home 10 miles with your bicycle or would you rather take your car?

The benefits of physical activity after work for employees' health and well-being have been well-established. For instance, physical activity has repeatedly been found to alleviate the negative effects of work on feelings of strain as it reduces negative affective states, feelings of stress, and emotional exhaustion (e.g., Hamer, 2012; Hogan et al., 2015; Janurek et al., 2018; Nägel et al., 2015; Reed & Ones, 2006; Sonnentag, 2001; Taylor et al., 2007), and promotes active recovery from work (Sonnentag, 2018). Moreover, it has positive effects for physical health as it decreases the risk of more than 25 different chronic illnesses and premature mortality (for a review, see Warburton & Bredin, 2017). For this reason, the World Health Organization (WHO, 2016) recommends engaging in moderate-to-vigorous physical activities (MVPA), including activities like exercising, cycling, and brisk walking, at least five times per week, for a minimum of 30 minutes each day (Haskell et al., 2007; WHO, 2010).

[8] This chapter was published as Abdel Hadi, S., Mojzisch, A., Parker, S. L., & Häusser, J. A. (2020). Experimental evidence for the effects of job demands and job control on physical activity after work. *Journal of Experimental Psychology: Applied.* Advance online publication. http://dx.doi.org/10.1037/xap0000333

However, even if people are aware of the positive effects of physical activity, they often fail to meet minimum recommendations for this activity (Guthold et al., 2018). For example, Troiano et al. (2008) found that less than 5% of the 6,329 adult participants in their study met recommended levels for physical activity. Hence, identifying factors that serve as barriers to and promoters of physical activity is a fruitful avenue to prevent employees from negative consequences of physical inactivity, like impaired well-being and chronic distress.

Despite the importance of stable inter-individual differences (e.g., self-concept; Babic et al., 2014) and social factors (e.g., environmental health climate; Niermann et al., 2014; Sonnentag & Pundt, 2016) as predictors of physical activity, recent theorizing suggests specific job characteristics as important contributors of physical activity after work (e.g., Häusser & Mojzisch, 2017; Sonnentag, 2018). According to the physical activity-mediated Demand–Control (pamDC) model, introduced by Häusser and Mojzisch (2017), the assumptions of many job strain models like the Job Demands-Resources model (Demerouti et al., 2001) and the Job Demands-Control (JDC) model (Karasek, 1979, Karasek & Theorell, 1990) also can be applied to predict physical activity.

Guided by the pamDC model, we draw on the JDC model more specifically, in order to understand how job characteristics can influence physical activity after work. The basic rationale of the JDC model is that job demands and job control are the two crucial job dimensions that explain work-related strain (i.e., fatigue, anxiety, depression, and physical illness). Job demands refer to cognitive (e.g., time pressure) and emotional (e.g., unfriendly customers) demands encountered at work (Karasek & Theorell, 1990), whereas job control refers to the autonomy to make decisions at work (Ganster & Fusilier, 1989). One of the central positions of the JDC model is that the most detrimental effects on health and well-being occur when job demands are high and job control is low (i.e., high-strain jobs; Karasek & Theorell, 1990).

In line with the pamDC model (Häusser & Mojzisch, 2017), we propose that job demands and job control are related to physical activity after work as well. Specifically, we predict that high demands at work hamper the extent of physical activity after work. Furthermore, we predict that job control positively affects physical activity after work. Regarding the psychological processes, we propose that i) the negative effects of job demands on physical activity are mediated through self-regulatory capacities, while ii) the positive effects of job control on physical activity are mediated through self-determination. Figure 4.1 illustrates our conceptual model.

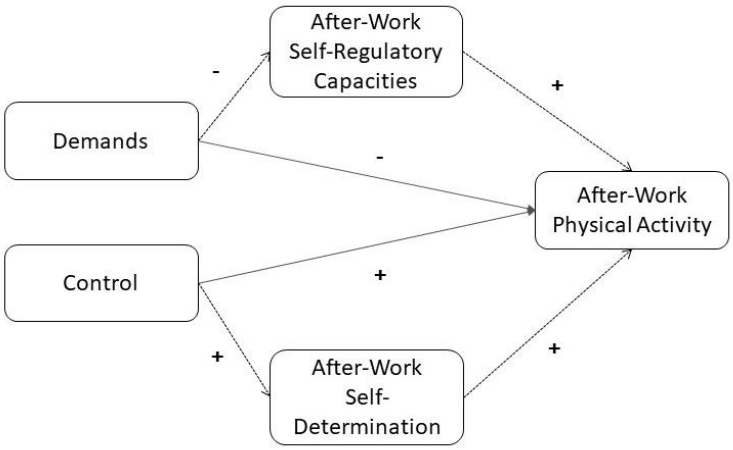

Figure 4.1 Conceptual model of our research.

Building on the pamDC model (Häusser & Mojzisch, 2017), the present studies provide first-time experimental tests of the proposed causal effects and underlying psychological pathways linking job demands and job control to physical activity after work. By doing so, we contribute to the understanding of how job characteristics affect off-job

health behavior. Moreover, we contribute to a better understanding with regard to the psychological mechanisms underlying the effects of job demands and job control on physical activity.

To test our assumptions, we conducted two experimental studies. First, participants completed a workplace simulation with manipulations of job demands (Study 1 and 2) and job control (Study 2). The workplace simulation consisted of customer inquiries and cognitive calculation tasks. To manipulate job demands, participants in the high demands condition were confronted with unfriendly customer requests, while participants in the low demands condition were confronted with friendly customer requests. Also, participants in the high demands condition had to perform a difficult arithmetic task, while participants in the low demands condition had to perform an easy arithmetic task. Job control was manipulated by providing participants with opportunities to make their own choices and framing task instructions in terms of autonomy and discretion over the task. After the workplace simulation, participants engaged in a physical activity task (bicycle ergometer). Our main dependent variable was time spent on the bicycle ergometer.

In the next section we present the theoretical rationale for our approach.

Job Demands, Self-Regulatory Capacities, and Physical Activity After Work

Several cross-sectional field studies have already found that high job demands are not only negatively related to well-being, as proposed by the JDC model (Karasek, 1979), but also negatively affect physical activity after work (e.g., Burton & Turrell, 2000; Kirk & Rhodes, 2012; Mutz et al., 2020; Ng & Jeffery, 2003; Payne et al., 2002; Popham & Mitchell, 2007). Following the pamDC model (Häusser & Mojzisch, 2017), we propose that this relationship is driven by self-regulation. Self-regulation in general describes the control of internal or external, mental or physical, undesired behaviors and impulses (Carver & Scheier, 2004). High job demands, such as working under time pressure (e.g.,

meeting a tight deadline) or having to suppress emotions (e.g., dealing with unfriendly customers), are assumed to drain self-regulatory capacities (e.g., Prem et al., 2016; Schmidt & Neubach, 2007). Although there is a lively and ongoing debate on the exact self-regulatory processes (cf. Friese et al., 2019), most influential theoretical accounts (e.g., strength model of self-control by Baumeister et al., 1998; "Central Governor" framework by Evans et al., 2016; process-model of ego-depletion by Inzlicht & Schmeichel, 2012) are in agreement regarding the notion that engaging in self-control at Time 1 (e.g., spending self-control to curb negative emotions during customer interactions at work) reduces the likelihood of successful self-control at Time 2 (e.g., engaging in physical exercising after work).

Self-regulatory capacities are crucial for most types of physical activity, since volitional self-regulatory control is typically required to initiate and execute these types of behaviors (Anderson et al., 2006; French et al., 2012; Rouse et al., 2013; Stadler et al., 2009). Hence, with regards to the effects of job demands on physical activity, we predict a (at least partial) mediation through reduced self-regulatory capacities. This assumption is preliminary supported by a field study by Sonnentag and Jelden (2009) who found a negative relationship between daily stressors, that is, dealing with situational constraints at work, and self-reported physical activity in police employees. Furthermore, they found that this relationship is mediated through individuals' current levels of energy (i.e., self-reported vigor).

In conclusion, we expect a negative direct effect of job demands on physical activity after work (*Hypothesis 1*). Furthermore, we predict a negative indirect effect of job demands on physical activity after work through reduced self-regulatory capacities. In other words, high demands are expected to decrease self-regulatory capacities, which, in turn, are positively related to physical activity (*Hypothesis 2*).

Job Control, Self-Determination, and Physical Activity After Work

Previous cross-sectional field studies suggest a positive effect of job control on physical activity (Bennett et al., 2006; Choi et al., 2010; Fransson et al., 2012; Hellerstedt & Jeffery, 1997; Johansson et al., 1991; Kouvonen et al., 2005; Tsutsumi et al., 2003). So far, however, no study has examined the causal effects of job control on physical activity after work, using an experimental approach. Hence, the relationships found in earlier research might be – in part – due to reversed or reciprocal causation. Furthermore, it is far from clear which mechanisms explain this relationship. In line with the pamDC model (Häusser & Mojzisch, 2017), we propose that job control is linked to physical activity after work via self-determination. Self-Determination Theory (SDT; Deci & Ryan, 1985, 2002) provides a framework for understanding how feelings of autonomy are connected to human motivation. When people are more autonomously motivated, it takes less effort to perform the same behavior compared to when they perform it due to a controlled motivation. According to the basic need satisfaction approach proposed by SDT, satisfying the psychological need for autonomy is connected to high levels of autonomously (i.e., intrinsically) motivated behavior. Low basic need satisfaction (or need thwarting), in contrast, leads to the emergence of more externally regulated forms of motivation. The latter are accompanied by a higher sense of pressure resulting in less enactment and persistence (Gagné & Deci, 2005). Consequently, satisfying the need for autonomy is crucial for motivated behavior, as it provides the necessary preconditions for intrinsic sources of motivation to develop (Deci & Ryan, 2000), as well as feelings of vigor and dedication (Parker et al., 2010).

In a similar vein, self-determination has been shown to be crucial for the initiation and execution of physical activity (Hagger & Chatzisarantis, 2007). For instance, Ryan and Deci (2007) found that high levels of self-determination in students was related to higher performance in physical exercise during physical education. Sheldon et al. (1996) argue

that feelings of self-determination are not only bound to a specific task but also exist in a more generalized form. This notion is supported by a study by Englert and Bertrams (2014) who found that an autonomy-supportive environment during a self-control demanding transcription task increased performance in a subsequent sports task compared to executing the identical task in a controlling environment. Hence, we propose a positive spillover effect of job control (i.e., high autonomy at work) into off-work behavior through self-determination, since high control at work satisfies the need for autonomy by offering possibilities to choose and decide freely during work progress (cf. Van den Broeck et al., 2008).

In conclusion, building on the pamDC model (Häusser & Mojzisch, 2017) and on empirical findings from field studies, we predict a positive direct effect of job control on physical activity after work (*Hypothesis 3*). Furthermore, we hypothesize that the positive effect of job control on physical activity after work is mediated through self-determination: Job control is assumed to be positively related to self-determination which, in turn, positively affects physical activity (*Hypothesis 4*).

Interplay of Job Demands and Job Control on Physical Activity After Work

Within the JDC model an important distinction between additive main effects of job demands and job control on well-being (the strain hypothesis) versus an interactive effect of job demands and control has been put forward (the buffer hypothesis; Ganster, 1989; see Häusser et al., 2010, and Hockey & Earle, 2006 for a discussion). Even if we consider that additive effects are the most plausible, it is also possible that job control might buffer the negative effects of job demands on physical activity (Häusser & Mojzisch, 2017). This assumption builds on the idea that job control offers the possibility to deal with high job demands by providing opportunities that help to sustain energy and well-being (especially, if job control matches the specific type of job demands; Häusser et al., 2010). To the best of our knowledge, so far, no study has tested the interactive effects

of job demands and job control on physical activity after work. However, past research has found an interaction of the proposed underlying mechanisms (i.e., self-regulation and self-determination; Muraven et al., 2008; Parker et al., 2017). That is, exerting self-regulation under conditions of high self-determination (autonomous motivation) does not reduce momentary self-regulatory capacities to the same extent as when working under conditions of low self-determination. Consequently, physical activity may be reduced to a lesser extent.

Although the main objective of our studies was to provide a first-time test of the causal effects of job demands and job control (and the proposed psychological pathways) using experimental work simulations, the design of Study 2 also allows the interactive effect of job demands and job control on physical activity after work to be tested. Hence, we propose an interaction of job demands and job control: High job control is assumed to buffer the negative effects of job demands on physical activity after work (*Hypothesis 5*).

The Present Research

The aim of the present research was to provide an experimental test of the effects of job characteristics (i.e., job demands and job control) on physical activity in a controlled workplace simulation. In our studies, we aimed at achieving high external validity while maintaining careful experimental control. We conducted two laboratory experiments in which participants worked on a call-center workplace simulation in the first part, followed by a second part, including a physical activity task (bicycle ergometer). Using this study design provides first time evidence regarding the causality of the proposed psychological pathways linking job characteristics with physical activity after work. Previous studies that tested the relationships of job characteristics and physical activity were correlational field studies that mostly analyzed cross-sectional data (e.g., Bennett et al., 2006; Burton & Turrell, 2000; Choi et al., 2010; Fransson et al., 2012; Hellerstedt & Jeffery, 1997; Johansson et al., 1991; Kirk & Rhodes, 2012; Kouvonen et al., 2005; Mutz et al., 2020; Ng & Jeffery, 2003; Payne et al., 2002; Popham & Mitchell, 2007; Tsutsumi et al., 2003). Importantly,

however, the likelihood of reversed or reciprocal effects is high, as physical activity is likely to alter the perception of job characteristics, for example due to altered resilience (Häusser & Mojzisch, 2017).

Apart from cross-sectional data, we are aware of only one study (Sonnentag & Jelden, 2009) that tested the relationships between job demands, self-regulation, and physical activity by applying a day-level design. Even though longitudinal designs are more conclusive about causal processes (as the measurement of the predictor precedes the measurement of the consequence), they are still not able to solve all methodological problems like the influence of third variables. For instance, individual differences, such as differences in self-efficacy, might cause spurious relationships in correlational field studies by simultaneously affecting both perceptions of job characteristics (e.g., Judge et al., 2000; Xanthopoulou et al., 2007) and physical activity after work (e.g., McAuley & Blissmer, 2000). Moreover, previous research exclusively relied on self-reports of physical activity, although it is likely that physical activity is over-estimated (e.g., Dyrstad et al., 2014; Helmerhorst et al., 2012; Motl et al., 2005), for example, due to self-serving biases, memory biases, or social desirability.

Against this background, we decided to use an experimental approach to examine the causal effects of job demands and job control on physical activity after work. In addition, we used an objective measure of physical activity instead of merely relying on self-report measures.

Study 1

Method

Participants

One hundred and one (67 female, 32 male, 2 other) undergraduate students were recruited (25 psychology students, 76 other students). Age of participants ranged from 19

to 33 years (M_{age} = 23.71, *SD* = 3.05). Mean Body-mass index (BMI) was 22.65 (*SD* = 3.57). Exclusion criteria for all participants were i) being a competitive athlete, ii) more than eight hours of physical exercise per week, or iii) physical constraints that impair moderate-to-vigorous physical activity on a bicycle ergometer. We had to exclude one participant because of technical problems during the physical activity task. Thus, 100 participants were included in the main analyses. A sensitivity analysis (using G*Power 3.1.9.7; Faul et al., 2009) revealed that, given our sample size of *N* = 100, alpha of .05, and power of .894 (adjusted for the calculation of mediation effects based on the assumption of .80 power; Cohen, 1988), we could detect medium size effects of f^2 = .08 (Fritz & MacKinnon, 2007). All subjects participated in the study for course credit or for financial compensation of € 18 (approximately USD 20).

Design and Procedure

Participants were randomly assigned to the experimental conditions of a one-factorial (demands: high vs. low) between-subjects design. Gender was stratified. Analyses for homogeneity of demographic characteristics (i.e., gender, age, and BMI) across the different conditions showed no significant differences (all *p*s > .24), suggesting that stratified randomization was effective.

Participants signed up for a study described as call-center training for future call-center agents. Two rooms were set up prior to the arrival of participants. Room 1 was prepared as a call-center workplace where participants had to carry out the workplace simulation. Room 2 was prepared as a break room with a bicycle ergometer and a table with a range of magazines (e.g., film magazines, boulevard magazines) within reach. This was to offer an appealing low-effort alternative activity. As a crucial feature of self-control is to withstand temptations by redirecting desires (Hofmann et al., 2012), the availability of an attractive low-effort activity should increase the self-regulatory effort needed to maintain physical activity. Participants were told that the study consisted of three phases: a baseline

examination phase, the main work phase, and an after-work phase. They were escorted to Room 1 to do the work simulation. Before the start of the work simulation, sociodemographic variables and (baseline) momentary self-regulatory capacities were measured.[9] After the end of the work simulation, they were asked to indicate their momentary self-regulatory capacities again and to respond to a manipulation check. Subsequently, participants went to the second room for the after-work phase. They were first asked to mount the bicycle ergometer to do a physical activity task while the experimenter was out of the room. Participants were instructed to ride the bicycle ergometer as long as they wished to. Time spent on the bicycle ergometer served as an indicator of physical activity after work and was our dependent variable. After finishing the physical activity task, participants had the opportunity to choose a magazine and to read it in a convenient sedentary position. After 15 minutes, the experimenter returned to end the experimental session.

All experimental sessions were scheduled in the morning (between 9:00 AM and 12:00 PM). The experimental procedure was approved by the local ethics committee.

Work Simulation

The work simulation consisted of three different parts implemented in SoSci Survey (Leiner, 2016). The mean total duration of the workplace simulation was 40.60 minutes (*SD* = 9.61). Participants were asked to adopt the role of a call center agent. During the work simulation, they had to i) answer different mailbox messages, which were related to smartphones produced by the company 'PHONIAK', ii) solve arithmetic problems

[9] We measured some additional constructs that were beyond the scope of this paper, focusing on the effects of job characteristics on physical activity. We additionally measured trait self-control (Self-Control Scale; Bertrams & Dickhäuser, 2009), implicit theories about willpower (Job et al., 2010), trait self-compassion (Self-Compassion-Scale; Hupfeld & Ruffieux, 2011), as well as exercise routines before the workplace situation. Furthermore, we captured subjective well-being at two time points of the study (prior to the workplace simulation and after the workplace simulation) by asking participants to indicate their current subjective levels of stress and mental fatigue on visual analogue scales (Aitken, 1969), as well as mood (Positive and Negative Affect Schedule; Krohne et al., 1996). To capture a measure for objective well-being, participants were fitted with a Schiller "Medilog AR12plus" portable ECG monitor, which recorded ECG trace for the whole experimental session.

that were related to sales operations of the same corporation, and iii) answer a live customer call.

In part one, participants had to answer eight pre-recorded customer inquiries by recording their response as a mailbox message. Customers had three different types of requests: information requests, complaints regarding a product, or product orders. To answer the requests, all participants were provided with a manual containing all information needed to answer the inquiries. Participants had no time constraints to prepare their answers but they were told to work as quickly as possible since a lot of customers were in the waiting line. The customer inquiries were based on Wegge et al.'s (2007) analysis of customer-induced stress in call center work.

In part two, to create a more complex and naturalistic working environment with qualitatively different kinds of demands, all participants had to solve a number of arithmetic problems. The task was adopted by Flynn and James (2009) and framed to be related to sales and distribution of PHONIAK. Participants were told that they had to calculate new prices for recent promotions or increases in prices (i.e., calculating discounts or adding taxes to the prices).

In part three, to further increase the ecological validity and the emotional demands of the task, participants were confronted with a customer inquiry again, but this time it was a live call by a confederate. Participants were presented with a customer e-mail with some brief information about the inquiry and a callback request. When participants finished reading the e-mail, the experimenter started the voice-to-voice conversation, conducted via Skype 8.0 (Microsoft Corp., 2018).

Experimental Job Demands Manipulation

Demands were manipulated in all three parts of the workplace simulation. In the mailbox task (part one) and the live interaction (part three), participants in the high de-

mands condition were confronted with unfriendly and demanding customers, while participants in the low demands condition were confronted with friendly customers. In a pretest (N = 56), all recorded customer inquiries of the mailbox task were evaluated for valence. There was a significant difference in friendliness ratings ("How would you rate this message": very unfriendly[1] – very friendly[7]) between unfriendly customers (M = 1.54, SD = 0.32) and friendly customers (M = 5.89, SD = 0.40; $t(9) = 46.66$, $p < .001$, d = 12.00). Furthermore, participants in the high demands condition were instructed to be very friendly throughout the complete task and "serve with a smile". Participants in the low demands condition were instructed to act authentically during the customer interactions. During the arithmetic task (i.e., part two of the work simulation), demands were manipulated in terms of difficulty as suggested by Flynn and James (2009). In the high demands condition, the task consisted of subtraction terms with two carry-over operations (e.g., 2759 € - 872 €). In the low demands condition, the task consisted of addition terms with no carry-over operations (e.g., 15 € + 42 €). Additionally, the terms were presented horizontally (high demands) versus vertically (low demands), as previous studies suggest that presenting arithmetic tasks vertically decreases the cognitive complexity (Flynn & James 2009; Trbovich & Lefevre, 2003).

Measures

Physical Activity After Work. As an indicator for physical activity after work, we captured time spent on a bicycle ergometer in seconds. Participants were seated on the bicycle ergometer (Christopeit® Blue T1) where they received the instruction to ride the bicycle ergometer for as long as they wanted. They were instructed to choose an individual resistance level that felt like driving slightly uphill. This would imply that carrying out the task would involve self-regulatory effort without being very physically exhausting. Participants could freely decide how long they wanted to engage physically, but the maximum time (unknown to the participants) was 15 minutes.

Momentary Self-Regulatory Capacities. To capture current states of self-regulatory capacities, we used five items from the German version of the situational self-control capacity scale (sample item: “I feel increasingly less able to focus on anything”) developed by Bertrams et al. (2011) as used before by Rivkin et al. (2015). Items were answered on a seven-point Likert scale ranging from 1 (= not at all) to 7 (= very much). As all items measure the depletion of self-regulatory capacities, they were reverse coded before our analyses. Momentary self-regulatory capacities were measured twice: Prior to the work simulation (T1) and again after completing it but prior to the physical exercise phase (T2). Internal consistency (alpha) was .91 (T1) and .92 (T2).

Manipulation Check. As a manipulation check, perceived demands (emotional and cognitive demands) were measured after the work simulation with three items (sample items: “I had to force myself to be friendly while talking to the customers”, “I found the arithmetic problems to be difficult”) on a seven-point Likert scale ranging from 1 (= not at all) to 7 (= very much). The item scores of the three items were aggregated to form an overall measure. Additionally, we used an adapted version of the self-control demands measure (subscale impulse control demands) developed by Schmidt and Neubach (2007). It consists of six items (sample item: “The task requires that I never lose my temper”) that were answered on a five-point Likert scale ranging from 1 (= not at all) to 5 (= a great deal). Internal consistency for the three items was alpha = .87 and alpha = .89 for the self-control demands measure.

Demographics. Age, gender, self-reported BMI, and field of study were captured before the experimental procedure.

Results and Discussion

Analytic Approach

To evaluate the direct effects of job demands on physical activity after work (time on the bicycle ergometer), we calculated an independent samples *t*-test to compare average time on the bicycle ergometer (in seconds) for both groups (high vs. low demands). Analyses were performed using SPSS v24 (IBM Corp., 2016). To analyze the mediating role of self-regulatory capacities for the effect of demands on physical activity we performed bootstrap analyses (Preacher & Hayes, 2008) using AMOS v24 (IBM Corp., 2016) with 5000 bootstrap samples. Furthermore, to control for baseline levels, we additionally entered baseline self-regulatory capacities (T1) as a covariate to the model. In order to test whether a partial-mediation model or a full-mediation model fitted the data best, we fixed the respective paths to zero. In the partial-mediation model, all paths were allowed to load freely. In the full-mediation model, the direct path of demands on physical activity was set to zero. All hypotheses tests were two-tailed. We report unstandardized estimates. Means, standard deviations, and zero-order correlations of the main study variables are shown in Table 4.1.

Table 4.1
Means, Standard Deviations, and Zero-order Correlations for Study 1

Variable	*M*	*SD*	1	2	3	4	5	6
Study variables								
(1) Demands [a]	–	–	–					
(2) Self-Regulatory Capacities After Work	5.63	1.23	-.36***	–				
(3) Physical Activity [b]	406.25	246.95	-.23*	.06	–			
Controls								
(4) Baseline Self-Regulatory Capacities	5.48	1.24	-.06	.62***	.22*	–		
(5) BMI	22.60	3.56	.11	.13	.05	-.01	–	
(6) Age	23.69	3.06	-.06	-.19	-.10	-.16	.10	
(7) Gender [c]	–	–	-.10	.17	-.03	.21*	-.27**	-.13

Note. $N = 100$. [a] 1 = low Demands and 2 = high Demands. [b] Physical activity indicates time spent on the bicycle ergometer (in seconds). [c] 1= male and 2 = female. *** = $p < .001$, ** = $p < .01$, * = $p < .05$.

Manipulation Check

An independent samples *t*-test revealed that participants in the high demands condition reported significantly higher subjective demands (M = 5.05, SD = 0.99) than participants in the low demands condition (M = 1.44, SD = 0.47), $t(70.194) = 23.228$, $p < .001$, $d = 4.66$. Furthermore, the subscale impulse control of the self-control demands measure (Schmidt & Neubach, 2007) revealed that participants in the high demands condition perceived having to control their impulses more strongly (M = 4.03, SD = 0.71) compared to participants in the low demands condition (M = 3.36, SD = 1.04), $t(86.643) = 3.777$, $p < .001$, $d = 0.75$. In conclusion, results confirm the effectiveness of our experimental manipulation.

Hypotheses Testing

First, we tested the direct effects of job demands on physical activity after work. As predicted, participants in the high demands condition spent significantly less time on the bicycle ergometer (M = 350.92 seconds, SD = 219.55) compared to participants in the low demands condition (M = 461.58 seconds, SD = 262.23), $t(98) = 2.29$, $p = .024$, $d = 0.46$, thereby supporting Hypothesis 1.

Next, we tested the mediating effect of self-regulatory capacities for the effects of job demands on physical activity after work. Inspections of the model fits for a partial-mediation model versus a full-mediation model revealed that the partial-mediation model showed the best model fit, $\chi^2 = 0.377$, $df = 1$, $p = .539$, root mean square error of approximation (RMSEA) < .001, comparative fit index (CFI) > .99, goodness of fit index (GFI) > .99, compared to the alternative full-mediation model, $\chi^2 = 8.89$, $df = 2$, $p = .012$, RMSEA = .19, CFI = .91, GFI = .96; $\Delta\chi^2 = 8.51$, $p < .01$. Consequently, we applied the unconstrained partial-mediation model.

In contrast to Hypothesis 2, we found a significant positive indirect effect of job demands on time spent on the bicycle ergometer through its effect on momentary self-regulatory capacities, *indirect effect (ab)* = 46.13, *SE* = 23.31, 95% CI [11.14, 104.48]. In line with our expectations, job demands significantly decreased self-regulatory capacities, *a* = -0.80, *SE* = 0.18, *p* < .001. However, against expectations, self-regulatory capacities were negatively related to physical activity after work, *b* = -57.84, *SE* = 26.60, *p* = .027. All results are displayed in Figure 4.2.[10]

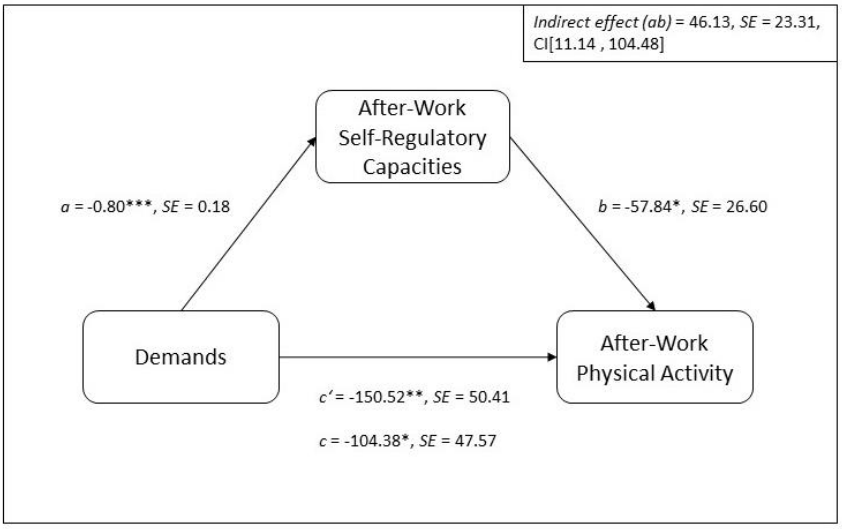

Figure 4.2 Study 1 mediation model on the relationship between job demands, self-regulatory capacities and physical activity. *N* = 100.
*** = *p* < .001, ** = *p* < .01, * = *p* < .05.

[10] To test for the robustness of our findings and to rule out alternative explanations, we also checked whether time-on-task serves as a further moderator for the proposed relationships between job demands and physical activity after work. When including time-on-task as a covariate in our analyses, findings remained the same (no changes with regard to direct or indirect effects). Moreover, there was no significant relationship between time-on-task with job demands or physical activity. This is in line with previous studies (e.g., Burton & Turrell, 2000) that found no evidence for a relationship between working hours and physical activity after work, thereby suggesting that the relationship between job demands and physical activity is not simply a result of a time conflict.

In sum, Study 1 provides first-time experimental evidence for a negative effect of job demands on physical activity after work, thereby supporting Hypothesis 1. However, in contrast to Hypothesis 2, there was a positive indirect effect of job demands on physical activity after work through self-regulatory capacities. Although, as expected, high demands led to decreased self-regulatory capacities, physical activity (i.e., time spent on the bicycle ergometer) was negatively related to self-regulatory capacities. There might be different reasons for this finding. One possible explanation may be that participants invested compensatory effort when facing self-regulatory deficits due to the highly demanding tasks. According to the compensation hypothesis (e.g., Kabanoff, 1980; Staines, 1980), participants could have increased their activity after work, as physical activity could be used as a recovery activity as well (e.g., Demerouti et al., 2009; van Hooff et al., 2019). In Study 2, we therefore aimed to test Hypothesis 2 for a second time to investigate whether the unexpected mediation effect will show again. In addition, we simultaneously manipulated both job demands and job control as independent variables.

Study 2

In light of the results of Study 1, the objectives of Study 2 were twofold. First, we aimed to replicate the negative effect of job demands on physical activity after work, including the proposed mediation (Hypotheses 1 and 2). Second, building on the pamDC model (Häusser & Mojzisch, 2017), we included job control as an additional experimental factor allowing us to test Hypotheses 3 and 4.

Method

Participants

One-hundred-fifty (105 female, 42 male, 3 other) undergraduate students were recruited (23 psychology students, 127 other students). The age of participants ranged from

18 to 53 years (M_{age} = 23.93, *SD* = 4.54). Mean BMI was 22.89 (*SD* = 4.66). We applied the same exclusion criteria as in Study 1 (no excessive physical activity on a regular basis, eligibility to use a bicycle ergometer). From the sample (*N* = 150), we had to exclude six participants: four participants because of problems during the experimental task (intense construction noise in the lab building during the tasks), one participant because of technical problems during the physical activity task, and one participant as he indicated he was a competitive athlete (i.e., competitive swimmer) after participation. Thus, 144 participants were included in the main analyses. A sensitivity analysis (using G*Power 3.1.9.7; Faul et al., 2009) revealed that, given our sample size of *N* = 144, alpha of .05, and power of .894 (adjusted for the calculation of mediation effects based on the assumption of .80 power; Cohen, 1988), we could detect small to medium size effects of f^2 = .06 (Fritz & MacKinnon, 2007). All subjects participated in the study for course credit or for financial compensation of € 18 (approximately USD 20). The experimental procedure was approved by the local ethics committee.

Design and Procedure

Study 2 used the same workplace simulation as Study 1. However, in addition to the between-subjects job demands manipulation (high vs. low), we added a between-subjects manipulation of job control (high vs. low). Consequently, Study 2 had a two-factorial between-subjects design. All participants were randomly distributed to one of the four conditions. Analyses for homogeneity of demographic characteristics (i.e., gender, age, and BMI) across the different conditions showed no significant differences (all *p*s > .12), suggesting that stratified randomization was effective.

Slightly different to Study 1, participants entered the break room first and had three minutes to get used to the bicycle ergometer. This was done to determine individual resistance in advance. As in Study 1, participants were instructed to choose an individual resistance level that felt like driving slightly uphill, to ensure self-regulatory effort. After the

workplace simulation, they were asked to ride the bicycle ergometer again as long as they wished to do so. As in Study 1, the experimenter was out of the room during this phase of the experiment. After 15 minutes, the experimenter came back into the room to end the experimental session.

Another difference to Study 1 was that all trait measures, as well as the sociodemographic variables, were collected at the end of the study.[11]

Experimental Job Demands Manipulation

Demands were manipulated in all three parts of the work simulation in the same way as in Study 1.

Experimental Job Control Manipulation

Following an approach to increase decision latitude, control was manipulated in all three parts of the work simulation via i) giving different opportunities to make own choices and ii) framing task instructions that aimed to emphasize autonomy and discretion over the task. Hence, our manipulation drew on various notions of autonomy-supportive task features (Deci & Ryan, 1987). In the first part of the work simulation (mailbox task), high control was manipulated via the opportunity to select 8 out of 10 customer requests. Furthermore, participants were free to choose the order of voice mails. All cases were presented on a selection screen with some brief customer information (i.e., customers' name and concern, e.g., "product order", "information" or "complaint"). In the low control condition, participants were told that they would have to answer a series of voice mails in a

[11] Again, we captured some additional constructs that were not included in our analyses. Participants also answered questions concerning trait self-control (Self-Control Scale; Bertrams & Dickhäuser, 2009), regulatory focus (German Regulatory Focus Questionnaire; Schmalbach et al., 2017), exercise identity (Exercise Identity Scale; Anderson & Cychosz, 1994), as well as exercise routines at the end of the study. Furthermore, we captured subjective well-being at three time points of our study (prior to the workplace simulation, after the workplace simulation, and after the physical activity task) by asking participants to indicate their current levels of subjective stress on visual analogue scales (Aitken, 1969), as well as mood (Positive and Negative Affect Schedule; Krohne et al., 1996). Task enjoyment and perceived competence (Intrinsic Motivation Inventory; Ryan, 1982) were captured after the workplace simulation. To capture a measure for objective well-being, participants were fitted with an "empatica e4" wristband, which recorded blood pressure volume for the whole experimental session.

fixed order without having the opportunity to choose. For this purpose, eight customer requests were randomly chosen and presented within the low control condition. In the second part (arithmetic task), participants in the high control condition could choose between different topics of the arithmetical tasks. They had the opportunity to choose whether they preferred to work on arithmetic tasks concerning a) price adjustments or b) sales taxes (tasks did not differ in difficulty as they were the same across conditions, but only varied in the wording). Participants in the low control condition were randomly assigned to one of the two arithmetical tasks without having a choice. In the third part of the work simulation (live customer interaction), participants in the high control condition could choose between different customer requests (i.e., product order or information – which were identical). Participants in the low control condition had no opportunity to choose between different customer requests. Instead, they were instructed to respond to the presented case they were randomly allocated. During the entire workplace simulation, instructions in the high control condition were framed to heighten feelings of autonomy (e.g., "…Therefore you have the opportunity to choose again, whether you prefer to work on a task regarding…"; e.g., Slemp et al., 2018; Vansteenkiste et al., 2004; Vansteenkiste et al., 2005).

Measures

Physical Activity After Work. As in Study 1, we captured time spent on the bicycle ergometer in seconds as an indicator of physical activity after work, serving as the dependent variable.

Momentary Self-Regulatory Capacities. This construct was measured using the same scale as in Study 1. Self-regulatory capacities were measured twice: Prior to the work simulation (T1) and again after completing it but before the physical exercise phase (T2). Internal consistency (alpha) was .91 for T1 and T2.

Momentary Self-Determination. To capture the current state of self-determination, we focused on the basic psychological need satisfaction approach, as posited by Self-

Determination Theory (Deci & Ryan, 2000). We focused on need for autonomy as this represents the most basic desire in individuals to be the origin of one's own actions (Cerasoli et al., 2016; de Charms, 1968), and especially draws from the notion of locus of causality (Van den Broeck et al., 2016). As self-determination was assessed repeatedly, we used a short three-item version of the basic need satisfaction scale (version "in general"; BNS-G; subscale autonomy"; Deci & Ryan, 2000; "I feel that I can choose freely", "I feel that I can be myself most of the time", "I feel pressured [reversed]") according to Johnston and Finney (2010). All items were adapted to the current work simulation. Items were answered on a seven-point Likert scale ranging from 1 (= not at all true) to 7 (= very true). Momentary self-determination was measured twice: Prior to the work simulation (T1) and again after completing it but before the physical exercise phase (T2). Internal consistency (alpha) was .75 (T1) and .70 (T2).

Manipulation Check. As a manipulation check, perceived demands were measured using the same three items as in Study 1. Furthermore, again we used self-control demands (impulse control) as a secondary measure for the effectiveness of the manipulation by using the same scale as in Study 1. Additionally, we measured perceived control with three items (sample item: "I consistently had the possibility to make a choice"). Internal consistency for perceived demands was alpha = .78, alpha = .82 for self-control demands, and alpha = .87 for perceived control.

Demographics. Age, gender, self-reported BMI, and field of study were captured at the end of the study.

Results and Discussion

Analytic Approach

To test the direct effects of job demands and job control on physical activity after work (time on the bicycle ergometer), we calculated a two-factorial between-subjects

ANOVA using SPSS v24 (IBM Corp., 2016). To analyze the mediating role of i) momentary self-regulatory capacities (T2) for the effects of job demands on physical activity and ii) momentary self-determination (T2) for the effects of job control on physical activity, we performed bootstrap analyses (Preacher & Hayes, 2008) using AMOS v24 (IBM Corp., 2016) with 5000 bootstrap samples. We entered self-regulatory capacities (T1) and self-determination (T1) as covariates to the models to control for baseline values. Again, in order to test whether a partial-mediation model or a full-mediation model fitted the data best, we fixed the respective paths to zero. In the partial mediation model, all paths were allowed to load freely. In the full mediation model, the direct path of i) demands to physical activity and ii) control to physical activity were constrained to zero. All hypotheses tests were two-tailed. We report unstandardized estimates.

Means, standard deviations, and zero-order correlations of the main study variables are shown in Table 4.2.

Table 4.2

Means, Standard Deviations, and Zero-order Correlations for Study 2

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9
Study variables											
(1) Demands [a]	–	–	–								
(2) Control [b]	–	–	.12	–							
(3) Self-Regulatory Capacities After Work	5.84	1.17	-.16*	-.02	–						
(4) Self-Determination After Work	4.24	1.35	-.30***	.17*	.39***	–					
(5) Physical Activity [c]	217.13	150.41	-.22**	-.02	.10	.05	–				
Controls											
(6) Baseline Self-Regulatory Capacities	5.56	1.26	-.06	-.07	.59***	.17*	.01	–			
(7) Baseline Self-Determination	5.08	1.24	.06	-.04	.31***	.33***	-.21*	.39***	–		
(8) BMI	23.10	4.41	-.02	-.15	.16	.01	-.03	.17*	.06	–	
(9) Age	23.92	4.65	-.12	.07	-.07	-.01	.04	-.02	-.03	.12	–
(10) Gender [d]	–	–	.15	-.02	-.19*	-.07*	-.09**	-.08	.02	-.09	-.11

Note. $N = 144$. [a] 1 = low Demands and 2 = high Demands. [b] 1= low Control and 2 = high Control. [c] Physical activity indicates time spent on the bicycle ergometer (in seconds).

[d] 1= male and 2 = female. *** = $p < .001$, ** = $p < .01$, * = $p < .05$.

Manipulation Checks

We calculated three separate 2 (demands) × 2 (control) between-subjects ANOVAs to test for the effectiveness of the experimental manipulations. Analyses revealed that participants in the high demands condition reported significantly higher demands (M = 4.65, SD = 0.94) compared to participants in the low demands condition (M = 1.51, SD = 0.62), $F(1, 140) = 568.116$, $p < .001$, $d = 3.94$. Importantly, the experimental manipulation of control did not affect perceived demands, $F(1, 140) = 0.780$, $p = .379$, $d = 0.04$, and no significant interaction of demands and control was found for perceived demands, $F(1, 140) = 0.008$, $p = .928$, $\eta^2 = .00$. Likewise, we found a significant effect of demands on impulse control ($F(1, 140) = 7.807$, $p = .006$, $d = 0.47$). Participants in the high demands condition reported higher demands to control impulses (M = 4.07, SD = 0.62) than participants in the low demands condition (M = 3.73, SD = 0.81). Importantly, we found neither an effect of control on impulse control ($F(1, 140) = 0.333$, $p = .565$, $d = 0.10$), nor an interactive effect of demands and control on impulse control ($F(1, 140) = 0.440$, $p = .508$, $\eta^2 = .003$). With respect to perceived control, participants in the high control condition reported significantly higher levels of control (M = 5.40, SD = 1.37) than participants in the low control condition (M = 2.60, SD = 1.07), $F(1, 140) = 188.253$, $p < .001$, $d = 2.29$. As expected, no effect was found for the experimental manipulation of demands on perceived control, $F(1, 140) = 0.113$, $p = .737$, $d = 0.05$, and no significant interaction of demands and control was found for perceived control, $F(1, 140) = 0.535$, $p = .466$, $\eta^2 = .004$. In conclusion, results confirm the effectiveness, as well as independence, of our experimental manipulation.

Hypotheses Testing

We analyzed the direct effects of job demands and control on physical activity after work (time on the bicycle ergometer) with a 2 (demands) × 2 (control) between-subjects ANOVA. Analyses revealed a main effect for job demands on physical activity, $F(1,140)$

= 6.926, p = .009, d = 0.45, thereby further supporting Hypothesis 1. As predicted, participants in the high demands condition spent significantly less time on the bicycle ergometer (M = 182.54 seconds, SD = 131.37) than participants in the low demands condition (M = 248.08 seconds, SD = 160.20). However, in contrast to Hypothesis 3, no main effect was found for job control on physical activity, $F(1,140) = 0.053$, p = .817, d = 0.04. Participants in the high control condition did not spend more time on the bicycle ergometer (M = 213.57 seconds, SD = 140.32) than participants in the low control condition (M = 220.41 seconds, SD = 160.01). In addition, we tested the multiplicative effect of demands and control on physical activity, but we did not find the proposed interaction of demands and control on time on the bicycle ergometer, $F(1,140) = 0.071$, p = .790 , η^2 = .001, rejecting Hypothesis 5.

To test Hypotheses 2 and 4, we calculated separate mediation models with the manipulation of job demands and job control as predictors and time spent on the bicycle ergometer as an outcome variable. In the different models, momentary self-regulatory capacities (T2) served as a mediating variable for the effects of demands on after-work physical activity, while momentary self-determination (T2) served as a mediating variable for the effects of control on after-work physical activity (while controlling for T1 values as covariates).

First, we tested the mediating role of momentary self-regulatory capacities for the effects of job demands on physical activity after work. Inspections of the model fits for a partial-mediation model versus a full-mediation model revealed that the unconstrained partial-mediation model showed the best model fit, $\chi^2 = 0.717$, $df = 1$, p = .397, RMSEA < .001, CFI > .99, GFI > .99, compared to the alternative full-mediation model, $\chi^2 = 7.17$, $df = 2$, p = .028, RMSEA = .14, CFI = .93, GFI = .97; $\Delta\chi^2 = 6.45$, $p < .05$. Hence, we used the partial-mediation model.

In contrast to Hypothesis 2, there was no indirect effect of job demands on time spent on the bicycle ergometer (in seconds) through its effect on momentary self-regulatory capacities as confidence intervals included zero, *indirect effect (ab)* = -3.98, *SE* = 4.29, 95% CI [-19.21, 0.72]. While demands were marginally negatively related to self-regulatory capacities, *a* = -0.28, *SE* = 0.16, *p* = .07, physical activity after work was unrelated to self-regulatory capacities, *b* = 14.25, *SE* = 13.22, *p* = .28. All results are displayed in Figure 4.3.[12]

Next, we tested the mediating role of momentary self-determination for the effects of job control on physical activity after work. As previous research suggests that a significant direct effect is not essential to the calculation of indirect effects (Mathieu et al., 2008), we calculated a mediation model for the relationship between job control and physical activity through self-determination. Inspections of the model fits for a partial-mediation model versus a full-mediation model revealed that the constrained full-mediation model does not show a better model fit, $\chi^2 = 1.09$, *df* = 2, *p* = .580, RMSEA < .001, CFI > .99, GFI = .99; $\Delta\chi^2 = 0.70$, *p* = .399, compared to the partial-mediation model, $\chi^2 = 0.387$, *df* = 1, *p* = .534, RMSEA < .001, CFI > .99, GFI > .99; $\Delta\chi^2 = 0.70$, *p* = .399. Hence, we used the partial-mediation model.

A bootstrap analysis revealed first evidence for Hypothesis 4 as it revealed a positive indirect effect of job control on time spent on the bicycle ergometer (in seconds) through its effect on momentary self-determination, *indirect effect (ab)* = 9.18, *SE* = 6.49, 95% CI [0.25, 26.62]. Momentary self-determination was higher for participants in the high control condition (*a* = 0.52, *SE* = 0.21, *p* = .012), whereas momentary self-determination, in turn, was marginally positively related to more time spent on the bicycle ergometer (*b* = 17.55, *SE* = 9.78, *p* = .073). All results are displayed in Figure 4.3.

[12] Similar to Experiment 1 we tested time-on-task as an alternative explanation by integrating it into our analyses as a covariate, but found no support for this variable as a factor that influenced physical activity.

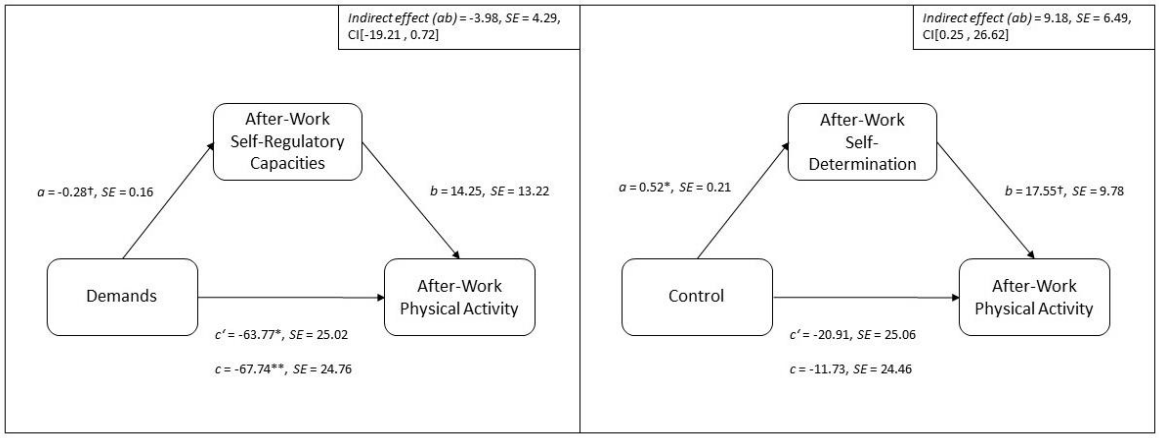

Figure 4.3 Study 2 mediation models on the relationships between job characteristics, self-regulatory capacities, self-determination, and physical activity. $N = 144$. ** = $p < .01$, * = $p < .05$, † = $p < .10$.

Taken together, Study 2 replicates the negative effect of high job demands on physical activity after work, lending further support to Hypothesis 1. Regarding Hypothesis 2, we found no support for the mediating effect of self-regulatory capacities for the effect of job demands on physical activity after work. In contrast to Study 1, this time the mediation pointed at least in the expected direction. Consequently, these analyses encourage the interpretation that the unexpected positive indirect effect of demands on physical activity via self-regulatory capacities found in Study 1 is likely to be a spurious finding (we will return to this issue in the General Discussion).

Beyond replicating the negative effect of job demands on physical activity found in Study 1, we included job control in Study 2 as an additional experimental factor in order to test Hypotheses 3 to 4. In relation to Hypothesis 3, these analyses revealed no significant direct effect of job control on physical activity after work (nor a multiplicative effect with job demands). However, we found first evidence for the predicted positive indirect effect of job control on physical activity after work through self-determination (Hypothesis 4) as

the index of mediation indicates significance (Hayes, 2017). Although the relationship between self-determination and physical activity is only marginally significant when applying two-tailed tests, Lakens (2014) suggests using one-tailed tests when hypotheses are directional. When doing so, the relationship between self-determination and time spent on the bicycle ergometer is significant ($p < .05$). Hence, this finding preliminarily supports the idea that job control is effective, as it increases employees' feelings of self-determination that, in turn, are beneficial for motivated effective behavior (Nix et al., 1999; Ryan & Frederick, 1997). Interestingly, as our study shows, this motivation does not seem to be restricted to the work context only, but spills over to other activities like exercising during off-work times, as proposed by the pamDC model (Häusser & Mojzisch, 2017).

General Discussion

Building on the pamDC model (Häusser & Mojzisch, 2017), we investigated the causal effects of job demands and job control on physical activity after work. Moreover, we tested for i) a negative indirect effect of job demands on physical activity through decreased self-regulatory capacities, and ii) a positive indirect effect of job control on physical activity through self-determination. To our knowledge, this is the first investigation using experimental methods to test the proposed pathways.

The results of the two experimental workplace simulations lend support to the hypothesis that job demands have a negative effect on physical activity after work. As predicted, participants in the high demands condition spent less time exercising after the workplace simulation, as compared to participants in the low demands condition. This finding was consistent over both experiments. Although we found consistent evidence for the effect of job demands on physical activity, participants' overall average time on the bicycle ergometer was lower in the second experiment, as compared to the first experiment (mean difference was 189.12 seconds). One tentative explanation of this finding is that

participants in Study 2 chose resistance levels before starting the workplace simulation, while in Study 1 resistance levels were chosen after the workplace simulation. This probably led to a difference in mean chosen resistance levels (mean resistance levels in Study 1 = 6.8, *SD* = 2.9; mean resistance levels in Study 2 = 8.7, *SD* = 2.9, $t(241) = 4.99$, $p < .001$). As a consequence, effort needed on the bicycle ergometer was higher in Study 2, as compared to Study 1, thereby probably reducing the average time on the bicycle ergometer. However, there were no differences regarding mean resistance levels between experimental groups in Study 1, $t(99) = 0.82$, $p = .414$.

Regarding the underlying psychological mechanisms, we did not find the expected indirect effect of job demands on physical activity through self-regulatory capacities. In Study 1, we even found evidence for a positive indirect effect of job demands on physical activity through self-regulatory capacities. Disentangling this indirect effect revealed that although high demands are negatively related to self-regulatory capacities (as predicted), self-regulatory capacities were positively related to physical activity. However, this indirect effect was not replicated in Study 2.

With regard to job control, we found first evidence for the predicted positive indirect effect of job control on physical activity through self-determination. However, we did not find support for the direct effect of job control on physical activity. Moreover, no interaction effect of job demands and job control on physical activity was found (Study 2).

Theoretical and Practical Implications

We found strong and consistent support for the proposed causal effect of job demands on physical activity after work. This finding is in line with earlier correlational research (e.g., Burton & Turrell, 2000; Kirk & Rhodes, 2012; Mutz et al., 2020; Ng & Jeffery, 2003; Payne et al., 2002; Popham & Mitchell, 2007), but provides first-time clear-cut evidence for the causal direction of this effect as proposed by earlier theorizing (Häusser & Mojzisch, 2017).

However, we found no support for the proposed underlying mechanism, that is, reduced self-regulatory capacities as a mediator of the effects of job demands on physical activity after work. As the findings were inconsistent, we calculated an integrated effect size for the mediation effect over both samples (total $N = 244$). This revealed a non-significant indirect effect of job demands on physical activity via self-regulatory capacities, $ES_r = 0.06$, 95 % CI [-0.19, 0.31].

More generally, it has been argued that temporary impairments in self-regulation do not necessarily translate into changes in behavior, as such impairments can be actively compensated for, particularly if required by the situational context (for an overview, see Loschelder & Friese, 2016). Additionally, alternative concepts describe self-control in terms of motivational and attentional shift processes (e.g., Inzlicht & Schmeichel, 2012; for an overview of the current debate on the underpinnings of self-regulation see Friese et al., 2019). Hence, future studies might consider alternative ways to define (and measure) self-regulation, for example, in terms of motivational or attentional processes. Furthermore, recent theorizing points to the idea that self-reported self-regulation might differ from more objective measures of self-regulation (e.g., systolic blood pressure or pupil dilation; cf. van der Wel & van Steenbergen, 2018). Self-reports might focus more strongly on perceived changes of subjective states due to self-regulatory effort, while objective measures might represent levels of effort invested during a self-regulatory demanding task (see Friese et al., 2019, for a discussion). Therefore, although it has been more common to use self-reports of self-regulation in organizational research for the past decades (Friese et al., 2019), including objective measures of self-regulation might be a promising avenue for future research.

Furthermore, it is possible that there are other variables that may serve as an underlying mechanism for the relationship between job demands and physical activity, such as after-work rumination. Rumination has been found to be linked to the individual ability to

unwind from work by cognitively switching off during leisure (Cropley & Zijlstra, 2011). Several studies show that high demands at work are positively related to rumination (e.g., Aronsson et al., 2003; Cropley & Millward Purvis, 2003). Ruminative processes, in turn, have been shown to inhibit motivation and active behavior, like exercising (Keune et al., 2012).

With regard to job control, we did not find a positive direct effect of job control on physical activity after work. However, we found first evidence for the predicted indirect effect of job control on physical activity through self-determination: Job control increased feelings of self-determination, which in turn, were marginally related to increased physical activity after work. These findings highlight the complex and manifold consequences of job control. In addition to a plethora of studies that found positive effects of job control, previous research also revealed a 'dark side' of job control. On the one hand, job control supports needs satisfaction which, in turn, has positive effects on physical activity (e.g., Reis et al., 2000). On the other hand, high job control might also lead to increased effort due to higher task involvement and work intensification, as has been suggested more recently (cf. Kubicek et al., 2017; Seitz & Rigotti, 2018). Increased effort might not always be a bad thing, at least when it feels like a personal choice (Inzlicht et al., 2018). However, exerting effort via job control might have unwanted side effects, like increased feelings of behavioral fatigue that hamper the willingness to engage in physical activity after work (e.g., Gerdenitsch et al., 2015; Parker et al., 2013).

With regard to the complexity of job control, recent research also points to the idea that the effects of job control might be rather curvilinear, suggesting that job control might be beneficial up to a certain level but turn negative when taken too far (e.g., de Jonge & Schaufeli, 1998; Kubicek et al., 2014; Warr, 1994). To give an example, increasing job control through decisional latitude might have positive effects as employees might experience higher work engagement through increased autonomy, competence, and relatedness.

However, up to a certain point, the effects of decisional latitude might turn negative, as too much work engagement might become harmful for detachment (i.e., *dis*engagement) from work, thereby hindering physical activities (Richter et al., 2016; Schaufeli et al., 2009). As our experimental manipulations consisted of two levels of job demands and job control (high vs. low levels), we are not able to test for curvilinear effects, but we call for future studies that test for non-linear relationships between job characteristics and physical activity.

Moreover, we also tested whether there was an interactive effect of job demands and job control on physical activity, that is, we tested whether high job control buffers the negative effect of high job demands on physical activity after work. This was not the case. To the best of our knowledge, this was the first empirical test of a demands × control interaction with respect to physical activity (for a discussion of empirical tests of demands × control interactions with respect to well-being, see de Jonge & Dormann, 2006, and Häusser et al., 2010). The rationale for such a buffer effect with respect to physical activity is the interplay of the proposed underlying mechanisms linking job characteristics to physical activity, that is, self-regulation for demands and self-determination for control (cf. Muraven et al., 2008). However, as self-regulation (at least when operationalized in terms of reduced self-regulatory capacities) did not turn out to be the relevant underlying mechanism for the effect of job demands on physical activity, an interplay with self-determination could not occur. In sum, our findings speak against a demands × control buffer effect with respect to physical activity after work.

However, a bivariate correlation between job demands and self-determination (r = -.30) in Study 2 indicates that the proposed paths might not be completely independent of each other. The pamDC model assumes distinct specific paths to link job demands to physical activity (via self-regulatory capacities) and job control to physical activity (via self-determination). Nonetheless, in line with our finding that job demands were related to self-

determination, it has been suggested that job demands might also undermine engagement in physical activity by negatively affecting feelings of self-determination and autonomous motivation (cf. Trepanier et al., 2013). To check for the robustness of our findings, in additional exploratory analyses we tested the indirect effect of job demands on physical activity via self-regulatory capacities while controlling for self-determination. Moreover, we calculated an integrated path model, testing all proposed paths simultaneously. Both analyses revealed very similar results to the original findings, and conclusions remained the same.

Regarding its practical implications, our results stress the importance of health-promoting work design. Unfavorable work designs, in particular, high demands at work, have far-reaching negative consequences within and beyond the job. As physical activity can help to prevent negative mental and physical health by improving well-being, organizations can help employees to engage in exercising by carefully considering specific demands at work and their impact on employees' physical activity during off-work time. Regarding the consequences of job control, the picture is less clear as – based on our findings – simply increasing job control is unlikely to result in increased after-work physical activity (no direct effect and no buffer effect). However, given the indirect effect via feelings of self-determination and the marginally positive relationship between feelings of self-determination and physical activity after work, designing workplaces that strengthen feelings of self-determination at work might be a fruitful endeavor. Self-determination at work can be created by different autonomy-related factors, like increasing decision latitude (like in our study) or increasing participation (Gagné & Deci, 2005; Gagné et al., 1997).

Limitations

The present studies are subject to some limitations that also suggest directions for further research. First, our samples were restricted to a group of young adults (i.e., college

students), raising the question of generalizability to other populations or settings. However, a growing number of researchers argue that generalizability does not only depend on sample characteristics or the study design (e.g., Highhouse, 2009; Stone-Romero, 2011). For example, Highhouse (2009) argues that generalizability is determined by the degree to which the operationalization of a construct is true to the construct itself. In our studies, we took great care to manipulate central aspects of job demands and job control and to tap into the proposed underlying psychological mechanism. Furthermore, Highhouse states that defining a typical organizational sample is *per se* not possible, as there is no typical organizational sample. Sample characteristics strongly differ with respect to the field of work. Finally, past research has shown that lab results in Industrial and organizational psychology that use student samples have considerable predictive power for field results with employees, even outperforming most other fields in psychology (Locke, 1986; Mitchell, 2012).

Second, although experimental studies are of great value for theory building and evaluation of causal inferences, they are limited with regard to their ecological validity. We tried to develop a highly naturalistic call-center simulation by combining various kinds of demands, that is, emotional demands and cognitive demands. The development of the customer requests in particular, was informed by an analysis of stress in call center workers (Wegge et al., 2007). Nonetheless, a work simulation will always be restricted regarding personal involvement and complexity (e.g., social environments that cause the need for cooperation). Future experimental research should aim to replicate these findings by adding additional job features or by testing different job environments.

Third, it should be noted that we used rather broad experimental operationalizations of job demands and control, for reasons of ecological validity. As a consequence, this approach does not allow for differentiation between specific effects of different types of job demands and control. Thus, in future research, it might be worthwhile to make stronger distinctions between different types of job demands (e.g., emotional demands, cognitive

demands, physical demands, challenge vs. hindrance demands) and job control (e.g., decision latitude and skill discretion), as some kinds of demands and control might be more strongly related to physical activity than others. In this vein, Steed et al. (2019) found in their meta-analytic review that although all psychosocial job demands (this was not the case for physical demands) consistently showed negative relationships with recovery experiences, the magnitude of these effects differed across types of demands. With regard to after-work physical activity, it might be interesting to examine whether, for example, hindrance stressors (e.g., performance constraints, cf. Sonnentag & Jelden, 2009) might be more harming for physical activity after work, as compared to challenge stressors (e.g., time pressure; cf. Cavanaugh et al., 2000). Moreover, it is plausible that a more fine-grained differentiation between different types of demands and control could elicit new insights into their interactive effects on physical activity, as past theorizing highlights the importance of a "match" between the specific types of control and demands (e.g., de Jonge & Dormann 2006; Häusser et al., 2010). For instance, giving the opportunity to freely schedule work breaks might be more effective when dealing with high workload rather than having challenging customer interactions.

Concluding Remarks

In two workplace simulations, we provide first-time experimental evidence for the causal effects of job demands and job control on physical activity. As job demands and job control have already been found in numerous studies to be related to health and well-being in general, our results point to the importance of considering their effects on more specific facets of health-related behaviors, like physical activity.

Chapter 5

The Relationships Between Job Characteristics and Physical Activity During Vacation[13]

Today's prospects when it comes to going on vacation are highly diverse. While some prefer to spend their holidays at home and decrease all activities to minimum levels, others are in favor of experiencing highly active vacations by seeking to experience various kinds of sports activities. This research aims to shed light on factors that explain how people spend their vacations, thereby focusing, in particular, on the role of job factors in engagement in physical activity during vacations. Building on the assumptions of the *physical activity-mediated Demand-Control (pamDC) model* (Häusser & Mojzisch, 2017), we tested whether job demands and job control are predictive for physical activity during vacation.

Vacation experiences in general offer a great opportunity to detach from work over an extended period of time, and thereby, help to sustain health and well-being by recovering one's own resources (e.g., Fritz & Sonnentag, 2006; Lounsbury & Hoopes, 1986; Strauss-Blasche et al., 2000). Moreover, a vacation influences positive and negative work reflection as well as work engagement (Fritz & Sonnentag, 2006). Sluiter et al. (2000) define vacation as a *macrorecovery experience* (i.e., being off from work for more than two days) which is of vital importance for the psycho(physio-)logical unwinding processes after times of chronic stress during work-time (Geurts & Sonnentag, 2006). In a meta-analysis, De Bloom et al. (2009) found positive medium-sized effects for the relationship between vacations and recovery.

[13] This study was conducted together with S. Sonnentag, S. L. Parker, & J. A. Häusser.

Above the beneficial effects of vacations, past theorizing on off-work recovery showed that the way in which leisure time is spent makes a difference for the recovery experience: One possibility to improve the quality of recovery is engagement in physical activity (cf. Sonnentag, 2018). Studies have revealed that physical activity during leisure time is positively related to psychological well-being (e.g., Sonnentag, 2001) and negatively related to emotional exhaustion (Janurek et al., 2018). There is also first evidence that physical activity boosts *macro*recovery processes during vacation (De Bloom et al., 2011). Therefore, it seems crucial to identify factors that are influential for physical activity behavior during vacations.

In line with the pamDC model by Häusser and Mojzisch (2017) we propose that job demands and job control are two crucial factors for engagement in physical activity during vacations. The term job demands usually refers to cognitive (e.g., time pressure), physical (e.g., heavy lifting), and emotional stressors (e.g., unfriendly customers) at work that require sustained physical and/or mental effort and are therefore associated with certain physiological and/or psychological costs (Demerouti & Bakker, 2011) whereas job control poses an important job resource that refers to the degree of skill discretion and decision latitude (Karasek & Theorell, 1990). While job demands are expected to negatively influence physical activity during vacations, job control should have positive effects. The conceptual model of our study is presented in Figure 5.1

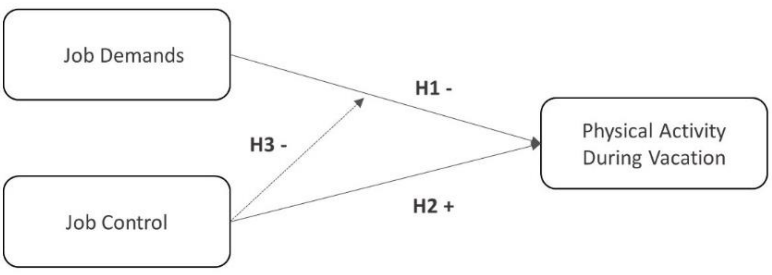

Figure 5.1 Conceptual model for the study.

In the following, we will outline previous theorizing and research that poses the fundament for the proposed relationships between job demands, job control, and physical activity during a vacation.

Relationships Between Job Demands, Job Control, and Physical Activity During Vacation

Although previous research has not explicitly focused on the relationships between job demands and physical activity during vacations, evidence for a negative relationship comes from research about general leisure-time physical activity (LTPA): Some studies have already revealed a negative relationship between job demands and LTPA (e.g., Burton & Turrell, 2000; Kirk & Rhodes, 2012; Mutz et al., 2020; Popham & Mitchell, 2007; Sonnentag & Jelden, 2009). For example, Sonnentag and Jelden (2009) found that police officers that were confronted with high job demands were less likely to exercise after work. With regard to job control, previous research has found that high control at work is positively related to the initiation and execution of LTPA (e.g., Choi et al., 2010; Fransson et al., 2012; Hellerstedt & Jeffery, 1997; Johansson et al., 1991; Kouvonen et al., 2005). For example, Johansson et al. (1991) found in a sample of 7201 Swedish employees that job control is related to increased regular physical exercise.

Theoretically, the pamDC model (Häusser & Mojzisch, 2017) does not make any propositions with regards to lagged effects of job characteristics on physical activity (e.g., during vacations). However, bringing together the propositions of the pamDC model with the basic assumptions of the active-learning hypothesis by Karasek (1979), job demands and job control should also show time-lagged effects on physical activity during vacations. As evidenced by past research, job demands and job control are connected to employees' motivation, engagement and commitment (e.g., Demerouti et al., 2001; Schaufeli & Bakker, 2004; Van Yperen & Hagedoorn, 2003). While chronically high job demands have been

found to be a negative predictor for employees' motivation, job control shows positive relationships. According to Karasek (1979), the effects of job characteristics on motivation and commitment are not limited to the working environment but also spill-over into other domains of life. Especially for the combination of high job demands and high job control, Karasek (1979) proposes a challenging and motivating influence that should spill-over into other domains of life and activities (cf. Demerouti et al., 2001). Based on this notion, the combination of high demands and high control at work will result in increased feelings of competence and in the development of new skills and behaviors such as (physically) active behaviors (Karasek & Theorell, 1990). This is empirically supported by Karasek (1976), as he could show relationships between an active job situation (i.e., high demands and high control) and higher rates of participation in physical engagement and socially active leisure activities in Swedish white-collar workers.

Hence, we derive the following hypotheses:

H1: Job demands are negatively related to physical activity during vacation.

H2: Job control is positively related to physical activity during vacation.

H3: The interaction of job demands and job control is related to physical activity during vacation: The combination of high job demands and high job control is positively related to the amount of physical activity during a vacation.

The Present Study

With this study, we make three contributions to the literature on health behavior in the form of physical activity during vacations.

First, the study adds to the literature on health behavior during vacations in the form of physical activity by focusing on the role of job characteristics (i.e., job demands and job control) as possible antecedences. While a range of studies point to the importance of job characteristics for physical activity during leisure time, so far no study has placed a special emphasis on physical activity during vacations.

Second, our study informs theorizing on the relationships between job characteristics and physical activity during leisure time (Häusser & Mojzisch, 2017) as it helps to clarify whether the predictive power of job demands and job control for leisure-time physical activity, as proposed by the pamDC model, can also be shown for various contexts of leisure and over extended periods of time.

Third, in a more exploratory manner, we aim to test the proposed relationships between different subtypes of job demands and job control with physical activity during vacations. As suggested by previous studies, not all kinds of job demands and job control might be related to physical activity to the same extent: For instance, Sonnentag and Jelden (2009) showed that some types of job demands (e.g., situational constraints) are particularly important to predict physical activity.

Method

Participants and Procedure

All participants were recruited via mailing lists of different local organizations, comparable institutions (e.g., administrative departments, schools) and online social media channels. Inclusion criteria to participate in the study were i) ongoing employment of at least 19.5 hours per week, and ii) a planned vacation trip during the upcoming six weeks after filling out the first survey. In total, 408 individuals were initially recruited to participate at the first part of our study. At the second time of measurement 314 participants remained. Hence, we had a drop out of 94 participants (23 percent) between both times of measurement. To analyze sample attrition, we checked for selective dropout with regard to age, gender, and household income but found no significant differences between participants that only took part during the first wave of measurement and participants that took part during both waves of measurement (all *p*s greater than .27),

During the course of the study, participants provided self-reports at two different points of measurement: The first survey was completed up to six weeks before going on vacation (Time 1); the second survey was answered one week after returning home (Time 2). At the first wave of measurement, participants were asked to fill in the survey questions regarding job characteristics as well as sociodemographic variables (age, gender, household income). At the second wave of measurement, beyond measures regarding job characteristics, participants provided information about their actual physical activity during their vacation.[14] Participants had the opportunity to take part in a lottery after answering both surveys where they had the chance to win up to 600€ (i.e., 10 x 25€, 3 x 50€, 1 x 100€).

Measures

Self-Reported Physical Activity During Vacation

To assess physical activity during participants' vacation at the second wave of measurement we used a single-item measure adapted by Sonnentag (2001; "Please indicate how much time you actually spent on the following activities: physical activities, for example, sports, cycling, walking, and skiing") on a scale ranging from 1 (= not at all) to 7 (= very much).

Job Characteristics

We focused on job demands and job control as two types of job characteristics that are expected to be related to physical activity during a vacation. Job demands were assessed in terms of *time pressure*, *emotional demands* and *physical demands* at work at both times of measurement (Time 1 and Time 2). To capture time pressure (sample item: "Do

[14] We captured some additional constructs that are out of the scope of our research question and therefore are not part of this study. At both waves of measurement, we additionally measured burnout (Büssing & Glaser, 1999), trait self-control (Bertrams & Dickhäuser, 2009), overcommitment (Siegrist et al., 2009), morning recovery (Sonnentag & Kruel, 2006), and organisational exercise climate (Sonnentag & Pundt, 2016). At the first wave of measurement we additionally measured physical activity intentions, while we included a measure for recovery experiences (Sonnentag & Fritz, 2007) at the second wave of measurement.

you have to work very fast?") and emotional demands (sample item: "Is your work emotionally demanding?"), we used three items of the German version of the Copenhagen Psychosocial Questionnaire (COPSOQ; Nübling et al., 2005) for each subscale. The response scale ranged from 1 (=never) to 7 (=always). The COPSOQ is a standardized questionnaire to measure various psychosocial job features that has been validated in multiple countries including Germany (Nübling & Hasselhorn, 2010). To measure physical demands (sample item: "My job demands a lot of physical effort") we used two items of the Job Content Questionnaire (Karasek et al., 1998). Participants responded on a scale ranging from 1 (= never) to 7 (= always).

Job control was measured in terms of *decision latitude* (sample item: "Do you have a large degree of influence concerning your work?") and *scheduling control* (sample item: "Can you decide when to take a break?") by two items for each subscale. Again, all items were chosen from the German version of the COPSOQ (Nübling et al., 2005). All items were rated on a response scale from 1 (= never) to 7 (= always).

Control Variables

We assessed a range of sociodemographic variables with single items to control for potential cofounding effects. This included age, gender, disposable household income per year (i.e., aggregated salaries across all family members per year), and (mean) working hours per week.

Statistical Analyses

All data were analyzed using SPSS Statistics 24 (IBM Corp., 2016). To test our hypotheses we used a hierarchical multivariate linear regression analysis and first entered all covariates to the model. This was followed by adding the main effects in the second step, and finally entering the interaction terms.

Results

Confirmatory Factor Analyses

In advance to hypothesis testing, we examined the factor structure of all job characteristics measures. Therefore, we conducted confirmatory factor analyses (CFA) with SPSS AMOS 24 (IBM Corp., 2016) to test several competing models. We started fitting a six-factor model (with (i) time pressure, (ii) emotional demands, (iii) physical demands, (iv) decisional control, and (v) scheduling control as distinct categories) and tested it against a two-factor Model (with (i) job demands and (ii) job control) and a one-factor model with a general job characteristics dimension.

The five-factor model showed a good fit, $\chi^2 = 139.177$, $df = 44$, $p < .001$, root mean square error of approximation (RMSEA) = .074, comparative fit index (CFI) = .951, Tucker-Lewis index (TLI) = .926) and was superior to the two-factor model ($\chi^2 = 775.169$, $df = 53$, $p < .001$, RMSEA = .185, CFI = .628, TLI = .536; $\Delta\chi^2 > 635$, $p < .001$) and the general factor model ($\chi^2 = 1029.719$, $df = 54$, $p < .001$, RMSEA = .213, CFI = .497, TLI = .385; $\Delta\chi^2 > 890$, $p < .001$). Consequently, we tested our hypotheses applying the five-factor solution for job characteristics (i.e., distinguishing between time pressure, emotional demands, physical demands, decision latitude and scheduling control).

Descriptive Statistics and Inter-correlations

Internal consistencies, means, standard deviations, and zero-order correlations of all study variables are displayed in Table 5.1. All sub-dimensions of job demands showed small-to-moderate inter-correlations (all correlations ranged between .15 and .42). There was also a small correlation between decision latitude and scheduling control ($r = .20$).

Furthermore, while decision latitude was uncorrelated to all sub-dimensions of job demands, scheduling control showed small-to-moderate negative correlations with job demands (*r* ranged from -.12 to -.34).

Table 5.1

Means, Standard Deviations, and Zero-order Correlations

Variable	∝	*M*	*SD*	1	2	3	4	5	6	7	8	9
Study variables												
(1) Time Pressure (T1)	.68	4.09	1.23	–								
(2) Emotional Demands (T1)	.78	3.74	1.50	.42***	–							
(3) Physical Demands (T1)	.93[a]	2.44	1.66	.15**	.34***	–						
(4) Decision Latitude (T1)	.69[a]	4.79	1.45	.06	.01	-.05	–					
(5) Scheduling Control (T1)	.62[a]	5.38	1.55	-.12*	-.29***	-.34***	.20***	–				
(6) Physical Activity (T2)	–	5.04	1.74	-.03	-.02	.03	.12*	-.04	–			
Controls												
(7) Age	–	37.17	11.26	.15**	.10	-.01	.03	.00	.02	–		
(8) Gender	–	–	–	.02	.14*	-.04	-.12*	-.12*	-.00	-.07	–	
(9) Working hours (Week)	–	34.84	9.00	.14*	.09	.06	.11*	-.04	.01	.16**	-.24***	–
(10) Household Income (Year)	–	–	–	.12*	.00	-.12*	.22***	-.01	.08	.32***	-.02	.21***

Note. $N = 314$. [a] We calculated bivariate correlations for all scales that consist of only two items. *** = $p < .001$, ** = $p < .01$, * = $p < .05$.

Job Characteristics and Physical Activity During Vacation

To test the influence of job characteristics on physical activity during vacation we calculated a hierarchical linear regression model. The model included all job characteristics dimensions (Time 1), as well as age, gender, household income, and working hours per week to control for potential confounding effects. We started to fit a model including all covariates. Second, we added job characteristics to test for main effects and went on with entering all interaction terms as a third step.

Analyses revealed no relationships between time pressure (β = -.044, p = .504), emotional demands (β = -.063, p = .374), and physical demands (β = .086, p = .194) with physical activity during a vacation – rejecting Hypothesis 1. Similarly, decision latitude (β = .132, p = .069) and scheduling control (β = -.037, p = .574) were found to be unrelated to physical activity during a vacation trip. Hence, we reject Hypothesis 2.

Against expectations (and therefore rejecting Hypothesis 3), results for the interactive effects between time pressure (β = .263, p = .404), emotional demands (β = -.454, p = .121), and physical demands (β = .231, p = .315) with decision latitude on physical activity during vacations suggest that these variables are unrelated. Similarly, the interaction term of time pressure (β = -.166, p = .569), emotional demands (β = -.015, p = .961), and physical demands (β = -.283, p = .186) with scheduling control on physical activity during vacations did not reach significance.

All results of the relationships between job characteristics (Time 1) and physical activity during vacations (T2) are displayed in Table 5.2.

Table 5.2
Associations of Job Characteristics with Physical Activity During Vacations

	Physical Activity During Vacations					
	Model 1		Model 2		Model 3	
	B	*SE*	*B*	*SE*	*B*	*SE*
Job Demands						
Time Pressure (TP)	–	–	-.061	.092	-.124	.389
Emotional Demands (ED)	–	–	-.072	.081	.354	.369
Physical Demands (PD)	–	–	.090	.069	.170	.305
Job Control						
Decision Latitude (DL)	–	–	.157	.074	.152	.247
Scheduling Control (SC)	–	–	-.041	.072	.289	.278
Interaction Terms						
TP x DL	–	–	–	–	.052	.062
ED x DL	–	–	–	–	-.085	.055
PD x DL	–	–	–	–	.047	.046
TP x SC	–	–	–	–	-.032	.056
ED x SC	–	–	–	–	-.003	.058
PD x SC	–	–	–	–	-.058	.044
Covariates						
Age	-.002	.009	.001	.010	-.002	.010
Gender	.025	.240	.136	.247	.153	.251
Household Income	.056	.037	.046	.038	.041	.038
Hours Worked (a week)	-.001	.012	-.002	.012	-.002	.012
R^2	.008		.032		.050	
F	0.62		1.06		0.99	
ΔR^2	–		.024		.018	

Note. N= 314. Unstandardized Estimates are reported.

Discussion

The goal of the present study was to shed light on the relationships between job demands, job control, and physical activity during vacations. Drawing on the assumptions of the pamDC model (Häusser & Mojzisch, 2017), we proposed a negative relationship between job demands and physical activity during vacations. Furthermore, we hypothesized that experiences of high job control are positively related to physical activity during vacations. Moreover, the interaction of job demands and job control should lead to higher physical activity during vacations as in particular the combination of high demands and high control has shown to empower employees in terms of personal engagement and motivation (Karasek, 1976, 1979).

In a nutshell, we found job demands (i.e., time pressure, emotional demands, and physical demands) and job control (i.e., decisional control, scheduling control) to be unrelated to physical activity during a vacation trip. Likewise, there was no interaction effect of job demands and job control on physical activity during vacations. However, the absence of effects contributes to the literature on predictors of vacation behavior as well as to theorizing on the relationships between job characteristics and physical activity during leisure time.

Implications for Theory and Future Research

Our findings that job demands and job control show no relationships with physical activity during vacations are unexpected as previous studies had already found relationships between job characteristics and physical activity off-work (e.g., Abdel Hadi et al., 2020; Hellerstedt & Jeffery, 1997; Johansson et al., 1991; Popham & Mitchell, 2007; Sonnentag & Jelden, 2009). However, none of these studies tested for lagged effects whereas a few rather revealed relationships between job characteristics and LTPA on a day-level (e.g., Sonnentag & Jelden, 2009) or within comparably short time frames within experimental settings (e.g., Abdel Hadi,

et al., 2020). This might lead to the conclusion that the effects of job characteristics on LTPA rather unfold in a shorter time frame than over extended periods of time (i.e., over several weeks). In this vein, the pamDC model (Häusser & Mojzisch, 2017) suggests self-regulation as a driver for the effects of job demands on physical activity while job control is expected to be linked to physical activity by self-determination. The lack of evidence for relationships between job characteristics and lagged physical activity might be seen as indirect evidence for the proposed mediators as, for example, self-regulatory capacities are rather hampered by high job demands within shorter periods of time. Previous research on self-regulation is mainly based on experimental approaches where a first self-regulatory task negatively affected self-control attempts in a subsequent unrelated self-regulation task within a few minutes (e.g., Baumeister et al., 1998). Moreover, research shows that self-regulatory capacities can, at least to some extent, be restored through a short rest and are usually not impaired over extended periods of time (Tice et al., 2007). Hence, the propositions as made by the pamDC model might be highly dynamic within the individual and job characteristics may not necessarily unfold their effects over multiple weeks.

Apart from that, physical activity and vacation planning have been both shown to be influenced by multiple factors suggesting that additional variables might be important to the understanding of activity planning during a vacation. For example, a study by Heung et al. (2001) revealed that travel motives are important predictors for the way in which a vacation is planned and spent. For instance, individual motives including socialization, novelty-seeking, adventure-seeking, and the need for escape (Chon, 1989) turned out to be important factors for travel activity planning. It might be interesting to test whether job characteristics are related to certain types of motives that are influential for physical activity during vacations. For instance, job characteristics might influence travel motives, such as challenge-seeking, that in turn affect physical activity during vacations (cf. Nägel et al., 2015).

Besides, additional organisational factors like an organisational exercising climate – which is described as shared perceptions of the importance with regards to employees' physical activity for the organization – could increase the understanding of the relationships between work and physical activity during vacations (Sonnentag & Pundt, 2016). Employees working for an organization with a pronounced exercise climate might be more likely to plan active vacations to comply with the values and expectations of their organization.

Limitations and Strengths

This study is subject to some limitations. First of all, as all of our measures were based on self-reports, concerns regarding common-method variance cannot be completely ruled out (Podsakoff et al., 2003). Additionally, we used self-reports to measure physical activity. However, self-reported physical activity has been shown to overestimate actual behavior thereby increasing error variance (Adams et al., 2005). Finally, the reliability of our measures to assess job characteristics was somewhat low. With regard to the results of our study, this might have caused inflated standard errors, thereby increasing the risk of type II (false-negative) errors (Higgins & Straub, 2006). However, we used well established measures to capture our constructs (cf. Nübling et al., 2005) and confirmatory factor analyses revealed evidence for the factor validity of our scales.

Apart from its limitations the strengths of our study should be also considered. First of all, this is the first study to focus on time-lagged effects of job characteristics on physical activity off-work (i.e., during a vacation) thereby extending previous theorizing on the relationships between job characteristics and LTPA. Above that, a major strength of our study is the longitudinal design to collect data with regard to the relationships between job characteristics and physical activity during a vacation. Most of the previous studies that tested the relationships used cross-sectional analyses (e.g., Burton & Turrell, 2000; Kirk & Rhodes, 2012; Mutz

et al.., 2020; Ng & Jeffery, 2003), thereby running the risk of overlooking reversed causations (i.e., physical activity might increase psychological resilience, thereby leading to alterations in the judgment of job characteristics; Zapf et al., 1996).

Practical Implications and Conclusions

This study found job demands and job control to be unrelated to physical activity during a vacation. However, previous research revealed the effects of job characteristics on physical activity within shorter time frames (e.g., Abdel Hadi et al., 2020). As physical activity is an important promoter of health and well-being, it is important to increase knowledge with regard to factors that affect physical activity during leisure time as well as boundary conditions for these effects (e.g., the time frame in which job characteristics exert their effects on physical activity) to build more effective physical activity interventions.

Chapter 6: General Discussion

This dissertation focuses on the relationships between job characteristics, leisure-time physical activity (LTPA), and well-being, and had four major research goals:

(1) Testing whether job demands and job control can be used to predict LTPA. Moreover, evaluating self-regulation and self-determination as potential underlying mechanisms for these effects: While the negative effect of job demands on LTPA is assumed to be mediated through self-regulatory capacities, the positive effect of job control on LTPA should be mediated through self-determination.

(2) Testing the mediating role of LTPA for the effects of job demands and job control on well-being as proposed by the pamDC model (Häusser & Mojzisch, 2017) thereby extending the basic assumptions of the JDC model (Karasek, 1979) to LTPA as a mediating variable.

(3) Taking several methodological approaches to test these questions, thereby increasing the eligibility of inferences especially with regard to causality. I used experimental designs that are suitable to draw conclusions regarding the direction of a relationship between job characteristics and LTPA as a supplement to externally more valid field studies. Furthermore, whenever it was possible, the assessment of LTPA is based on more objective measures such as accelerometry to rule out concerns regarding response biases due to self-reports.

(4) Further elaborating on the temporal dynamics of the proposed relationships. Previous theorizing and empirical studies, so far, have mostly neglected the time frame in which the effects of job characteristics on LTPA rather unfold (e.g., by focusing on intra-individual differences over days within a diary study). However, this seems important to increase understanding of the proposed relationships between job characteristics,

LTPA, and well-being and to be crucial for the creation of a practical output (i.e., the planning of interventions that aim to increase well-being and health through LTPA). Additionally, I differentiate between various types of leisure, such as after-work hours and vacation. This also helps to increase knowledge regarding the generalizability of the effects across different kinds of leisure.

To answer these questions, I conducted five empirical studies that are presented in Chapters 2 to 5. The studies differed in *i)* their scope of research (testing the pamDC model in an integrated framework [*Study 1*], testing the relationships between job demands, job control, and LTPA [*Studies 3* to *5*], and developing and testing a workplace simulation that can be used to test the causal effects of job characteristics on LTPA [*Study 2*]), *ii)* the methodological approach that was employed to test the propositions (field studies in a natural environment [*Studies 1* and *5*] versus experimental studies with manipulations of job demands and job control and exact measures of physical activity [*Studies 2* to *4*]), and *iii)* the time focus (short term focus [*Studies 1* to *4*] versus extended time focus [*Study 5*]). In the following sections, I will summarize the key findings for every study (see Table 1.1 in the general introduction section for an overview). This will be followed by a general discussion for the joint implications across all studies including their importance for theory and practice.

Summary of Results

Study 1: Testing the Assumptions of the pamDC Model in an Integrated Framework

The *first study* in Chapter 2 investigated whether the effects of job demands and job control on psychological well-being are mediated by LTPA. In an ambulatory assessment study, a sample of 207 employees wore an accelerometer to monitor physical activity and answered, three times a day, brief questionnaires addressing job characteristics, self-regulatory capacities, feelings of self-determination, and psychological well-being (8,059 observations

in total). Results showed that day-specific job demands were negatively related to different indicators of daily well-being in the evening and to LTPA. I also found evidence for the predicted mediation of the relationship between day-specific job demands and daily well-being in the evening via daily LTPA after work. Contrary to expectations, job control was not related to LTPA on a daily basis and LTPA did not mediate the effects of job control on well-being.

Study 2: Development and Evaluation of a Workplace Simulation

Chapter 3 (*Study 2*) describes a pilot study to develop and evaluate a workplace simulation consisting of call center customer interactions that should be used to test the effects of job characteristics on LTPA under more controlled experimental conditions. Results based on data provided by 98 participants revealed that the customer interactions were effective in altering perceived demands as participants reported higher levels of (impulse control) demands in the high demands condition compared to low demands.

Studies 3 and *4*: Experimental Tests for Causal Effects of Job Characteristics on Off-Work Physical Activity

Studies 3 and *4* (Chapter 4) aimed to test for causal effects of job demands (through self-regulation) and job control (through self-determination) on physical activity after work. In two experiments (total $N = 251$), participants completed a work simulation that was followed by a physical activity task (cycling on a bicycle ergometer). In *Studies 3* and *4*, task demands (high vs. low) were manipulated between-subjects in terms of customer friendliness in a call center task and difficulty of arithmetic tasks. In *Study 4*, I additionally manipulated job control (high vs. low) in terms of decision latitude. As predicted, *Studies 3* and *4* showed negative effects of job demands on physical activity, that is, time on the bicycle ergometer was lower for individuals in the high demands condition, as compared to the low demands condition. However, this effect was not mediated by self-regulatory capacities. Regarding job

control, I found the expected indirect effect on physical activity through increased self-determination in *Study 4*.

Study 5: Examining the Relationships Between Job Characteristics and Physical Activity During Vacation

Study 5 (Chapter 5) sought to investigate whether job demands and job control act as a predictor for physical activity during vacation. I conducted a prospective study with two waves of measurement (Time 1: up to six weeks in advance of a vacation [N = 408]; Time 2: one week after returning back home [N = 314]). Results revealed no relationships between job demands, job control, and physical activity during vacation. The absence of effects of job demands and job control on physical activity during vacation might be explained by the highly dynamic relationship of job design features with physical activity (i.e., effects might unfold in shorter time frames, like evenings and weekends).

Theoretical Contributions for the Relationships Between Job Characteristics, LTPA, and Well-Being

Overall, findings across all studies provide important insights into the relationships between job characteristics, LTPA, and psychological well-being. First of all and in accordance with the pamDC model (Häusser & Mojzisch, 2017), the analyses lend broad support for the assumption that job characteristics affect LTPA. This was mainly the case for job demands as three out of four studies (*Studies 1*, *3*, and *4*, but not *Study 5*) – that explicitly tested for negative effects of job demands on physical activity – revealed significant results. However, integrating the findings of all studies, the mediation of self-regulation for the effect of job demands on after-work physical activity could not be supported as only one out of three studies (*Study 3*) found a mediation of job demands on off-work physical activity through self-regulation which was even in the opposite direction (a positive indirect effect instead of

the expected negative mediation). Regarding the relationships between job control and physical activity, findings are rather mixed: None of the three studies (*Studies 1, 4,* and *5*) – that explicitly tested for a positive relationship between job control and after-work physical activity – found direct effects. However, one study (*Study 4)* found an indirect effect of job control on physical activity through self-determination. Above that, the assumed mediation of LTPA for the relationships between job characteristics and well-being was found for job demands (S*tudy 1*), whereas no mediating effect of LPTA for the effects of job control on well-being was found due to the missing link between job control and LTPA.

(Causal) Effects of Job Characteristics on Physical Activity

I used a mixed methods approach to extensively test the relationships between job demands, job control and LTPA to rule out concerns regarding causality while sustaining external validity high.

As stated above, altogether the studies support the relationship between job demands and after-work physical activity as three out of four studies (that tested these relationships) found an effect. The combination of longitudinal data studies with an experimental approach leads to the conclusion that it is highly likely that these findings can be generalized to a broad working force while evidence regarding causal inferences is also provided. However, *Study 5*, which focused on time-lagged effects of job demands on physical activity during a vacation, found no support for the assumption that physical activity is influenced by job demands. Overall, this leads to the conclusion that job demands do have effects on physical activity, although these effects might highly fluctuate within persons over days rather than unfolding in an extended time frame. In light of these findings, job characteristics are suggested to mainly spill-over into physical activity behavior during after-work hours.

Moreover, across all studies, I found no support for a mediating effect of self-regulation for the effects of job demands on physical activity (although one study revealed an unexpected positive indirect effect through self-regulation; see Chapter 4 for a more detailed discussion). Consequently, the studies provide support for a direct effect of job demands on after-work physical activity whereas the mechanisms for this effect remain unclear. One possible explanation for the lack of support might be that other variables are more important as an underlying mechanism, for example, ruminative thinking. Employees are sometimes faced with cognitive ruminative processes after dealing with high demands at work (Aronsson et al., 2003; Cropley & Millward Purvis, 2003; Vahle-Hinz et al., 2014). Ruminative thoughts that are triggered by dealing with high job demands might lead to behavioral inhibition and decreased LTPA as a consequence (Keune et al., 2012). Apart from that, another reasonable explanation for the non-significant findings of self-regulation as a mediator might be an unfavorable operationalization of self-control as a capacity (that can get drained). Currently, there is an ongoing debate on the foundations of self-control as a recent meta-analysis by Hagger et al. (2016) cast doubt on the – until then – well-established definition of self-regulation as a resource that can get depleted (the so called ego-depletion hypothesis; Baumeister et al., 1998). Friese et al. (2019) argue that evidence regarding the ego-depletion effect is inconclusive and that there is also the chance that it is mainly a result of publication bias and *p*-hacking. Although this dissertation did not explicitly build on Baumeister's self-regulation theory, the measure used to assess self-regulatory capacities was developed on the basis of the ego-depletion effect (cf. Bertrams & Dickhäuser, 2009). Integrating measures that draw on other theoretical accounts of self-regulation might offer new perspectives on its role for the effects of job demands on LTPA. For example, alternative theorizing focuses on *affective-motivational shifts* that are the reason for impairments in self-control (Inzlicht & Schmeichel, 2012). Considering measures that capture volitional processes might therefore be a fruitful endeavor to shed light on motivational and attentional self-control processes. Alternatively, considering

the assumptions of the opportunity cost model (Kurzban et al., 2013), self-control can be conceptualized as a *decision* to engage in one course of action (e.g., exercising during leisure) over another (e.g., relaxing in front of the television after work). According to Kurzban et al. (2013), individuals are constantly weighing up the costs and benefits associated with engagement in an activity. Hence, accounting for cognitive processes that are linked to opportunity costs might be also helpful to increase understanding with regard to the role of self-control for engagement in LTPA.

Regarding the effects of job control on LTPA, this dissertation consistently revealed no support. This finding is in contrast to previous studies that did show positive relationships between job control and LTPA (e.g., Bennett et al., 2006; Choi et al., 2010; Fransson et al., 2012; Hellerstedt & Jeffery, 1997; Johansson et al., 1991; Kouvonen et al., 2005; Payne et al., 2002; Tsutsumi et al., 2003). There are different explanations that might be helpful to the understanding of this discrepancy. One reason might be that most of the studies in this dissertation focused on short-term effects (*Study 1*: effects of job control on physical activity within days; *Study 3*: effects of job control on physical activity within a lab experiment). It is probable that job control needs time to exert its positive effects, for instance, by building self-efficacy and a personal drive to learn and try new things (cf. Bond & Flaxman, 2006). However, *Study 5*, which did test for time-lagged effects, also revealed no relationships between job control and physical activity. Hence, it might be more reasonable to argue that the non-significant findings are due to the fact that job control does not substantially impact LTPA and that relationships found in previous studies might be mostly due to reversed causation as all of the past studies were cross-sectional. In contrast to previous research, the studies of this dissertation provide results that allow causal interpretations (at least to some extent) since all of the studies measured job control in advance to physical activity or even employed experimental designs. Consequently, earlier findings might be due to positive effects of LTPA on factors that affect the perception of job control (cf. Calderwood et al., 2016). For example, LTPA

might be able to increase self-efficacy, feelings of competence or resilience, which in turn might alter the perception of job control through altered appraisal processes or even lead to crafting behaviors in terms of shaping and developing personal spaces of autonomy and decision making (Tims & Bakker, 2010).

Furthermore, the pamDC model proposes that the relationships between job control and LTPA are mediated through self-determination. Findings regarding this assumption are inconsistent. In two studies (*Studies 1* and *4*), I tested the mediation effect of self-determination for the effects of job control on LTPA: While *Study 1* found no support for this assumption, *Study 4* found a positive indirect effect of job control on post-work physical activity through self-determination (i.e., need for autonomy satisfaction). Hence, this dissertation revealed mixed findings and follow up studies are needed to develop further knowledge with regard to this gap.

Mediating Role of LTPA for the Effects of Job Characteristics on Well-Being

A further key contribution of this dissertation is the first empirical evaluation of LTPA as a mediator for the relationships between job characteristics and well-being. In line with expectations, I found a mediating effect of LTPA for the relationships between job demands and various well-being dimensions in the evening. Job demands were negatively related to LTPA, which in turn, showed positive relationships with well-being. Further studies of this dissertation that focused on the effects of job demands on LTPA under more controlled conditions aimed to increase confidence with regard to the assumed processes (that job characteristics affect LTPA, which in turn has been shown to be related to well-being in a wealth of prior research; cf. Penedo & Dahn, 2005). This is important as mediation hypotheses are always based on strong assumptions with regard to causality but often do not account for the possibility of reversed effects (Stone-Romero & Rosopa, 2011). With regard to the mediating

role of LTPA for the effects of job control on well-being, I could not find any support as evidence for a relationship between job control and LTPA is not given (except by preliminary evidence for an indirect effect through self-determination). Overall, this implies that the mediation hypothesis as proposed by the pamDC model (Häusser & Mojzisch, 2017) is preliminarily supported. However, this is only the case for the health impairing effects of job demands on well-being. With regard to job control, other factors might be more likely to explain why job control is positively related to well-being. In this vein, Sonnentag and Zijlstra (2006) revealed *need for recovery* as a mediator of the link between job control and well-being: Job control was negatively related to need for recovery, which in turn was predictive for subjective well-being. Hence, job control seems to be crucial for vitality management as expected by the pamDC model, but these effects might not spill-over into leisure time health behavior. Consequently, it is possible that the assumed mediation by the pamDC model (Häusser & Mojzisch, 2017) is limited to job demands.

Importance of Mixed Method Approaches in Occupational Health Research

Occupational Health Psychology in general is concerned with the identification of organizational factors that cause health issues or factors that can serve as promoters of health. Hence, it is of great importance to identify issues in real life working environments and to evaluate the impact of an intervention directly where it is needed. However, despite their importance for theory and practice some concerns regarding causality and confounding variables still remain in such field research (Cook et al., 1979). The only way to test for causality is within experimental settings (Highhouse, 2009). Even cross-lagged panel analyses were earlier questioned in their ability to test for causality (Hamaker et al., 2015). A suitable way to sustain the generalizability of findings while developing profound knowledge regarding causality is applying a mixed methods approach (Turner et al., 2017). With regard to this dissertation, using mixed methods turned out to be an effective way, once more. As earlier men-

tioned, *Study 1* (daily diary study) is an important source of evidence with regard to the relationships between job characteristics, physical activity, and well-being in a natural environment but these data do not offer the possibility to draw reliable conclusions regarding causality, that is, whether the proposed relationship might be due to changes in the perception of job characteristics, with physical activity influencing employees' appraisal of a stressor or even leading to proactive behaviors that shape working environments (Calderwood et al., 2016; Tims & Bakker, 2010). Therefore, the findings of the experimental studies in Chapter 4 complemented the findings of the field studies. For theory and practice, the synergy of both approaches to test and further develop psychological theories is crucial. For instance, theoretical knowledge about the impact of job characteristics on LTPA might build the fundament for the planning of interventions in practice. However, building interventions based on the assumption that job characteristics influence physical activity, although these relationships are reversed, can cause serious damage for theory and practice and furthermore can lead to issues regarding confidence and credibility of scientific output.

Temporal Dynamics of the Relationships Between Job Characteristics, LTPA, and Well-Being

Regarding the temporal dynamics in which the effects of job demands, and job control unfold on LTPA, the provided data lead to the conclusion that the effects of job characteristics on LTPA – more specifically the effects of job demands as I found no support for the relationships between job control and LTPA – rather unfold within shorter time frames. All studies that found effects focused on relationships within experimental settings (usually taking less than two hours; *Studies 3* and *4*) or within-persons over days (*Study 1*). Analyses of lagged effects *in Study 5* revealed no relationships between job characteristics and LTPA. Moreover, the proposed mediation of job characteristics on well-being through LTPA was

also found on a day-level. Hence, the central ideas of the pamDC model (Häusser & Mojzisch, 2017) seem to describe mostly short-term processes. However, they are still relevant as short-term effects can have long-term consequences: For example, chronically high job demands can lead to habitually low levels of physical activity (cf. Pérusse et al., 1989; Rydwik et al., 2010), which, in turn, increases the general risk of mental and physical ill-health (Pasco et al., 2011).

Strengths and Limitations

Overall, this dissertation project has a number of strengths that are noteworthy. A major strength is the application of a mixed methods approach to converge on the "big picture" of the relationships between job characteristics, LTPA, and well-being. Thereby, the combination of various psychological research methods allows to *i)* generalize findings to the real world as it uses methods to study the relationships where they occur, and *ii)* draw conclusions regarding causality as I employed micro-world workplace simulations with experimental manipulations of the proposed predictors. This is especially of importance in the field of Occupational Health psychology as most findings are based on field data. A study in the early 2000s by Austin et al. (2002) found that about 78 percent of the scientific output in the *Journal of Applied Psychology* was based on correlational field data. However, overreliance on correlational field data is a problem as they do not allow strict conclusions to be drawn regarding causality (Highhouse, 2009; Mitchell, 2012).

A second strength, with regard to the methodology of this project, is the use of different methods to assess physical activity. This helps to decrease the risk of common-method bias (Podsakoff et al., 2003). Common-method bias (also known as common-method variance) can lead to the overestimation of real effects due to unwanted response tendencies (Podsakoff et al., 2012). Furthermore, individuals tend to over-report physical activity as it is a highly appreciated behavior by the social environment (Adams et al., 2005). In contrast to

previous research, many of the studies in this dissertation used more objective methods (e.g., accelerometry in *Study 1*, and objective assessment of physical activity on a bicycle ergometer in *Studies 2* to *4*) rather than self-reports. Thereby, confidence in the validity of the assessment is increased and the influence of reporting biases decreased to some extent (Reilly et al., 2008). Apart from physical activity, self-reports also have their pitfalls when it comes to researching job characteristics. Previous studies that used self-reports to assess job characteristics often do not account for the influence of confounding variables or reversed effects instead of treating them as rather objective (Bakker & Demerouti, 2017). Asking employees to indicate their working conditions (retrospectively) leads to highly subjective evaluations and carry a high risk of biases due to cognitive and perceptual processes (Mazzetti et al., 2016). For example, individuals that are high in rumination might have difficulties in detaching from work, thereby feeling increasingly unrecovered (Kinnunen et al., 2011). This might lead to a different perception of job characteristics as work demands might seem harder to meet with high levels of need for recovery (Demerouti et al., 2007). Consequently, using experimental approaches is a great way to more objectively examine the effects of job characteristics (cf. Häusser et al., 2011).

Last but not least, all conclusions are based on data that offer a fairly high statistical power. I took great care to find a sufficient sample size in all conducted studies, in combination with various other factors that are relevant for statistical power. For example, results of *Study 1* are based on a large sample (207 employees that provided 8,059 surveys) combined with within-person analyses that further increase the possibility to detect relevant effects. In a similar vein, I tried to decrease error variance in the experiments through creating powerful and distinct manipulations. Highhouse (2009) argues that specific experimental manipulations with a low level of error variance are crucial to increase statistical power in experimental studies.

Although the combination of the studies in this dissertation project has a number of strengths, without any doubt it also has some limitations which should be considered when drawing conclusions from the present findings. First of all, although we can assume that job demands affect LTPA, the possibility should not be ruled out that this relationship is bi-directional as we did not test reversed effects.

Second, job characteristics were collected as rather broad dimensions in all studies (apart from *Study 5*). I did so, as these studies were the first to test the assumptions as proposed by the pamDC model (Häusser & Mojzisch, 2017). Therefore, rather broad categories were applied to establish the relationships in different settings (laboratory and field settings) for the first time and specific effects of subtypes of job characteristics cannot be addressed.

Third, although most of the studies in this dissertation applied more objective methods to measure physical activity, with regard to the underlying mechanisms for the relationships between job characteristics and LTPA (i.e., self-regulation and self-determination) I used self-reports to assess the variables. Self-reports are still the most common approach to assess inner processes like self-regulatory processes or psychological need satisfaction (cf. Baumeister et al., 2007). Especially with regard to self-regulation there is no evidence for the proposed mediation which leaves room for alternative ways to operationalize this construct. More objective measures of self-control (e.g., systolic blood pressure or pupil dilation; cf. van der Wel & van Steenbergen, 2018) might be able to provide new insights into the mediating role of self-regulation and offer new perspectives on the theory debate surrounding the foundations of self-regulation as Friese et al. (2019) recently questioned the idea of treating self-control as a resource that can be depleted (for a detailed discussion, see above).

Implications for Future Research

This dissertation project provides many important implications for future research. As this dissertation used rather broad operationalizations of job characteristics in most of its studies it might be worthwhile for future research to follow up on this topic by testing effects of subdimensions of job demands and job control. With regard to job demands, some types might be more strongly related to LTPA compared to others. Therefore, it might be worthwhile to extend the assumptions of the pamDC model by integrating ideas from related frameworks and conceptualizations. For instance, the basic assumptions of the challenge-hindrance framework (Cavanaugh et al., 2000; Podsakoff et al., 2007) might offer important implications for future research, as for example hindrance demands (e.g., interruptions) might be more influential for LTPA compared to others that are based on challenge (e.g., time pressure). In this vein, Sonnentag and Jelden (2009) found relationships between job demands and LTPA only for situational constraints, which reflect a typical hindrance stressor. Moreover, and in line with the assumptions of the pamDC model, certain types of job demands that require regulatory control (e.g., impulse control) might be more important when it comes to LTPA compared to others as they might have a higher potential to spill-over into leisure-time through the impairment of self-regulatory capacities (Schmidt & Neubach, 2007). Similarly, some types of job control might be more influential for LTPA compared to others. In light of the findings, types of job control that are able to increase self-determination without increasing demands too much seem more likely to increase LTPA (cf. Gerdenitsch et al., 2015).

With regard to the underlying mechanisms (i.e., self-regulation and self-determination) for the relationships between job characteristics and LTPA, future studies should try to apply alternative conceptualizations to develop new insights. As there is especially a lack of evidence regarding the role of self-control for the effects of job demands on LTPA, researchers might consider conceptualizing self-control more in the form of motivational-attentional processes as

suggested by Inzlicht and Schmeichel (2012) rather than a limited capacity (cf. Baumeister et al., 1998). Other ways to conceptualize self-control might be based on opportunity costs that come with the decision to engage in self-control after work (Kurzban et al., 2013). Apart from different theoretical accounts of self-regulation, it seems worthwhile to apply additional (more) objective measures of self-control to supplement self-reports. Although the latter are most common in psychological research, Friese et al. (2019) suggest integrating objective measures of self-control (e.g., systolic blood pressure or pupil dilation; cf. van der Wel & van Steenbergen, 2018) as both types of measurement might reflect different aspects of self-control. While self-reports are based on perceived changes of subjective states due to self-regulatory effort, objective measures reflect physical effort that has been invested during a self-regulatory demanding task (see Friese et al., 2019, for a discussion).

Furthermore, it might be worthwhile to add further mediating mechanisms for the relationships between job characteristics and after-work physical activity. As the present studies found no mediating effect of self-regulatory capacities for the relationship of job demands and after-work physical activity, future studies should consider alternative pathways that link job demands to physical activity, for example, ruminative cognitions (Keune et al., 2012). Regarding the relationships between job control and LTPA, future research might consider integrating additional constructs that are related to self-determination. Our studies mostly build on the need for autonomy as it turned out to be one of the most fundamental psychological needs for human functioning (Cerasoli et al., 2016; de Charms, 1968). However, adding other psychological needs like the need for competence and the need for relatedness might increase the predictive power of self-determination as a mediator for the effects of job control on LTPA (cf. Vlachopoulos & Michailidou, 2006). Furthermore, it might be interesting to consider other mediators that can add further explanatory power for these relationships, like reduced work-non-work conflict due to increased scheduling control (Nijp et al., 2012).

Apart from that, as the WHO recommendations (2016) for physical activity are based on moderate-to-vigorous physical activities, the present dissertation project mostly focused on these kinds of LTPA. However, it is worthwhile to test for differences with regard to other levels of physical activities (e.g., whether engagement in activities like going for a walk is impaired to the same extent as vigorous exercising at a gym). Furthermore, it seems to be a fruitful avenue to integrate habit strength as a moderating variable for the relationships between job characteristics and LTPA (cf. Gardner et al., 2011). While employees in the early stages of physical activity intentions might be more prone to be physically inactive due to high job stressors, employees that have well established physical activity routines may not rely on mental resources to initiate physical activities to the same extent (cf. Dorris et al., 2012). Furthermore, motives for engagement in physical activity might be an important factor that should be considered when it comes to the mediating role of LTPA for the relationships of job characteristics and well-being. In this vein, some motives might be more strongly related to the experiences of joy and pleasure when engaging in LTPA (Hagger et al., 2002). The experience of joy might play a crucial role for the understanding of particular conditions under which LTPA mediates the effects of job characteristics on well-being. On the one hand, when LTPA is seen as a pleasurable activity it might be less prone to become impaired by job demands. On the other hand, LTPA that is done for pleasure might be more powerful in increasing health and well-being (Nägel et al., 2015).

Last but not least, a key concern of this dissertation was to employ a mixed methods approach to increase confidence with regards to internal validity while keeping external validity high (Turner et al., 2017). Since the test of the mediation of LTPA for the effects of job characteristics on well-being was based on correlational field data it might be worthwhile to add studies that are based on experimental approaches to test for mediation effects. Stone-Romero and Rosopa (2011) argue that experimental tests of mediation are superior to non-

experimental tests in terms of internal validity and thereby are important opportunities in addition to field studies.

Practical Implications

Several practical implications can be drawn from the research presented in this dissertation. First of all, the studies show that workplace health promotion with a focus on physical activity performed outside work is of great importance as LTPA helps to maintain the mental well-being of employees. Hence, it should be an organizational effort to support physical activity. However, the studies also show that individuals with high job demands are more prone to be physically inactive although physical activity could be an effective strategy to compensate for negative effects of job demands on well-being. Organizations should take this into account when planning physical activity programs as these offers might not reach out to individuals with high demands at work although they could benefit most from it. Furthermore, this research points to the crucial importance of reducing job demands wherever it is possible and to integrate job resources such as certain types of job control that can satisfy the basic need for autonomy. Helping employees to stay physically active during leisure time by optimizing work conditions has important effects for organizations in the long run as healthy employees show reduced periods of sickness absence (Cooper & Dewe, 2008) and increased work engagement (Wright & Cropanzano, 1998).

Concluding Remarks

A plethora of research has found evidence for the assumption that job characteristics are highly influential for workers' health and well-being. This dissertation made several contributions to the research on the relationships between job characteristics, LTPA, and well-being by providing causal evidence that job characteristics have an effect on LTPA. This was most evident for job demands, but I also found preliminary evidence for an indirect effect of

job control on LTPA through self-determination. Furthermore, I found that LTPA can act as a mediator for the effects of job characteristics on well-being since job demands turned out to be a negative predictor for LTPA, which, in turn, positively contributes to well-being. Apart from that, this dissertation suggests that the effects of job characteristics on LTPA mainly unfold in a shorter time frame (e.g., within days) as I could not find time-lagged effects of job characteristics on physical activity during vacations but mainly effects within days. Regarding the underlying mechanisms for the effects of job characteristics on LTPA, future research is needed to identify mediators for these relationships as especially for self-regulation no evidence could be found. To sum up, it is highly valuable to consider the interplay of job characteristics, LTPA, and well-being to sustain employee health.

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Abdel Hadi, S., Bakker, A. B., Häusser, J. A. The role of leisure crafting for emotional exhaustion in telework during the corona virus pandemic. Revise and resubmit request at *Anxiety, Stress, & Coping*.

Abdel Hadi, S., Mojzisch, A., Krumm, S., & Häusser, J. A. Day-level relationships between work, physical activity, and well-being: an ambulatory assessment study. Revise and resubmit request at *Work & Stress*.

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