



# Challenge and hindrance demands in relation to self-reported job performance and the role of restoration, sleep quality, and affective rumination

Michelle Van Laethem<sup>1\*</sup> , Debby G. J. Beckers<sup>2</sup>,  
 Jessica de Bloom<sup>3,4</sup>, Marjaana Sianoja<sup>3</sup> and Ulla Kinnunen<sup>3</sup>

<sup>1</sup>Department of Work and Organizational Psychology, University of Amsterdam, The Netherlands

<sup>2</sup>Behavioural Science Institute, Radboud University, Nijmegen, The Netherlands

<sup>3</sup>Faculty of Social Sciences (Psychology), University of Tampere, Finland

<sup>4</sup>Faculty of Economics and Business, HRM &OB, University of Groningen, The Netherlands

Longitudinal research on the relationship between job demands and job performance and its underlying mechanisms is scarce. The aims of this longitudinal three-wave study among 920 Finnish employees were to ascertain whether (1) challenge job demands (i.e., workload, cognitive demands) and self-reported job performance are positively related over time, (2) job insecurity (i.e., a hindrance demand) and job performance are negatively related over time, (3) restorative experiences during off-job time and sleep quality are underlying mechanisms in these relations, and (4) affective rumination mediates the proposed relations of job demands and job insecurity with restoration and sleep quality. Self-report data were analysed with structural equation modelling. The results revealed a positive, temporal relationship between challenge job demands and job performance (task and contextual performance) across 1 year, but no temporal relationship between job insecurity and self-reported job performance. Moreover, high challenge job demands were positively related to the restorative value of off-job activities, and favourable restoration was positively related to subsequent task performance. Finally, affective rumination mediated the relationship of challenge job demands with both restoration and sleep quality. Job insecurity was not longitudinally related to restoration, sleep quality, or affective rumination. The implications of our findings for occupational health psychology are discussed.

## Practitioner points

- Provide employees with sufficient job resources (e.g., high autonomy and social support) to adequately deal with high job demands.
- Allow employees sufficient time to recover from high job demands during off-job time and provide training sessions in recovery, relaxation, meditation, and goal setting.
- Employees may attempt to counteract perseverative thoughts by actively pursuing distracting restoration activities (e.g., exercise, meditation).

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\*Correspondence should be addressed to Michelle Van Laethem, Department of Work and Organizational Psychology, University of Amsterdam, P.O. Box 15919, 1001 NK Amsterdam, The Netherlands (e-mail: m.vanlaethem@uva.nl).

Numerous scientific theories and empirical studies have focused on explaining how job demands (i.e., stressors) affect health and job performance (Cheng & Chan, 2008; Gilboa, Shirom, Fried, & Cooper, 2008; Schaufeli & Taris, 2014). Job stress models, such as the job demands–control model (Karasek, 1979) and the job demands–resources model (Demerouti, Bakker, Nachreiner, & Schaufeli, 2001; Schaufeli & Taris, 2014), suggest that job demands are important predictors of well-being and job performance. In addition, it has been proposed that some job demands may be appraised as challenges (i.e., as challenge demands) and may have a favourable effect on performance, while others may be appraised as hindrances (i.e., as hindrance demands), negatively impacting performance (Cavanaugh, Boswell, Roehling, & Boudreau, 2000; LePine, Podsakoff, & LePine, 2005). However, few empirical studies so far have aimed to provide a detailed picture of the mechanisms underlying the pathway from high challenge and hindrance demands to job performance.

Two underlying mechanisms may be key in explaining the complex relationship between job demands and job performance: restorative experiences during off-job time and sleep quality. These are essential for replenishment of an employee's resources during off-job time (Meijman & Mulder, 1998), enabling sustainable performance. To date, the role of restoration and sleep quality as underlying mechanisms in the association between job demands and job performance has been often overlooked and not properly studied (cf. mostly with cross-sectional designs).

A more detailed picture of the pathway from job demands to performance also includes a focus on the role of stress-related cognitive processes, like rumination, preceding and influencing restoration and sleep quality (Åkerstedt, Nilsson, & Kecklund, 2009). Affective rumination refers to a negative thought process defined as 'a cognitive state characterized by the appearance of intrusive, pervasive, recurrent thoughts, about work, which are negative in affective terms' (Cropley & Zijlstra, 2011, p. 493). Affective rumination may act as a mediator in the relationship between job demands on the one hand, and restoration and sleep quality on the other hand.

Examining challenge and hindrance demands in relation to job performance, as well as possible underlying mechanisms, is warranted for both theoretical and practical reasons. From a theoretical perspective, this study contributes to the literature by addressing important research gaps: Few empirical studies so far aimed to provide a detailed picture of the underlying mechanisms in the pathway from high challenge and hindrance demands to job performance. Additionally, longitudinal designs have rarely been used to examine the temporal relations between the concepts of these pathways. The three-wave longitudinal design used in our study offers a unique possibility to study the pathways and the consequences for job performance for up to 2 years. Thus theoretically, our aim was to fill these research gaps and expand the challenge–hindrance stressor model developed by Cavanaugh *et al.* (2000) by including potential underlying mechanisms of the long-term demand–performance relationship. From a practical perspective, our findings may be of help to improve job design, to develop and plan organizational interventions, and enhance productivity of the workforce.

The specific objectives of this study were to examine whether (1) challenge demands and job performance are positively related over time, (2) hindrance demands and job performance are negatively related over time, (3) restorative experiences during off-job time and sleep quality are underlying mechanisms in these relations, and (4) affective rumination mediates the relations of challenge and hindrance demands with restoration (i.e., the restorative value of off-job activities) and sleep quality.

### **Challenge and hindrance demands in relation to job performance**

Researchers initially assumed high levels of job demands to be invariably unfavourable for employees' performance (Kwag & Kim, 2009). However, previous research revealed inconsistent findings, including evidence for both negative and positive relations (see LePine *et al.*, 2005; for a review). This indicates that the relationship between job demands and job performance is complex. The challenge–hindrance stressor model of Cavanaugh *et al.* (2000) addresses this complexity. A core element of the model is the distinction between 'challenge' and 'hindrance' demands. Challenge demands refer to demands offering an opportunity for personal growth and rewards, such demands being workload and job complexity (Cavanaugh *et al.*, 2000; Crawford, LePine, & Rich, 2010; Webster, Beehr, & Love, 2011). To the extent that they are not too high, these challenge demands may be positively related to job performance. Hindrance demands refer to stressful demands such as long-term exposure to high job insecurity (i.e., the perceived threat of losing the current job), role ambiguity, or role conflict (Cavanaugh *et al.*, 2000; Crawford *et al.*, 2010; Webster *et al.*, 2011). These demands are either not associated with the opportunity for personal growth and rewards or may even hinder them and are expected to be negatively related to job performance in the long run.

A meta-analysis of mostly cross-sectional studies by LePine *et al.* (2005) indeed found support for the challenge–hindrance stressor model. In the studies included in the meta-analysis, job performance was most often self-reported and reflected overall job performance, but also objective assessments and supervisor and peer ratings were used. More specifically, it revealed that many studies reported a positive relation between challenging job demands (e.g., workload, cognitive demands) and job performance. Additionally, research has supported a slight negative relation between job insecurity (i.e., a hindrance demand) and job performance (see Cheng & Chan, 2008; Sverke, Hellgren, & Näswall, 2002, for meta-analyses). Most of the studies in these meta-analyses relied on self-reported measures of performance.

Notably, research on the demand–performance association has been quite one-dimensional, with insufficient attention paid to the richness of the performance concept (see Koopmans *et al.*, 2011; Sonnentag, Volmer, & Spychala, 2008). Most earlier studies have almost exclusively focused on task performance. However, performance is a multidimensional concept encompassing an outcome aspect and behavioural aspect (Sonnentag *et al.*, 2008). The outcome aspect refers to the product or result of an employee's behaviour (e.g., number of sales, targets attained). The behavioural aspect consists of the behaviour itself and what employees actually do to establish the preferred outcomes (e.g., sale negotiations with customers). In our study, we included both aspects of performance. The behavioural aspects are mostly reflected in the measurement of contextual performance, and the outcome aspects are central in the measurement of task performance. The distinction between contextual and task performance is another element of the multidimensionality of job performance.

Whereas task performance refers to employee's success in performing the duties formally required on the job (reflecting accomplishment of tasks), contextual performance refers to work behaviours that benefit the organizational, social, and psychological environment in a broader sense, potentially also supporting core task performance but not formally required on the job (Motowildo, Borman, & Schmit, 1997). It includes organizational citizenship behaviour and prosocial behaviour at work (Sonnentag *et al.*, 2008) such as helping colleagues with their tasks or endorsing organizational initiatives. As both contextual performance and task performance are key to organizational prosperity (Bolino & Turnley, 2005; Podsakoff, MacKenzie, Paine, & Bachrach, 2000), it

is essential to include both types of performance in research, as each performance dimension may be predicting different aspects of organizational success (Sonnentag *et al.*, 2008).

The few studies that examined challenge demands (e.g., workload, time pressure) in relation to contextual performance found support for a positive relationship (Ohly & Fritz, 2010; Rodell & Judge, 2009) or found no evidence for a relation between challenge demands and contextual performance (Wallace, Edwards, Arnold, Frazier, & Finch, 2009). So far, most earlier studies used various designs such as cross-sectional or experience sampling and relied on self-rated and/or supervisor-rated performance. Moreover, task and contextual performance are often combined into one overall factor of job performance. The relationship of challenge demands with task and contextual performance may differ and may thus be an explanation for some of the previous null-findings in studies focusing on one overall performance concept. Having a high workload and cognitive demands may leave little room (no time, no mental capacity) for work behaviours beyond one's formal work tasks. It may be hard to 'walk the extra mile' if one is burdened with a lot of work and deadlines, resulting in a weaker positive relationship between challenge demands and contextual performance compared to task performance. For hindrance demands, the negative relationship with contextual performance seems more straightforward. Most studies have revealed evidence for a negative relation between hindrance demands (e.g., job insecurity) and contextual performance (King, 2000; König, Debus, Häusler, Lendenmann, & Kleinmann, 2010; Reisel, Probst, Chia, Maloles, & König, 2010). All of the mentioned studies used self-rated behaviour measures, and only König *et al.* (2010) used supervisor ratings in addition to self-report measures.

Performance has often been assessed with other ratings (e.g., supervisor ratings, co-worker ratings) which are considered to be less susceptible to social desirability biases compared to self-reported performance (Carpenter, Berry, & Houston, 2014; Chan, 2009). However, employees are often more knowledgeable about their own work behaviour and actual work tasks than their supervisors or co-workers (Berry, Carpenter, & Barratt, 2012; Carpenter *et al.*, 2014; Chan, 2009). Moreover, self-ratings are more feasible when striving for large datasets. Even though job performance ratings may be slightly inflated, the focus in our longitudinal study was on changes over time within the same persons. For these reasons, we chose to assess self-reported performance in the present study.

In our longitudinal study, we expect to replicate earlier cross-sectional findings and additionally find longitudinal support for a positive temporal relationship between challenge job demands (i.e., workload and cognitive demands) and two core dimensions of job performance, that is, task performance and contextual performance. We anticipate the positive relationship with contextual performance to be weaker compared to task performance. Moreover, we expect to find longitudinal evidence for a negative relationship between hindrance demands (i.e., job insecurity) and both dimensions of job performance.

*Hypothesis 1:* Challenge demands (i.e., workload and cognitive demands) at T1 and T2 are positively related to task performance (H1a) and contextual performance (H1b) 1 year later. The relationship between challenge demands and contextual performance will be weaker compared to the relationship with task performance.

*Hypothesis 2:* Hindrance demands (i.e., high job insecurity) at T1 and T2 are negatively related to task performance (H2a) and contextual performance (H2b) 1 year later.

### ***Insufficient restoration and sleep quality as mechanisms***

In addition to the scarcity of longitudinal research on challenge and hindrance demands and their connection to two key aspects of job performance, specific underlying mechanisms in these relations are not yet fully understood (Sonnentag *et al.*, 2008). Earlier studies have found that some factors, for example, job strain, offset the positive relationship between challenge demands and task and contextual performance (LePine *et al.*, 2005; Rodell & Judge, 2009). More research into underlying mechanisms, and in particular longitudinal research, is necessary to understand the complex relationship between job demands and job performance.

Poor restoration during off-job time may be one likely mechanism that may offset the relation between challenging job demands and favourable job performance and may explain the relation between hindrance demands (i.e., job insecurity) and unfavourable job performance. Restoration refers to processes of replenishing resources or capacities that have been depleted by exposure to demands of everyday life (Hartig, 2004). In occupational health psychology, this process is usually referred to as 'recovery' (Korpela, de Bloom, & Kinnunen, 2015). According to effort–recovery theory (Meijman & Mulder, 1998), replenishment of resources after work is crucial to reduce load effects (unavoidably associated with expending effort at work) and to let stress-related psychophysiological systems return to baseline (pre-demand) levels (Geurts & Sonnentag, 2006). When restoration is insufficient while facing new cognitive, emotional, and/or physical challenges, compensatory effort is needed to adequately meet these challenges and to sustain a satisfactory performance level (Hockey, 2013), thereby further increasing the demands on the restoration process. Following McEwen's (1998) allostatic load theory, a chronic imbalance between effort and restoration will result in an adverse bodily state called 'allostatic load', which is proposed to have negative consequences not only for health but also for performance (Hammen, 2005; Kivimäki & Kawachi, 2015; McEwen, 2008).

Research has shown that high challenge job demands are associated with a greater need for recovery (Sonntag & Zijlstra, 2006), but also with less effective recovery processes during off-job time, including poorer detachment from work and poorer sleep quality (Kinnunen, Feldt, Siltaloppi, & Sonnentag, 2011; Linton *et al.*, 2015; Sonnentag & Fritz, 2007; Van Laethem, Beckers, Kompier, Dijksterhuis, & Geurts, 2013). Likewise, hindrance demands (i.e., job insecurity) have been associated with decreased restoration and poor sleep quality in several cross-sectional studies (Burgard & Ailshire, 2009; Vander Elst, Baillien, De Cuyper, & De Witte, 2010; Vander Elst, De Cuyper, Baillien, Niesen, & De Witte, 2016; Virtanen, Janlert, & Hammarstrom, 2011). Thus, there seem to be indications that increased challenge and hindrance demands negatively relate to restoration and sleep quality (i.e., sleep quality is defined as sleep in terms of sleep continuity).

Based on recovery theories and the limited amount of research so far, we propose insufficient restoration and poor sleep quality to be key mechanisms in *offsetting* the positive effects of high challenge job demands on job performance and *explaining* the negative effects of high job insecurity on job performance.

*Hypothesis 3:* Restoration at T2 mediates the relationship between challenge demands (H3a) and hindrance demands (H3b) at T1 and job performance at T3 such that high challenge and hindrance demands are related to decreased restoration, which in turn is related to impaired job performance (in terms of task performance and contextual performance).

*Hypothesis 4:* Sleep quality at T2 mediates the relationship between challenge demands (H4a) and hindrance demands (H4b) at T1 and job performance at T3 such that high challenge and hindrance demands are related to decreased sleep quality, which in turn is related to impaired job performance (in terms of task performance and contextual performance).

### **Affective rumination as a mechanism**

In addition to restoration and sleep quality, we examine stress-related cognitive processes following job demands as mechanisms in the job demands–performance relationship. One such cognitive process is affective rumination (Åkerstedt *et al.*, 2009). According to prolonged activation theory (Brosschot, Pieper, & Thayer, 2005) and the perseverative cognition hypothesis (Brosschot, Gerin, & Thayer, 2006), perseverative thought following job demands may be related to prolonged physiological activation and thus delay recovery and sleep. There is some evidence showing that perseverative cognitions are key mediators in the unfavourable relations between job demands and sleep (De Witte, Pienaar, & De Cuyper, 2016; Van Laethem *et al.*, 2015). Moreover, challenge (e.g., workload, cognitive demands) and hindrance (e.g., job insecurity) demands have previously been related to high affective rumination, lower psychological detachment from work during off-job time, and greater need for recovery (Höge, Sora, Weber, Peiró, & Caballer, 2015; Kinnunen, Mauno, & Siltaloppi, 2010; Kinnunen *et al.*, 2017). A recent meta-analysis has shown that especially challenge demands relate to poor detachment from work during off-job time (Bennett, Bakker, & Field, 2018), which may refer to affective rumination. Hence, the most likely response of an employee faced with high challenge job demands and high job insecurity is not to adequately detach from work, but to continue a mental connection to work, which may be associated with physiological activation (Sonnentag & Fritz, 2015) to some extent preventing psychophysiological recovery. Thus, affective rumination may act as a mediator in the relationship between challenging job demands and job insecurity on the one hand and restoration and sleep quality on the other.

*Hypothesis 5:* Affective rumination at T2 mediates the relation between challenge demands (H5a) and hindrance demands (H5b) at T1 and restoration at T3 such that high challenge and hindrance demands are related to increased affective rumination, which in turn is related to decreased restoration.

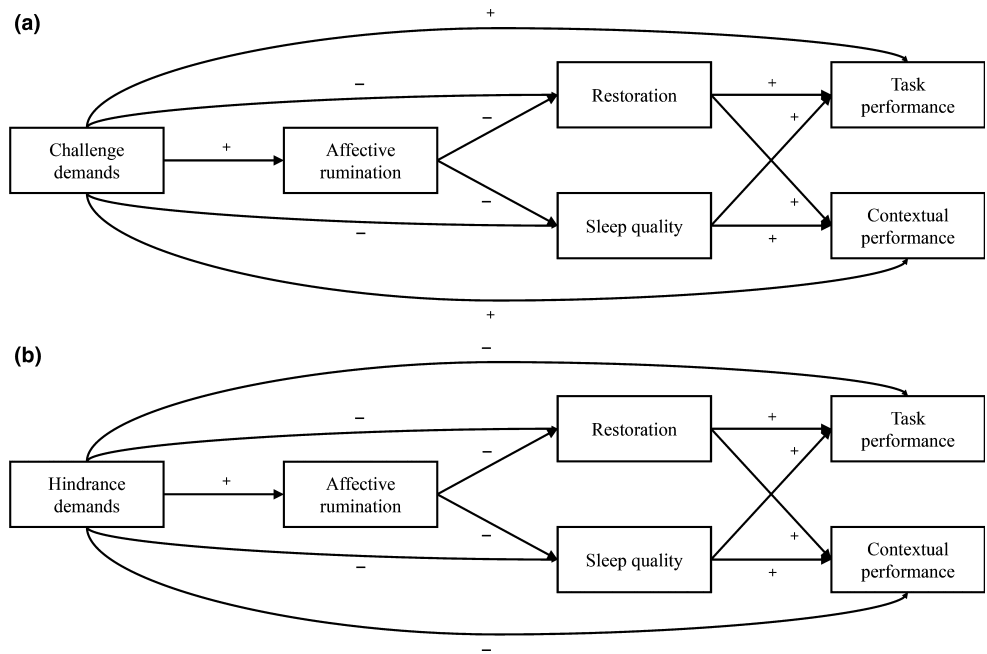
*Hypothesis 6:* Affective rumination at T2 mediates the relation between challenge demands (H6a) and hindrance demands (H6b) at T1 and sleep quality at T3 such that high challenge and hindrance demands are related to increased affective rumination, which in turn is related to impaired sleep quality.

See Figure 1 for a heuristic model of our hypotheses. For clarity, the heuristic model was divided into two separate figures: one for challenge demands and one for hindrance demands.

## **Methods**

### **Design and participants**

We tested our hypotheses using a three-wave longitudinal design with time lags of 1 year. Because it is often difficult to define a ‘perfect’ time lag when examining specific temporal



**Figure 1.** (a) The proposed research model for challenge demands without a time frame. All relationships are examined as temporal, that is, from T1 to T2–T3 and from T2 to T3. (b) The proposed research model for hindrance demands without a time frame. All relationships are examined as temporal, that is, from T1 to T2–T3 and from T2 to T3.

associations, partly due to a lack of theories of change (Kelloway & Francis, 2013), it would be optimal to include multiple measurement waves over different time lags (Sonnentag *et al.*, 2008; Taris & Kompier, 2014). However, in our case this was impossible due to the reality of collecting data in multiple organizations. In this study, we chose time lags of 1 year to examine the long-term lagged relationships, because using time lags of 1 year controls for potential seasonal effects that may affect job demands or job performance (e.g., returning to work from a vacation). In addition, 1-year time lags appear to be most common and useful in longitudinal studies investigating the long-term job demand–strain relationship (see Ford *et al.*, 2014; for a review) and recovery (Kinnunen & Feldt, 2013; Rodriguez-Muñoz, Sanz-Vergel, Demerouti, & Bakker, 2012). Also with regard to affective rumination, previous research has shown that perseverative modes of thinking may prevail over longer time periods (Van Laethem *et al.*, 2015). Concerning self-rated performance, most existing research is cross-sectional. As performance is a dynamic construct that varies over time, longitudinal research on the relationship between stressors and performance is warranted (Beal, Weiss, Barros, & MacDermid, 2005). In addition, Sonnentag *et al.* (2008) expressed a need to systematically investigate time frames as there may not be only one suitable time lag to examine performance. The few longitudinal studies that exist have used a variety of time lags from a few weeks to several years. Given that we examined long-term associations between stressors and performance, we considered a 1-year time lag as an acceptable choice.

The study population consisted of employees in 12 Finnish organizations from different sectors. There was high diversity in jobs, and largest sectors were education,

public administration, information technology, and media. Organizations were mainly contacted via the client organizations pool of a company providing occupational health care services. Online questionnaire surveys were distributed in three phases. In each phase, information about the study goals was included in the questionnaires. Participants were moreover assured that their responses would be treated in confidence and that participation was voluntary. In 11 organizations, the data were collected in the spring of 2013 (T1), 2014 (T2), and 2015 (T3). One organization ( $N = 603$  employees contacted) entered the study 1 year later, and the participants from this company completed the questionnaires in 2014 and 2015. Surveys were either sent directly to the employees' work email addresses or to a contact person, who distributed the survey (e.g., HR manager).

Of the employees contacted at T1 ( $N = 3,593$ ), 1,347 returned the questionnaire after two reminders, yielding a response rate of 37.5%. At T2, the electronic questionnaire was sent to those employees' email addresses who responded at T1 and who were still employed in the same organizations ( $N = 1,192$ ) and to the employees working in the organization that entered in 2014 ( $N = 603$ ). Of these, 841 (70.6%) and 359 (59.5%), respectively, returned the questionnaire. The final wave was in the spring of 2015 (T3). Again, the survey was sent to those employees' email addresses who had responded to the previous questionnaire and who had not changed jobs ( $N = 1,140$ ). Of the employees contacted, 920 responded after two reminders (response rate: 80.7%).

Of the sample, 62.5% was female, most participants were between 40 and 60 years old ( $M_{\text{baseline}} = 47.26$ ,  $SD_{\text{baseline}} = 9.79$ ; range: 21–66 years) and were highly educated (41% of participants had a bachelor's degree or higher). In addition, most participants held a full-time job and worked at least 38 hr per week (see Table 1 for characteristics of the study sample at T1 in more detail). In analysing sample attrition, we compared the final sample ( $N = 920$ ) to non-respondents at T3. There were no differences in gender, education, occupational status, or having children. However, the respondents more often had a permanent employment contract (89.8% vs. 80.5%,  $p < .001$ ), worked more often on regular day shifts (92.5% vs. 87.0%,  $p < .01$ ), were somewhat older ( $M = 47.3$  vs. 46.1 years,  $p < .001$ ), and worked slightly shorter hours ( $M = 35.2$  vs. 36.5 hr,  $p < .01$ ) than the non-respondents.

## Measures

The present study had a full-panel design as all concepts were measured at every measurement point. Reliability coefficients (Cronbach alphas) of all measures except for the contextual performance measure ( $< 0.70$ ) were at least acceptable ( $> 0.80$ ).

*Challenge job demands* were assessed with three items adapted from Spector and Jex (1998) assessing workload (e.g., 'How often does your job require you to work very fast?') and three items inspired by Pejtersen, Kristensen, Borg, and Bjorner (2010) and De Jonge et al. (2007) measured cognitive demands (e.g., 'How often do you need to display high levels of concentration and precision at work?'). The response scale ranged from 1 (very seldom or never) to 5 (very often or always). All items were combined to calculate an overall score for challenging job demands. Cronbach's alpha coefficients were 0.84 across T1–T3.

*Job insecurity as a job hindrance demand* was assessed with three items (e.g., 'I think I might get fired in the near future') from De Witte (2000). All items were answered on a five-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). Cronbach's alphas were 0.93 across T1–T3.



**Table 1.** Sample characteristics of final sample at T1

|   | N   | %    |
|---|-----|------|
| Gender  |     |      |
| Men   | 345 | 37.5 |
| Women   | 574 | 62.4 |
| Undisclosed   | 1   | 0.1  |
| Age   |     |      |
| 21–29   | 46  | 5.0  |
| 30–39   | 173 | 18.8 |
| 40–49   | 274 | 29.8 |
| 50–59   | 346 | 37.6 |
| 60–66   | 79  | 8.6  |
| Undisclosed   | 2   | .2   |
| Educational level                                     |     |      |
| Comprehensive school                                  | 15  | 1.6  |
| Vocational qualification or upper secondary education | 111 | 12.1 |
| Specialized vocational qualification                  | 34  | 3.7  |
| Vocational college qualification                      | 161 | 17.5 |
| Bachelor's degree or polytechnic bachelor's degree    | 225 | 24.5 |
| Master's degree                                       | 359 | 39.0 |
| Doctoral or other higher degree                       | 15  | 1.6  |
| Average working hours per week                        |     |      |
| 12–23   | 15  | 1.6  |
| 24–37   | 385 | 41.8 |
| 38–49   | 425 | 46.2 |
| 50–60   | 12  | 1.3  |
| Undisclosed   | 83  | 9.0  |

Note. T1 = time point 1.

*Job performance* was evaluated with measures of task and contextual performance. *Task performance* was measured with five items from the personal accomplishment scale of the Maslach Burnout Inventory, which has been validated in Finland (Kalimo, Hakanen, & Toppinen-Tanner, 2006; Maslach, Jackson, & Leiter, 2006). These items (e.g., 'I have accomplished many worthwhile things in this job') reflect being able to attain work-related achievements and thus fit well with the definition of task performance presented in the introduction. Answers were given on a seven-point scale ranging from 1 (never) to 7 (always, every day). Cronbach's alphas ranged between 0.80 and 0.81. *Contextual performance* was assessed with three items (cf. Goodman & Svyantek, 1999; Staufenbiel & Hartz, 2000). The items (e.g., 'I volunteer to do things not formally required by my job') were answered on a five-point rating scale (1 = very seldom or never, 5 = very often or always). Cronbach's alphas for contextual performance ranged from 0.60 to 0.65.

The *restoration* scale measured the restorative (i.e., resource replenishing) value of off-job activities. It consisted of four items adapted from the Restoration Outcome Scale (Korpela, Ylén, Tyrväinen, & Silvennoinen, 2008). An example item is 'My free time activities provide me with new enthusiasm and energy for my everyday routines'. All items were scored on a seven-point scale ranging from 1 (not at all) to 7 (completely). Cronbach's alphas ranged from 0.92 to 0.93.

*Sleep quality* was assessed with four items adapted from the Karolinska Sleep Questionnaire and the Sleep Quality Index (see Åkerstedt, Hume, Minors, & Waterhouse, 1994a, 1994b; Kecklund & Åkerstedt, 1997). Sleep complaints assessed were frequency of difficulty falling asleep, repeated awakenings (including difficulties going back to sleep), premature (final) awakening, and not feeling refreshed at wake-up. The time frame was adapted from 6 to 1 month ('How often have you perceived any of the following complaints during the last month?'), and all items were answered on a five-point scale ranging from 1 (very seldom or never) to 5 (very often or always). Cronbach's alphas ranged from 0.80 to 0.81.

*Affective rumination* was measured with three items from the affective rumination subscale of the Work-Related Rumination Questionnaire (Cropley, Michalianou, Pravettoni, & Millward, 2012). All three items were reformulated into statements instead of the original questions and elicited the respondent's feelings when thinking about work during free time (e.g., 'I become tense when I think about work-related issues in my free time'). The items were answered on a five-point scale (1 = very seldom or never, 5 = very often or always). Cronbach's alphas ranged between 0.87 and 0.89.

### **Analytic strategy**

We analysed the longitudinal data with structural equation modelling using the lavaan 5.20 package in R Statistical computing and graphics software (R Core Team, 2015; Rosseel, 2012). Mean scores of all scales were entered as observed variables in the structural equation models (all tested path models included lagged effects and are described in the Results section). Full information maximum likelihood estimation was used to reduce possible bias due to missing data (Arbuckle, 2006). In accordance with recommendations of Hu and Bentler (1999), the root-mean-square error of approximation (RMSEA), comparative fit index (CFI), and the standardized root-mean-square residual (SRMR) were used to assess model fit. Standardized estimates were calculated and are reported in the results section.

Earlier research has established that several factors may influence our study variables and should be accounted for (cf. Åkerstedt *et al.*, 2009; De Lange, Taris, Kompier, Houtman, & Bongers, 2003). Sleep problems, for example, are more prevalent among women and older individuals (Lichstein, Durrence, Riedel, Taylor, & Bush, 2004; Prinz, 2004). Moreover, individuals with a higher educational level and employees working many hours in a week appear to have higher status jobs and are more likely to experience higher levels of challenge job demands (Moen, Lam, Ammons, & Kelly, 2013) and less job insecurity (Keim, Landis, Pierce, & Earnest, 2014). Thus, the analysis was controlled for gender (1 = female, 2 = male), age (in years), education (1 = comprehensive school, 2 = vocational qualification or upper secondary education, 3 = specialized vocational qualification, 4 = vocational college qualification, 5 = bachelor's degree or polytechnic bachelor's degree, 6 = master's degree, 7 = doctoral or other higher degree), and mean weekly working hours across all waves. Also, challenge job demands and job control are closely related and usually depend on each other (Demerouti *et al.*, 2001; Häusser, Mojzisch, Niesel, & Schulz-Hardt, 2010). In the job demand-control model, for example, high job demands are only seen as a challenge if job control is high (Karasek, 1979; Karasek & Theorell, 1990). As job control was rather high in our study sample ( $M = 3.32$ ,  $SD = 0.72$ ), we concluded that job demands could be considered challenge demands. Nevertheless, job control across all waves (measured as autonomy at work) was used as a control

variable in this study. Autonomy was assessed with five items from the QPS Nordic-ADW (Dallner *et al.*, 2000). An example item is 'I can set my own work pace'. All items were answered on a five-point response scale ranging from 1 (very seldom or never) to 5 (very often or always) (Cronbach's  $\alpha_{T1} = 0.78$ ).

Mediation effects were assessed with indirect effects obtained by multiplying the relation between the independent variable and the mediator by the estimate of the relation between the mediator and the dependent variable (i.e., the product of coefficients method; MacKinnon, 2014). According to Hayes (2013), a direct relationship between independent and dependent variable in a mediation pathway is not required as this relationship may be influenced by third variables. Statistical significance of the mediation effects was estimated using the bootstrapped 95% confidence intervals with 5,000 iterations. Mediation is established when the confidence interval does not contain 0 (Zhao, Lynch, & Chen, 2010).

## Results

### *Descriptive statistics and model fit*

Means, standard deviations, and correlations between all study variables are presented in Tables A1–A3 in Appendix. Most of the correlations between the main study variables were significant and in the expected direction. Autoregressions were high and ranged between 0.55 and 0.78. This indicates that the stability of variables over time was high.

We first tested whether a model with free pathways (i.e., all pathways were allowed to vary between T1 and T3) fitted the data better than a model with constrained pathways (i.e., pathways between T1–T2 and T2–T3 were forced to be equal). The structural equation model including free pathways did not fit the data better than the models including constrained pathways. Thus, all results reported here originate from the constrained model which, being the simplest model (e.g., with the most degrees of freedom), should be preferred.

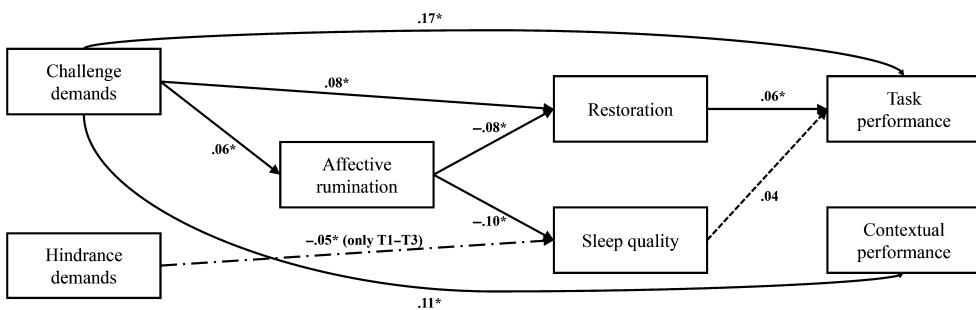
Next, we examined whether the structural equation model including all proposed relations fitted the data better than a null model including only autoregressions over time (e.g., pathways from task performance at T1 to task performance at T2 as well as from T2 to T3). The proposed model (see Figure 1) included autoregressions over time as well as all temporal paths hypothesized (e.g., the path from job demands at T1 to task performance at T2 and from job demands at T2 to task performance at T3). A chi-square difference test was conducted to compare both models and showed that the proposed model fitted the data significantly better than the null model. In addition, the proposed model fitted the data reasonably well. This suggests temporal relationships between challenge demands (i.e., workload, cognitive demands), hindrance demands (i.e., job insecurity), task performance, contextual performance, restoration, sleep quality, and affective rumination. An overview of model fit and all comparisons of structural equation models is presented in Table 2. A simplified visualization of all significant structural pathways is presented in Figure 2.

To test robustness of our results, we tested the proposed model without control variables and found the results to be identical (see also Table 2). In addition, we followed Williams, O'Boyle, and Yu (2017) recommendations and performed condition nine tests. This procedure involves isolating effects for the hypothesized paths. Overall, isolating the hypothesized paths resulted in identical results as testing the complete model (i.e.,

**Table 2.** Model fit and comparisons for structural equation models

| Model                           | Model fit     |       |              |       |       | Model comparison $\chi^2$ |
|---------------------------------|---------------|-------|--------------|-------|-------|---------------------------|
|                                 | $\chi^2$ (df) | RMSEA | 90% CI RMSEA | CFI   | SRMR  |                           |
| Free model                      | 664.60* (163) | 0.058 | 0.053–0.062  | 0.946 | 0.047 |                           |
| Constrained model               | 687.48* (179) | 0.056 | 0.051–0.060  | 0.946 | 0.048 | 22.88                     |
| Null model                      | 817.72* (203) | 0.057 | 0.053–0.062  | 0.934 | 0.066 |                           |
| Proposed model                  | 687.48* (179) | 0.056 | 0.051–0.060  | 0.946 | 0.048 | 130.24*                   |
| Proposed model without controls | 537.81* (109) | 0.065 | 0.060–0.071  | 0.952 | 0.053 |                           |

Note. \* $p < .001$ .



**Figure 2.** Overview of the temporal pathways and standardized regression coefficients ( $\beta$ ). The temporal pathways include relationships from T1 to T2 and from T2 to T3, which were constrained to be equal. The model is adjusted for age, gender, educational level, work hours, and autonomy, but in the interests of clarity, these pathways are not illustrated. Due to possible content overlap of one job insecurity item with affective rumination, all analyses including job insecurity were also performed excluding the possible overlapping item. However, findings were identical.

including all hypothesized paths at once) except for the small difference regarding the direct relationship between challenge job demands and restoration discussed below.

**Temporal relations between challenge demands, hindrance demands, and job performance**

Hypothesis 1 proposed a temporal, positive relationship between challenge job demands and job performance over 1 year. We were interested in the direct, across-wave relations (T1–T2, T2–T3) due to our choice of the 1-year time lag. Only in mediation analyses were direct relations from T1 to T3 examined to calculate direct effects. We therefore report the direct across-wave relations in the current results section. Direct across-wave pathways from high challenge job demands to high task performance and contextual performance were significant. The positive relation between challenge job demands and contextual performance ( $\beta = .11, p < .001$ ) was weaker compared to the relation between challenge job demands and task performance ( $\beta = .17, p < .001$ ). These results support hypotheses 1a and 1b.

The second hypothesis suggested a temporal, negative relationship between hindrance demands (i.e., job insecurity) and job performance over 1 year. However,

hypotheses 2a and 2b were not supported, as pathways from job insecurity to task performance and contextual performance were not significant. While not significant, there was an overall trend towards negative relations between job insecurity and both performance outcomes.

### **Restoration and sleep quality as mediators**

The third hypothesis proposed that restoration mediates the positive relation between challenge job demands and job performance in such a way that restoration offsets the positive relation between challenge demands and performance (H3a). Moreover, hypothesis 3 also predicted that restoration mediates the negative relation between hindrance demands (i.e., job insecurity) and job performance in such a way that it (partly) explains this negative relationship (H3b).

Challenge job demands were related to restoration (i.e., the restorative value of off-job activities) 1 year later. However, the relationship was not in the expected direction as it was positive instead of negative. This effect did not hold for the isolated condition 9 effect (see also Williams et al., 2017) in which there was no evidence for a temporal relationship between challenge job demands and restoration. Regarding hindrance demands, high job insecurity was not related to lower restoration 1 year later. Restoration, in turn, was positively associated with task performance, but not with contextual performance at a later time. These results do not lend support to hypothesis 3.

Requirements for mediation were fulfilled related to challenge job demands, restoration, and task performance, as the associations between an independent variable and mediator (i.e., challenge job demands and restoration) as well as between mediator and dependent variables (i.e., restoration and task performance) were significant (cf. Hayes, 2009, 2013). Specifically, we examined whether restoration at T2 mediated the positive relation between challenge job demands at T1 and task performance at T3. The confidence interval of the indirect effect from challenge job demands to task performance did contain 0. Thus, restoration did not mediate the temporal relation between challenge job demands and task performance. See Table 3 for an overview of indirect and total effects as well as standardized estimates.

The fourth hypothesis suggested that sleep quality mediates the positive relation between challenge job demands and job performance in such a way that low sleep quality offsets the positive relation between challenge demands and performance (H4a). Moreover, hypothesis 4 also predicted that sleep quality mediates the negative relation between hindrance demands (i.e., job insecurity) and job performance in such a way that it (partly) explains this negative relationship (H4b).

Challenge job demands and job insecurity were not related to sleep quality. It has to be noted that even though the direct across-wave relationship between job insecurity and sleep quality was not significant, the lagged pathway from job insecurity at T1 to sleep quality at T3 was significant. However, sleep quality was not significantly related to either task performance or contextual performance across time. Overall, these results do not support hypothesis 4.

### **Affective rumination as a mediator**

Hypothesis 5 argued that affective rumination may act as a mediator in the relationship of challenge (H5a) and hindrance demands (H5b) with restoration. Hypothesis 6 stated that affective rumination may act as a mediator in the relationship of challenge (H6a) and

**Table 3.** Indirect and total effects of mediation analyses

| Direction of effect | Type of effect | Standardized estimate | Unstandardized estimate (CI) |                    |
|---------------------|----------------|-----------------------|------------------------------|--------------------|
| JD → RES → TP       | Indirect       | 0.003                 | 0.005                        | (-0.001 to 0.012)  |
| JD → TP             | Total          | 0.005                 | 0.007                        | (-0.109 to 0.124)  |
| JD → AR → RES       | Indirect       | -0.003*               | -0.005*                      | (-0.010 to -0.001) |
| JD → RES            | Total          | -0.023                | -0.032                       | (-0.137 to 0.076)  |
| JD → AR → SQ        | Indirect       | -0.005*               | -0.006*                      | (-0.012 to -0.001) |
| JD → SQ             | Total          | 0.020                 | 0.027                        | (-0.062 to 0.121)  |
| Jl → AR → RES       | Indirect       | -0.002                | -0.002                       | (-0.005 to 0.001)  |
| Jl → RES            | Total          | -0.055                | -0.043                       | (-0.101 to 0.020)  |
| Jl → AR → SQ        | Indirect       | -0.003                | -0.003                       | (-0.006 to 0.001)  |
| Jl → SQ             | Total          | -0.069*               | -0.055*                      | (-0.107 to -0.004) |

Notes. AR = affective rumination, CI = confidence interval, JD = challenge job demands, Jl = job insecurity, RES = restoration, SQ = sleep quality, TP = task performance, indirect effect = amount of mediation, total effect = sum of indirect and direct effect.

Indirect effects indicate relations from challenge job demands/job insecurity at T1 to the mediator at T2 to the outcome variable at T3. The total effect is the indirect effect plus the direct effect from challenge job demands/job insecurity at T1 to the outcome variable at T3.

hindrance demands (H6b) with sleep quality. The result revealed that only high challenge job demands (and not high job insecurity) were associated with high affective rumination 1 year later, suggesting a statistically positive (i.e., adverse), temporal relation (i.e., not supporting hypothesis 5b and 6b). High affective rumination, in turn, was associated with lower restoration (resource replenishing value of off-job activities) and lower sleep quality at a later time.

As requirements for mediation were fulfilled, we tested for potential mediation effects. Specifically, we examined whether challenge job demands at T1 affected restoration and sleep quality at T3 via affective rumination at T2. The confidence interval of the indirect effect from challenge job demands to both restoration and sleep quality did not contain 0. Thus, affective rumination mediated the temporal pathways between challenge job demands and restoration and between challenge job demands and sleep quality, lending support to hypotheses 5a and 6a. Affective rumination mediated 16% of the relation between high challenge job demands and poor restoration. In addition, affective rumination mediated 22% of the relation between high challenge job demands and poor sleep quality. Thus, there was evidence for partial mediation for both mediation effects. See Table 3 for an overview of all indirect and total effects as well as standardized estimates.

## Discussion

In this longitudinal study, we aimed to shed light on the temporal relations between challenge and hindrance demands and job performance. A second goal was to examine poor restoration and sleep quality as possible offsetting (for challenge demands) and mediating mechanisms (for hindrance demands) in this relationship. Lastly, we examined whether affective rumination acts as a mediator in the relationship between challenge and hindrance demands and restoration and sleep quality.

### **Challenge and hindrance demands in relation to job performance**

Our finding that employees who experienced high challenge job demands reported higher levels of task performance and contextual performance 1 year later was in line with our hypotheses and with existing research (LePine *et al.*, 2005; Ohly & Fritz, 2010; Rodell & Judge, 2009; Wallace *et al.*, 2009). Our results are not only in line with the challenge–hindrance stressor model (Cavanaugh *et al.*, 2000), but also add to the model as we found *longitudinal* evidence across 1 year for a positive relationship between challenging job demands and job performance. In addition, this positive long-term relation seems to be rather robust as it holds even while simultaneously including hindrance demands, further strengthening our findings.

It has to be noted that in this study the average level of challenge job demands, including workload and cognitive demands, was fairly high ( $M = 4.00$ , equivalent to ‘rather often’ on a five-point scale) and was combined with fairly high average scores on autonomy ( $M = 3.32$ , corresponding to ‘sometimes’ to ‘rather often’ on a five-point scale). The Finnish sample of this study is in many ways typical of the modern knowledge worker: highly educated, facing high challenge demands at work, but at the same time also enjoying high decision latitude to organize demanding work. According to the job demands–control model, this combination results in ‘active jobs’, which are related to high motivation and well-being in employees (Karasek, 1979; Karasek & Theorell, 1990) and may therefore result in high job performance such as innovative work performance (De Spiegelaere, Van Gyes, De Witte, & Van Hootegem, 2015).

We expected slightly stronger relations between challenge demands (i.e., workload, cognitive demands) and task performance than between challenge job demands and contextual performance. Challenge job demands were indeed more strongly related to task performance compared to contextual performance. Engaging in work behaviours that benefit contextual performance appeared to be slightly less of a priority compared to task performance under high challenge job demands. When facing high workload and cognitive demands, there may be little time and mental capacity left for work behaviours beyond one’s formal work tasks. The different results regarding task and contextual performance are in line with the Conservation of Resources theory (Hobfoll, 1989): When experiencing high challenge demands, cognitive resources may first be allocated towards task performance. Only when sufficient resources are available, employees may focus on contextual performance.

Contrary to our expectations, job insecurity (i.e., a hindrance demand) was not related to task or contextual performance over time, even though there was a trend towards a negative relation between job insecurity and both job performance measures. Job insecurity was also not related to the examined mediators (i.e., restoration, sleep quality, and affective rumination). The absence of a significant association with performance is not in line with the challenge–hindrance stressor framework (Cavanaugh *et al.*, 2000). A possible explanation may be that job insecurity is not an unequivocal hindrance demand. In fact, there are single studies (e.g., Staufienbiel & König, 2010) showing that job insecurity can, in certain situations, lead to enhanced performance. This may occur when performance is used as the evaluation criterion for layoff decisions. In the organizations studied in present study, there occurred no layoffs during the study period as far as we know. In fact, the level of perceived job insecurity was low ( $M = 2.14$  on a scale from 1 to 5). It may be that a certain threshold level of job insecurity is needed to make it function as a real hindrance demand, influencing job performance negatively in the long run.

Another possible explanation for the contradicting results may lie in the conceptualization of challenge and hindrance demands as two different categories or types of

demands. Staufenbiel and König (2010) argue that it may be more appropriate to evaluate each demand based on two dimensions: a challenge and a hindrance dimension. Thus, job insecurity could be a hindrance demand to some extent while simultaneously being a challenge demand to a certain level. Similarly, challenging job demands may have a high score on the challenge dimension, but a low score on the hindrance dimension. This alternative conceptualization of challenge and hindrance demands may explain why this study revealed a positive relationship between challenge job demands and job performance, but no association between job insecurity and job performance. Future studies may empirically test the different conceptualization discussed by Staufenbiel and König (2010).

Based on the different results regarding the association of challenge demands with two important types of job performance, we recommend that future research investigates this difference more closely. Our results also suggest that the common practice of combining both types of performance into one single factor may not be advisable. Possible null-findings reported in earlier studies may be explained by differences in (strength of) relationships with task or contextual performance. In addition, in future studies a more complete range of different challenge and hindrance demands may be examined. For example, job responsibility and complexity (challenge demands), resource inadequacy, and role ambiguity/conflict (hindrance demands) could be included. Their relationships with job performance may turn out to be different from the ones found in our study.

### **Poor restoration, sleep quality, and affective rumination as underlying mechanisms in the challenge demands–performance relation**

Our results did not support poor restoration as a mechanism in the pathway from challenge demands to job performance. Contrary to our expectations, we found that employees with higher challenge job demands reported higher subsequent restoration (i.e., higher restorative value of off-job activities), which in turn predicted favourable task performance 1 year later. These findings are partly in line with earlier research on job demands, recovery, and job performance (e.g., Binnewies, Sonnentag, & Mojza, 2010). However, the results are not in line with other research reporting an unfavourable relationship between job demands and recovery processes, including recovery experiences and sleep quality (Kinnunen *et al.*, 2011; Linton *et al.*, 2015; Sonnentag & Fritz, 2007; Van Laethem *et al.*, 2013).

One explanation for the unexpected positive relationship between challenge demands and restoration relates to our measurement of restoration. In our research, this variable was not directly operationalized as ‘need for recovery’, but rather as ‘the recovery value of off-job activities’. It could be that for workers faced with high challenge demands, off-job activities have more recuperative value than for workers faced with fewer challenge demands. If an employee experiences high challenge demands, (s)he therefore experiences higher levels fatigue after work and thus the leisure activities pursued may have a high resource replenishing value. This is also in line with the effort–recovery theory (Meijman & Mulder, 1998), which postulates that recovery is mostly needed in demanding and stressful jobs. Thus, the full potential of recovery processes is reached when demands are high (Sonnentag & Fritz, 2015). However, regarding all alternative explanations for the positive relationship between challenge job demands and restoration, it should be kept in mind that the relationship was not robust when isolating hypothesized effects. Before paying too much attention to this effect, the positive relationship should be replicated in future longitudinal studies to ensure its robustness.



No longitudinal evidence was found for a relationship between challenge or hindrance demands and sleep quality. This contradicts some earlier research (Åkerstedt *et al.*, 2015; De Lange *et al.*, 2009), but concurs with some other longitudinal studies on job demands and sleep quality (Van Laethem, Beckers, van Hooff, Dijksterhuis, & Geurts, 2016; Van Laethem *et al.*, 2015). Earlier research into the mechanisms underlying the demand–sleep relationship found that the direct relationship between a demand and sleep often disappeared when simultaneously testing for rumination, as is also the case in the present study. This is generally seen as an indication for rumination as an important underlying mechanism in the job demands–sleep relationship.

Experiencing challenge job demands was prospectively associated with an increase in affective rumination, which in turn was related to decreased restoration and sleep quality. Thus, affective rumination was a mediating mechanism in the longitudinal relationship between challenge job demands, restoration, and sleep quality, which lends support to the perseverative cognition hypothesis and prolonged activation theory (Brosschot *et al.*, 2005, 2006) and also to earlier research on this topic (Sonnetag & Fritz, 2015; Van Laethem *et al.*, 2015, 2016). In addition, this study extends the existing research on the job demands–affective rumination–restoration/sleep quality sequence by including different job performance outcomes as distal outcome measures of the pathway.

### **Strengths, limitations, and suggestions for future research**

The present study has several strengths. First, we employed a full-panel longitudinal design with three waves, which enabled us to explore mediation. In addition, we were able to shed light on the relations between challenge and hindrance demands and two job performance outcomes as well as several explanatory mechanisms such as restoration, sleep quality and affective rumination.

Our study also has some limitations. Although longitudinal, our non-experimental study design only allows us to draw tentative conclusions about causal relationships. Future studies may use varying approaches in examining the job demand–performance relationship to optimally investigate the causality of this complex relationship. One example could be an experimental study in which highly challenging job demands are induced in one group and their subsequent restoration, sleep, and performance are compared to that of a control group. In addition, longitudinal studies examining demands in relation to performance may use varying time lags. As outlined in the methods section, we chose to use 1-year time lags. In our study, exposure to challenge and hindrance demands was rather stable (autoregressions were high and ranged between 0.55 and 0.78), so our 1-year time lag implied long-term exposure to certain demands in relation to a change in performance. Other time lags (e.g., day-to-day examination of the same associations), and even varying time lags within the same longitudinal study, may also be interesting to consider in future research as we lack theories of change (Kelloway & Francis, 2013).

A second limitation may concern the time frame included in our assessment of sleep quality. All study variables except for sleep quality were measured by asking participants to report their average level of the specific variable, not having a specific time frame in mind. While measuring sleep quality, however, participants were asked to report their sleep quality over the past month. We chose this approach as we were interested in long-term associations between general levels of demands and performance. Therefore, we did not include a specific time frame for most of the study variables. Only for sleep quality we chose a specific time frame of 1 month as previous sleep research suggests that a 1-month time frame is adequate to assess sleep (e.g., Jenkins, Stanton, Niemcryk, & Rose, 1988).

The difference in time frames may have had implications for the effect sizes (i.e., the standardized beta coefficients) of this study. Future research may use identical time frames to match time frames of all measured variables.

A third limitation may be the risk of common method bias due to the exclusive use of self-report measures. Nonetheless, it has been argued that the issues underlying common method bias, such as social desirability, may not be as problematic as previously thought (Spector, 2006). Monomethod correlations between variables do not seem to be higher than multimethod correlations, and in longitudinal studies, in particular this may not be an issue. In addition, most of our study variables are best measured or even have to be measured with self-report measures (e.g., perceived job demands including job insecurity, affective rumination, restoration). Other variables may additionally be assessed with objective measures (e.g., sleep quality/performance) or observer reports (performance). Using an objective measure in addition to subjective performance measures may possibly improve validity and generalizability of results. However, given the longitudinal design of this study and the necessity of a large sample, we chose to solely focus on self-report measures. Nonetheless, future research may also attempt to include more objective measures to assess sleep quality and performance to provide an even more nuanced picture of relations between demands, sleep, and performance. It is also worth noting that the reliability coefficients of the contextual performance measure were rather low (0.60–0.65). This may relate to the fact that this measure included a variety of different behaviours (e.g., helping and cheering-up colleagues) and thus functioned as an index rather than a scale. Internal reliability (=consistency) may therefore not be a good criterion for the validity of this measure (Streiner, 2003).

A final limitation may be that most effect sizes were small, which is rather common in longitudinal research. It is crucial to note that small effect sizes in absolute terms do not imply small effects in relative terms. When examining changes over time in outcomes and employing the structural equation modelling approach, baseline levels of all variables are controlled for and usually explain a large part of the variance (cf. the high autocorrelations over time in the supplementary material) (Van Hooff *et al.*, 2005). In addition, many factors beyond the demands of this study may possibly influence job performance, thus small effect sizes should not be deemed irrelevant.

### **Practical implications**

The present study makes several contributions to the field of occupational health psychology and has implications for job design. The fact that challenge demands were positively related to performance and restorative value of off-job activities is useful information for employees and employers alike. Apparently challenge job demands are not necessarily harmful for job performance. However, too high job demands may turn a challenging work environment into a stressful work environment. Accordingly, it is essential to also provide employees with sufficient job resources (e.g., high autonomy and social support) which help them to adequately deal with high job demands (Demerouti *et al.*, 2001; Schaufeli & Taris, 2014) and to prevent challenging job demands from becoming overwhelmingly high and hindering.

Our results further suggest that sufficient restoration is important for performance. Thus, employers should allow their employees sufficient time to recover from high job demands during off-job time (e.g., by preventing long working hours). The restorative value of off-job time may be further increased by providing trainings in recovery, relaxation and meditation techniques (i.e., mindfulness meditation and particularly acting

with awareness; Querstret, Cropley, & Fife-Schaw, 2017), which have been shown to reduce stress and anxiety, and improve mental health and sleep quality (e.g., Hahn, Binnewies, Sonnentag, & Mozja, 2011; Jain *et al.*, 2007; Querstret & Cropley, 2013; Richardson & Rothstein, 2008).

Lastly, ruminating about job demands may interfere with restoration and sleep quality, ultimately harming performance. Cognitive behavioural interventions seem to be especially effective in reducing rumination, because these interventions do not only reduce negative thoughts and feelings (such as relaxation and meditation techniques), but also help employees to actively change dysfunctional behaviours (Richardson & Rothstein, 2008). An efficient low-cost intervention to prevent rumination is instructing employees to set daily goals and to create an action plan at the end of the day for (1) where, (2) when, and (3) how they will accomplish unfulfilled goals (Smit, 2016), which can be triggers for rumination (Syrek & Antoni, 2014). Finally, employees may also attempt to counteract perseverative thoughts by actively pursuing distracting restorative leisure activities, for example, by exercising (De Vries, van Hooff, Geurts, & Kompier, 2016).

### Conclusion

To conclude, the present study showed that challenge job demands are positively related to later task and contextual performance and restoration (i.e., higher restorative value of off-job activities), which in turn predicts favourable task performance 1 year later. Affective rumination is an important unfavourable mechanism in the challenge demand–restoration/sleep relationship. Challenge job demands are not necessarily harmful for job performance or restoration, as long as employers and employees pay special attention to sufficient opportunities for restoration during off-job time and attempt to keep rumination to a minimum.

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**Appendix :**

**Table A1.** Correlations between control variables and all constructs at time point 1

|                                    | M     | SD   | 1      | 2      | 3      | 4     | 5      | 6      | 7      | 8      | 9     | 10     | 11     |
|------------------------------------|-------|------|--------|--------|--------|-------|--------|--------|--------|--------|-------|--------|--------|
| 1. Age                             | 47.26 | 9.79 |        |        |        |       |        |        |        |        |       |        |        |
| 2. Gender <sup>a</sup>             | 1.38  | 0.49 | .05    |        |        |       |        |        |        |        |       |        |        |
| 3. Education (1-7)                 | 4.75  | 1.44 | -.13** | -.02   |        |       |        |        |        |        |       |        |        |
| 4. Working hours                   | 36.90 | 5.66 | -.02   | .16**  | -.01   |       |        |        |        |        |       |        |        |
| 5. Autonomy (1-5)                  | 3.32  | 0.72 | -.09*  | .16**  | .14**  | -.03  |        |        |        |        |       |        |        |
| 6. Challenge job demands T1 (1-5)  | 4.02  | 0.62 | -.02   | -.13*  | -.02   | .27** | -.16** |        |        |        |       |        |        |
| 7. Job insecurity T1 (1-5)         | 2.16  | 1.12 | -.17** | -.01   | -.15** | .04   | -.16** | .05    |        |        |       |        |        |
| 8. Task performance T1 (0-6)       | 4.62  | 1.07 | .06    | .05    | -.04   | .10*  | .29**  | .19**  | -.19** |        |       |        |        |
| 9. Contextual performance T1 (1-5) | 3.43  | 0.67 | -.06   | -.07   | -.07   | .16** | .12*   | .25**  | -.01   | .33**  |       |        |        |
| 10. Restoration T1 (1-7)           | 5.19  | 0.94 | .08*   | -.04   | .02    | -.03  | .14**  | .05    | -.11*  | .30**  | .16** |        |        |
| 11. Sleep quality T1 (1-5)         | 3.44  | 0.92 | -.07   | .12*   | .01    | -.06  | .27**  | -.20** | -.10*  | .25**  | .05   | .27**  |        |
| 12. Affective rumination T1 (1-5)  | 2.43  | 0.88 | -.11*  | -.16** | .07    | -.01  | -.30** | .26**  | .17**  | -.26** | -.02  | -.18** | -.44** |

Notes. Means, standard deviations, and correlations were calculated with the statistical program JASP (JASP Team, 2017).

\* $p < .05$ , \*\* $p < .001$ ,  $N = 648-920$ , T1 = time point 1.

<sup>a</sup> 1 = male, 2 = female.

**Table A2.** Correlations between job demands and other constructs at all time points

|                                    | M    | SD   | 1      | 2      | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | 11    | 12    | 13 | 14 | 15 | 16 | 17 |
|------------------------------------|------|------|--------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|----|----|----|----|
| 1. Challenge job demands T1 (1-5)  | 4.02 | 0.62 |        |        |       |       |       |       |       |       |       |       |       |       |    |    |    |    |    |
| 2. Challenge job demands T2 (1-5)  | 4.00 | 0.62 | .74**  |        |       |       |       |       |       |       |       |       |       |       |    |    |    |    |    |
| 3. Challenge job demands T3 (1-5)  | 4.00 | 0.64 | .66**  | .75**  |       |       |       |       |       |       |       |       |       |       |    |    |    |    |    |
| 4. Task performance T1 (0-6)       | 4.62 | 1.07 | .19**  | .18**  | .21** |       |       |       |       |       |       |       |       |       |    |    |    |    |    |
| 5. Task performance T2 (0-6)       | 4.51 | 1.08 | .24**  | .26**  | .22** | .65** |       |       |       |       |       |       |       |       |    |    |    |    |    |
| 6. Task performance T3 (0-6)       | 4.53 | 1.07 | .24**  | .23**  | .26** | .64** | .71** |       |       |       |       |       |       |       |    |    |    |    |    |
| 7. Contextual performance T1 (1-5) | 3.43 | 0.67 | .25**  | .21**  | .20** | .33** | .31** | .32** |       |       |       |       |       |       |    |    |    |    |    |
| 8. Contextual performance T2 (1-5) | 3.47 | 0.69 | .30**  | .27**  | .21** | .35** | .38** | .33** | .66** |       |       |       |       |       |    |    |    |    |    |
| 9. Contextual performance T3 (1-5) | 3.43 | 0.67 | .30**  | .23**  | .21** | .33** | .35** | .37** | .61** | .70** |       |       |       |       |    |    |    |    |    |
| 10. Restoration T1 (1-7)           | 5.19 | 0.94 | .05    | .09*   | .07   | .30** | .25** | .26** | .16** | .15** | .15** |       |       |       |    |    |    |    |    |
| 11. Restoration T2 (1-7)           | 5.20 | 0.88 | .06    | .06    | .10*  | .26** | .32** | .29** | .12*  | .18** | .17** | .59** |       |       |    |    |    |    |    |
| 12. Restoration T3 (1-7)           | 5.19 | 0.89 | .05    | .04    | .07*  | .25** | .29** | .35** | .11*  | .14** | .18** | .55** | .60** |       |    |    |    |    |    |
| 13. Sleep quality T1 (1-5)         | 3.44 | 0.92 | -.20** | -.14** | -.10* | .25** | .23** | .21** | .05   | .06   | .04   | .27** | .19** | .22** |    |    |    |    |    |

Continued

**Table A2. (Continued)**

|                          | M    | SD   | 1      | 2      | 3      | 4      | 5      | 6      | 7     | 8     | 9     | 10     | 11     | 12     | 13     | 14     | 15     | 16    | 17    |
|--------------------------|------|------|--------|--------|--------|--------|--------|--------|-------|-------|-------|--------|--------|--------|--------|--------|--------|-------|-------|
| 14. Sleep quality        | 3.38 | 0.92 | -.16** | -.15** | -.09*  | .22**  | .22**  | .19**  | .04   | .01   | .02   | .21**  | .21**  | .23**  | .73**  |        |        |       |       |
| T2 (1-5)                 |      |      |        |        |        |        |        |        |       |       |       |        |        |        |        |        |        |       |       |
| 15. Sleep quality        | 3.34 | 0.91 | -.12*  | -.11*  | -.12** | .21**  | .23**  | .23**  | .07   | .07*  | .04   | .23**  | .21**  | .30**  | .69**  | .72**  |        |       |       |
| T3 (1-5)                 |      |      |        |        |        |        |        |        |       |       |       |        |        |        |        |        |        |       |       |
| 16. Affective rumination | 2.43 | 0.88 | .26**  | .19**  | .15**  | -.26** | -.19** | -.19** | -.02  | .02   | -.02  | -.18** | -.18** | -.16** | -.44** | -.38** | -.36** |       |       |
| T1 (1-5)                 |      |      |        |        |        |        |        |        |       |       |       |        |        |        |        |        |        |       |       |
| 17. Affective rumination | 2.45 | 0.89 | .24**  | .26**  | .17**  | -.23** | -.25** | -.22** | -.04  | -.06  | -.03  | -.14** | -.20** | -.18** | -.40** | -.48** | -.42** | .66** |       |
| T2 (1-5)                 |      |      |        |        |        |        |        |        |       |       |       |        |        |        |        |        |        |       |       |
| 18. Affective rumination | 2.48 | 0.90 | .16**  | .20**  | .19**  | -.22** | -.22** | -.27** | -.09* | -.07* | -.07* | -.15** | -.19** | -.24** | -.34** | -.40** | -.47** | .56** | .70** |
| T3 (1-5)                 |      |      |        |        |        |        |        |        |       |       |       |        |        |        |        |        |        |       |       |

Notes. Means, standard deviations, and correlations were calculated with the statistical program JASP (JASP Team, 2017). \* $p < .05$ , \*\* $p < .001$ ,  $N = 648-920$ , T1 = time point 1, T2 = time point 2, T3 = time point 3.

**Table A3.** Correlations between job insecurity and other constructs at all time points

|                           | M    | SD   | 1      | 2      | 3      | 4     | 5     | 6     | 7     | 8     | 9     | 10    | 11    | 12    | 13    | 14    | 15 | 16 | 17 |
|---------------------------|------|------|--------|--------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|----|----|
| 1. Job insecurity         | 2.16 | 1.12 |        |        |        |       |       |       |       |       |       |       |       |       |       |       |    |    |    |
| T1 (1-5)                  |      |      |        |        |        |       |       |       |       |       |       |       |       |       |       |       |    |    |    |
| 2. Job insecurity         | 2.09 | 1.07 | .70**  |        |        |       |       |       |       |       |       |       |       |       |       |       |    |    |    |
| T2 (1-5)                  |      |      |        |        |        |       |       |       |       |       |       |       |       |       |       |       |    |    |    |
| 3. Job insecurity         | 2.18 | 1.16 | .61**  | .69**  |        |       |       |       |       |       |       |       |       |       |       |       |    |    |    |
| T3 (1-5)                  |      |      |        |        |        |       |       |       |       |       |       |       |       |       |       |       |    |    |    |
| 4. Task performance       | 4.62 | 1.07 | -.19** | -.20** | -.17** |       |       |       |       |       |       |       |       |       |       |       |    |    |    |
| T1 (0-6)                  |      |      |        |        |        |       |       |       |       |       |       |       |       |       |       |       |    |    |    |
| 5. Task performance       | 4.51 | 1.08 | -.14** | -.19** | -.15** | .65** |       |       |       |       |       |       |       |       |       |       |    |    |    |
| T2 (0-6)                  |      |      |        |        |        |       |       |       |       |       |       |       |       |       |       |       |    |    |    |
| 6. Task performance       | 4.53 | 1.07 | -.14** | -.16** | -.15** | .64** | .71** |       |       |       |       |       |       |       |       |       |    |    |    |
| T3 (0-6)                  |      |      |        |        |        |       |       |       |       |       |       |       |       |       |       |       |    |    |    |
| 7. Contextual performance | 3.43 | 0.67 | -.01   | -.05   | -.07   | .33** | .31** | .32** |       |       |       |       |       |       |       |       |    |    |    |
| T1 (1-5)                  |      |      |        |        |        |       |       |       |       |       |       |       |       |       |       |       |    |    |    |
| 8. Contextual performance | 3.47 | 0.69 | .01    | -.03   | -.03   | .35** | .38** | .33** | .66** |       |       |       |       |       |       |       |    |    |    |
| T2 (1-5)                  |      |      |        |        |        |       |       |       |       |       |       |       |       |       |       |       |    |    |    |
| 9. Contextual performance | 3.43 | 0.67 | -.07   | -.08*  | -.08*  | .33** | .35** | .37** | .61** | .70** |       |       |       |       |       |       |    |    |    |
| T3 (1-5)                  |      |      |        |        |        |       |       |       |       |       |       |       |       |       |       |       |    |    |    |
| 10. Restoration           | 5.19 | 0.94 | -.11*  | -.10*  | -.05   | .30** | .25** | .26** | .16** | .15** | .15** |       |       |       |       |       |    |    |    |
| T1 (1-7)                  |      |      |        |        |        |       |       |       |       |       |       |       |       |       |       |       |    |    |    |
| 11. Restoration           | 5.20 | 0.88 | -.11*  | -.10*  | -.01*  | .26** | .32** | .29** | .12*  | .18** | .17** | .59** |       |       |       |       |    |    |    |
| T2 (1-7)                  |      |      |        |        |        |       |       |       |       |       |       |       |       |       |       |       |    |    |    |
| 12. Restoration           | 5.19 | 0.89 | -.11*  | -.09*  | -.08*  | .25** | .29** | .35** | .11*  | .14** | .18** | .55** | .60** |       |       |       |    |    |    |
| T3 (1-7)                  |      |      |        |        |        |       |       |       |       |       |       |       |       |       |       |       |    |    |    |
| 13. Sleep quality         | 3.44 | 0.92 | -.10*  | -.12*  | -.12*  | .25** | .23** | .21** | .05   | .06   | .04   | .27** | .19** | .22** |       |       |    |    |    |
| T1 (1-5)                  |      |      |        |        |        |       |       |       |       |       |       |       |       |       |       |       |    |    |    |
| 14. Sleep quality         | 3.38 | 0.92 | -.11*  | -.15** | -.15** | .22** | .22** | .19** | .04   | .01   | .02   | .21** | .21** | .23** | .73** |       |    |    |    |
| T2 (1-5)                  |      |      |        |        |        |       |       |       |       |       |       |       |       |       |       |       |    |    |    |
|                           | 3.34 | 0.91 | -.14** | -.18** | -.17** | .21** | .23** | .23** | .07   | .07*  | .04   | .23** | .21** | .30** | .69** | .72** |    |    |    |

Continued

**Table A3.** (Continued)

|                          | M    | SD   | 1     | 2     | 3     | 4      | 5      | 6      | 7     | 8     | 9     | 10     | 11     | 12     | 13     | 14     | 15     | 16    | 17    |
|--------------------------|------|------|-------|-------|-------|--------|--------|--------|-------|-------|-------|--------|--------|--------|--------|--------|--------|-------|-------|
| 15. Sleep quality        |      |      |       |       |       |        |        |        |       |       |       |        |        |        |        |        |        |       |       |
| T3 (1-5)                 | 2.43 | 0.88 | .17** | .20** | .17** | -.26** | -.19** | -.19** | -.02  | .02   | -.02  | -.18** | -.18** | -.16** | -.44** | -.38** | -.36** |       |       |
| 16. Affective rumination |      |      |       |       |       |        |        |        |       |       |       |        |        |        |        |        |        |       |       |
| T1 (1-5)                 | 2.45 | 0.89 | .16** | .27** | .23** | -.23** | -.25** | -.22** | -.04  | -.06  | -.03  | -.14** | -.20** | -.18** | -.40** | -.48** | -.42** | .66** |       |
| 17. Affective rumination |      |      |       |       |       |        |        |        |       |       |       |        |        |        |        |        |        |       |       |
| T2 (1-5)                 | 2.48 | 0.90 | .11*  | .20** | .20** | -.22** | -.22** | -.27** | -.09* | -.07* | -.07* | -.15** | -.19** | -.24** | -.34** | -.40** | -.47** | .56** | .70** |
| 18. Affective rumination |      |      |       |       |       |        |        |        |       |       |       |        |        |        |        |        |        |       |       |
| T3 (1-5)                 |      |      |       |       |       |        |        |        |       |       |       |        |        |        |        |        |        |       |       |

Notes.. Means, standard deviations, and correlations were calculated with the statistical program JASP (JASP Team, 2017).

\* $p < .05$ , \*\* $p < .001$ ,  $N = 648-920$ , T1 = time point 1, T2 = time point 2, T3 = time point 3.