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RESEARCH ARTICLE

Recovery from work-related effort: A meta-analysis

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Summary

This meta-analytic study examines the antecedents and outcomes of four recovery experiences: psychological detachment, relaxation, mastery, and control. Using 299 effect sizes from 54 independent samples (N = 26,592), we extend theory by integrating recovery experiences into the challenge–hindrance framework, creating a more comprehensive understanding of how both after-work recovery and work characteristics collectively relate to well-being. The results of meta-analytic path estimates indicate that challenge demands have stronger negative relationships with psychological detachment, relaxation, and control recovery experiences than hindrance demands, and job resources have positive relationships with relaxation, mastery, and control recovery experiences. Psychological detachment after work has a stronger negative relationship with fatigue than relaxation or control experiences, whereas control experiences after work have a stronger positive relationship with vigor than detachment or relaxation experiences. Additionally, a temporally driven model with recovery experiences as a partial mediator explains up to 62% more variance in outcomes (ΔR^2 = .12) beyond work characteristics models, implying that both work characteristics and after-work recovery play an important role in determining employee well-being.

KEYWORDS

challenge–hindrance framework, fatigue, meta-analysis, recovery experiences, vigor

1 | INTRODUCTION

Work requires energy and effort to accomplish required tasks. Both work conditions and task demands can deplete psychological resources (Meijman & Mulder, 1998). After expending energy over a period, it is necessary to *recover* or replenish resources that were used up at work (Zijlstra & Sonnentag, 2006). For many employees, the recovery process occurs each day after work. This recovery process plays a "crucial intervening role in the relationship between stressful work characteristics on the one hand, and health, well-being and performance capability on the other hand" (Sonnentag & Geurts, 2009, p. 2). This study focuses on *recovery experiences* because "it is not a specific activity per se that helps [one] to recover from job stress but its underlying attributes" (Sonnentag & Fritz, 2007, p. 204). In other words, recovery experiences are the mechanisms through which recovery processes occur (Sonnentag & Geurts, 2009). In this way, after-work recovery experiences are considered a mediator between work characteristics and well-being outcomes (Kinnunen, Feldt, Siltaloppi, & Sonnentag, 2011).

The four most researched recovery experiences are *psychological detachment*, not thinking about work during nonwork time; *relaxation*, having a low activation level; *mastery*, facing a positive challenge to learn something new; and *control*, having a feeling of control over nonwork time (Sonnentag & Fritz, 2007). Although there has been considerable research about recovery over the past two decades, several major questions remain unanswered: How do recovery experiences fit into recent work characteristic and employee well-being models? Is one recovery experience more effective for improving individual well-being? Does researching recovery experiences add to our understanding of well-being in a practically significant way beyond work characteristics models? The current study aims to address these unanswered questions as well as additional questions surrounding after-work recovery experiences.

The past three decades of employee well-being research have yielded important contributions to the understanding of how work and nonwork experiences relate to individual well-being. Lee and Ashforth (1996) meta-analyzed the relationship between work characteristics and burnout, finding that work demands have the strongest correlation with emotional exhaustion. Several years later, the Job Demands–Resources model (JD-R; Demerouti, Bakker, Nachreiner, & Schaufeli, 2001) proposed that job demands and job resources are associated with burnout in different ways. Subsequent

research using this model suggests job demands and job resources uniquely predict positive outcomes such as work engagement (Bakker & Demerouti, 2007, 2014). Another research stream drew upon Lazarus and Folkman's (1984) seminal work to recognize that work demands can be characterized as either a "positive" challenge or a "negative" hindrance (Cavanaugh, Boswell, Roehling, & Boudreau, 2000). Crawford, LePine, and Rich (2010) used meta-analytic structural equation modeling (MASEM) to show that all demands are positively associated with burnout. Furthermore, they reported that hindrance demands are negatively associated with engagement whereas challenge demands are positively associated with engagement.

As an alternative to studying work characteristics, Sonnentag (2001) extended research on employee respite and explored how evening leisure helped employees reduce stress and improve well-being. We now know that work characteristics typically explain more variance in distal outcomes such as burnout (Podsakoff, LePine, & LePine, 2007) and performance (LePine, Podsakoff, & LePine, 2005) than do proximal outcomes (e.g., affect). One benefit of this newer emphasis on after-work recovery is that it focuses on proximal well-being outcomes such as fatigue and vigor (Sonnentag, 2012) that are more volatile and fluctuate from day to day in employees (Ten Brummelhuis & Bakker, 2012).

This study has three main objectives. First, this study integrates the recovery literature with the work characteristics literature. This is valuable because most studies have included work characteristic variables but not explicitly theorized how antecedents are related to recovery experiences. In addition, we contend that previous models are a starting point but are incomplete. For example, Crawford et al. (2010) provided distinctions between challenge demands and hindrance demands with outcomes, but did not include recovery experiences that can occur each day and are also related to well-being. Kinnunen et al. (2011) used a single sample to test recovery experiences as mediators within the JD-R model, but did not differentiate work demands as challenges or hindrances, which has been shown to have different relationships with well-being outcomes (Crawford et al., 2010). Similarly, Armon, Melamed, and Shirom (2012) found that job resources were related to vigor and job demands were not, but did not include any hindrance demands. Last, Sonnentag and Zijlstra (2006) found that need for recovery mediated the relationship between work characteristics and fatigue, but needing recovery is not the same as experiencing recovery. Therefore, to fill these research gaps, we use MASEM to provide a more comprehensive understanding of the relationships between work demands and resources, after-work recovery experiences, and fatigue and vigor. Using such a procedure is useful because meta-analytic correlations provide a more comprehensive understanding of the relationships between constructs than do correlations found in a single sample, and structural models provide more accurate conclusions of the relationships between constructs than do zero-order correlations.

Second, this study clarifies inconsistencies within the recovery literature. One inconsistency concerns outcomes from recovery experiences, as some authors have concluded that psychological detachment is "the most powerful recovery experience" (Siltaloppi, Kinnunen, & Feldt, 2009, p. 344), whereas others have found that "for achieving positive activation and serenity in the morning, it does not help to detach oneself from work during off-job time but to engage in mastery experiences or relaxation" (Sonnentag, Binnewies, & Mojza, 2008, p. 682). Thus, a meta-analysis can provide a more consistent overview of specific relationships between recovery experiences and outcomes. Another inconsistency is the relationship between job resources and recovery experiences, as some authors theorize that job resources are positively related to all recovery experiences (Kinnunen & Feldt, 2013), whereas others contend that job resources may only be related to mastery and control (Shimazu, Sonnentag, Kunota, & Kawakai, 2012).

Third, this study investigates the practical value of after-work recovery research. Primary studies vary greatly in the amount of variance that recovery experiences explain above and beyond work characteristics. For example, findings range from less than 1% (e.g., Querstret & Cropley, 2012; Sonnentag, Binnewies, & Mojza, 2010) to as high as 6–10% (e.g., Fritz, Yankelevich, Zarubin, & Barger, 2010; Sonnentag, Kuttler, & Fritz, 2010) of the variance explained in the relationship between evening psychological detachment and fatigue. This variability could be because each primary study includes different work characteristics and recovery experience variables rather than all variables together. As such, we test how including recovery experiences adds to a model of work characteristics and well-being.

2 | THEORETICAL BACKGROUND

2.1 | Work-related antecedents of recovery experiences

Drawing on JD-R theory, much of the literature describes that work demands are negatively related to recovery experiences (Demerouti, Bakker, Geurts, & Taris, 2009). Sonnentag and Fritz (2007) outlined how both work demands and job control are related to recovery experiences. Consistent with the stress appraisal literature, which suggests that work demands can be positive or negative (Lazarus & Folkman, 1984), work characteristics are now typically categorized as challenge demands, hindrance demands, and job resources (Cavanaugh et al., 2000). These newer categorizations and refinements are important because they have uncovered unique relationships with well-being outcomes (e.g., Crawford et al., 2010; Podsakoff et al., 2007). The purpose of this section is to summarize previous research, build off integrations of JD-R with recovery (e.g., Kinnunen et al., 2011), and extend theory to explore the potentially distinct relationships of challenge demands, hindrance demands, and job resources with recovery experiences.

Challenge demands are work demands such as time pressure and high workload that are stressful but also produce positive feelings and can foster psychological resources such as self-efficacy (Cavanaugh et al., 2000). Challenge demands are positively related to autonomous work motivation, which is when employees choose to work because they enjoy it and gain meaning from it (Tadić Vujčić, Oerlemans, & Bakker, 2017). It has been suggested that individuals who enjoy their work and find their work interesting may engage in problem-solving pondering (Cropley & Zijlstra, 2011). Problem-solving pondering refers to thinking about solutions for work-related problems

during nonwork time and is negatively related to psychological detachment (Querstret & Cropley, 2012). Greater challenge demands are also associated with higher positive affect at the end of the day (Tadić Vujčić et al., 2017). Although high positive affect can be beneficial, it typically involves higher levels of activation. We expect that prolonged high activation from challenge demands (Brosschot, Pieper, & Thayer, 2005) spills over to nonwork time and will be negatively related to relaxation experiences. Enthusiastic emotions towards work goals have also been linked with interference into nonwork time (Wood & Michaelides, 2016), so challenge demands should be negatively related to control experiences. However, challenge demands are work conditions that result in learning (Tadić, Bakker, & Oerlemans, 2015), and this interest to explore can spill over to after-work time and is positively associated with mastery experiences (Michel, Turgut, Hoppe, & Sonntag, 2016).

> **Hypothesis 1.** Challenge demands will have a (a) negative relationship with psychological detachment, (b) negative relationship with relaxation, (c) positive relationship with mastery, and (d) negative relationship with control experiences.

Unlike challenge demands, hindrance demands are when an employee's work relationships or environment interferes with goal attainment. We expect these to also prohibit after-work recovery experiences, although they do so in different ways. Measures for this construct often include role conflict, role ambiguity, conflict at work, and overload.[1] Issues such as conflict at work can create negative emotional responses in the form of anxiety and anger (Tuckey, Searle, Boyd, Winefield, & Winefield, 2015). In addition, anxiety at the end of the work day is linked to lower detachment at home (Van Hooff, 2015). Martinez-Corts, Demerouti, Bakker, and Boz (2015) showed that daily task conflicts and interpersonal conflicts acted as hindrance demands and spilled over to the home domain in the form of strain-based work-to-family conflicts, suggesting that those who experienced conflicts at work could not detach psychologically from their work. Thus, hindrance demands should be negatively related to psychological detachment. These negative affective responses from hindrance demands such as anger and anxiety also are highly activated, so we expect hindrance demands to be negatively related to relaxation experiences. Hindrance demands are also related to lower motivation to actively cope with demands (Crawford et al., 2010), such as engaging in mastery experiences. Last, hindrance demands such as overload include the feeling that there is too much to do with no control, which could spill over to experiencing low levels of control during after-work time.

> **Hypothesis 2.** Hindrance demands will have a negative relationship with (a) psychological detachment, (b) relaxation, (c) mastery, and (d) control experiences.

[1]Although there is some discrepancy in categorizing workload (e.g., Tuckey et al., 2015), we categorize time pressure and high workload as a challenge demand, but overload as a hindrance demand because having an unmanageable workload (e.g., White, 2010) prevents work goals (Tuckey et al., 2015) and provides no growth potential (Tadić et al., 2015).

Job resources are work attributes that help an individual achieve work goals or stimulate personal growth (Demerouti, Bakker, de Jonge, Janssen, & Schaufeli, 2001). Typical job resources are job control, job autonomy, job variety, and job growth opportunities (Sonnentag, 2015). Although resources such as job control are positively related to well-being, Sonnentag and Fritz (2007) also noted that increased control means an individual will be more likely to continue thinking about work during nonwork time and maintain a high level of activation from work-related issues. Indeed, individuals with higher job control also report lower combinations of after-work psychological detachment and relaxation experiences (Bennett, Gabriel, Calderwood, Dahling, & Trougakos, 2016). Nonetheless, individuals with greater job resources are more able "to protect themselves from the strains of further resource depletion" (Crawford et al., 2010, p. 837). In other words, job resources can also be positively related to recovery experiences. For example, increased competence arising from job growth opportunities or job variety can spill over and increase the desire for additional learning opportunities after work. Similarly, feelings of job control may spill over as feelings of control over leisure time. Thus, in line with previous findings (e.g., Siltaloppi et al., 2009), we expect that job resources are positively related to mastery and control recovery experiences.

> **Hypothesis 3.** Job resources will have a negative relationship with (a) psychological detachment and (b) relaxation experiences, but a positive relationship with (c) mastery and (d) control experiences.

2.2 | Outcomes of recovery experiences

The main basis for examining recovery experience outcomes is the Effort-Recovery model (ERM; Meijman & Mulder, 1998), which extended the load–capacity model from exercise physiology to integrate psychological effort and restoration of resources. ERM has three main components: Individuals mobilize psychological resources such as energy to engage in a work-related process, this resource mobilization leads to both task performance and resource depletion, and recovery occurs when the work-related processes end. If recovery does not happen, individuals incur negative effects such as impaired well-being.

As described in the ERM, energy is a key resource used to engage in a work procedure (Meijman & Mulder, 1998). Human energy is frequently described as a subjective affective assessment of one's psychophysiological system (Quinn, Spreitzer, & Lam, 2012) and is a limited resource (Hobfoll, 2011) that varies each day within individuals (Ten Brummelhuis & Bakker, 2012). Energy fluctuations have been linked to organizational outcomes such as job performance (e.g., Bakker & Xanthopoulou, 2009), turnover (e.g., Wright & Cropanzano, 1998), and citizenship behaviors (for a review, see Sonnentag, 2015).

In the past decade, the structure of affect has been refined into a model with 12 core dimensions around a circumplex (Yik, Russell, & Steiger, 2011). Human energy fits best in two dimensions: pleasant activation (e.g., vigor, vitality, energetic, and excited) and unpleasant deactivation (e.g., fatigued, exhausted, sluggish, and tired). For

consistency with most of the recovery literature, we use the term *vigor* rather than pleasant activation and *fatigue* rather than unpleasant deactivation. In accordance with this affective model, vigor and fatigue are different affective dimensions rather than two poles on the same dimension because individuals can simultaneously experience high levels of vigor and fatigue (Mäkikangas et al., 2014) and vigor and fatigue have unique antecedents and outcomes (e.g., Fritz, Lam, & Spreitzer, 2011; Halbesleben, 2010).

In the context of the ERM, completing work processes during formal work periods increases high activation and creates short-term load reactions (e.g., increases fatigue). Recovery experiences reverse these reactions in multiple ways. Psychological detachment after work is beneficial because it removes the individual mentally from work-related activation, thus providing time for resources to return to the previous state (Meijman & Mulder, 1998). Relaxation experiences after work contribute to employee well-being because relaxation involves little or no activation of the psychophysiological system, thus allowing for previously depleted resources to be replenished (Stone, Kennedy-Moore, & Neale, 1995). Mastery experiences, which typically occur when engaging in a more demanding leisure task such as learning a new language or playing a musical instrument, both reduce activation from work (like psychological detachment) and also increase an individual's personal resources such as competence. Experiencing control can also be beneficial to employee well-being because it builds resources such as an individual's feeling of self-efficacy (Sonnentag & Fritz, 2007).

In sum, there are two different pathways that recovery experiences are related to fatigue and vigor. One pathway is reducing or stopping psychological load from work tasks, typically occurring due to psychological detachment and relaxation experiences. This halts the prolonged negative effects (e.g., fatigue) and allows this state to return to normal levels. The second pathway is by building up additional psychological resources, typically occurring due to mastery and control experiences. Conservation of resources theory (Hobfoll, 2011) describes how an increase in one personal resource (e.g., self-efficacy) will also increase another resource (e.g., vigor). In line with previous conceptualizations that psychological detachment and relaxation experiences have a more robust relationship with negative outcomes, whereas mastery and control experiences have a more robust relationship with positive outcomes (Siltaloppi et al., 2009), we posit that different recovery experiences will have unique associations with outcomes.

> **Hypothesis 4.** (a) Psychological detachment and (b) relaxation experiences will have stronger negative relationships with fatigue than will mastery and control experiences.

> **Hypothesis 5.** (a) Mastery and (b) control experiences will have stronger positive relationships with vigor than will psychological detachment and relaxation experiences.

2.3 | Recovery experiences as mediators

Theoretically, recovery experiences are considered mediators between work characteristics and well-being (Demerouti et al., 2009). This is especially evident when one considers how the recovery process unfolds over time: An employee experiences demands and resources at work and then recovery experiences after work, with both experiences related to well-being. For example, the stressor-detachment model (Sonnentag & Fritz, 2015) describes that work demands have the potential to impair psychological detachment, and this lack of detachment is related to low well-being. The majority of findings support this mediating role of recovery experiences (e.g., Safstrom & Hartig, 2013; Sonnentag et al., 2010).

We build off the work of Kinnunen et al. (2011) who proposed a partial mediation model by expanding the processes within the challenge–hindrance framework and testing all four recovery experiences at the same time. The partial mediation process is an important distinction for two reasons. First, this continues to keep the direct relationships between work characteristics and well-being evident in the JD-R model. Second, partial mediation implies that work characteristics are related to recovery experiences and that recovery experiences are related to well-being. As described in earlier hypotheses, we contend that challenge demands, hindrance demands, and job resources can be uniquely related to recovery experiences, and these relationships may therefore alter the indirect associations between work characteristics and outcomes. For example, challenge demands have a positive direct relationship with fatigue (impaired well-being), but challenge demands can also have negative relationships with after-work detachment and relaxation experiences, so the total relationship (both direct and indirect effects through low recovery experiences) with fatigue may be stronger than may the direct effects only. As a second example, job resources should have a direct negative relationship with fatigue. However, if job resources are also negatively related to detachment experiences, this may decrease the total effect because of negative indirect effects through detachment. As a third example, hindrance demands may have a lower negative relationship with detachment, relaxation, and control experiences than challenge demands because they create less nonwork interference (Wood & Michaelides, 2016), so indirect effects on outcomes from hindrance demands may be relatively minimal. Thus, we propose:

> **Hypothesis 6.** Recovery experiences will partially mediate the relationship between work characteristics and outcomes.

3 | METHOD

3.1 | Literature search and inclusion criteria

In June 2013, we conducted a comprehensive electronic literature search on all forms of recovery related to work stress. Manuscripts were identified using ABI Inform Complete, PsychInfo, and Academic Search Complete databases with keywords of *recovery*, *recovery experience*, and *job stress*. In January 2015, we conducted an electronic search of all available Academy of Management, Society for Industrial and Organizational Psychology, and Southern Management Association conference proceedings, as well as dissertations through ProQuest and requested unpublished studies through the email listserv of the Academy of Management Organizational Behavior

division (i.e., OBlistserv). We also double checked that our search contained all manuscripts citing Sonnentag and Fritz (2007) or were used in previous meta-analyses (i.e., Crawford et al., 2010; Lee & Ashforth, 1996). This yielded 989 studies.

We then read the titles, abstracts, and/or methods sections to discern if a study included at least one correlation between two variables of interest. Following previous categorizations (e.g., Crawford et al., 2010), we read items of all measures and categorized variables into the hindrance–challenge framework. Time pressure and high workload were categorized as challenge demands. Role conflict, conflict at work, overload, and stress[2] were categorized as hindrance demands. Job control, autonomy, job growth opportunities, and job variety were categorized as job resources. Recovery experience variables were psychological detachment, relaxation, mastery, or control. Outcome variables of vigor, vitality, positive activated affect, and excited were categorized as vigor. Variables of fatigue, exhaustion, and emotional exhaustion were categorized as fatigue. To be consistent with the temporal ordering proposed, we focused on work-related antecedents, after-work recovery experiences, and end-of-day outcomes. For daily diary studies, variables were assessed in this temporal order (e.g., work characteristics measured at work, and recovery experiences measured after work). For cross-sectional studies, items needed to include temporal wording, such as "during time after work" (used in Sonnentag & Fritz, 2007) when assessing recovery experiences. By request, three authors provided additional correlations that were not included in published manuscripts. The final database included 299 effect sizes from 54 independent samples with a total sample size of 26,592.

3.2 | Coding procedures

Data pertaining to effect size, sample size, independent variable reliability, and dependent variable reliability were independently extracted by three coders, with one coder naïve to the hypotheses of this study. The coders agreed on 1,001 (84%) of the 1,196 coding assignments. In addition, consistent with previous meta-analyses of this type (e.g., Colquitt et al., 2013), the ICC(2) form of the intraclass correlation was computed as a secondary assessment of interrater reliability. More specifically, absolute agreement was calculated using a two-way random model in SPSS version 22. This yielded an ICC(2) of .97 and a Pearson correlation of .94, exceeding the recommended .70 threshold for an acceptable ICC(2) value (Bliese, 2000). All coding discrepancies were resolved with the assistance of the first author. For cross-sectional data, we used the effect size provided in the correlation table. For daily diary studies, we used the between-person correlation because the between-person information in a diary study is the mean variance across all days (not partitioning the variance for each day), or the general amount of variance for each person, which is what the cross-sectional data examines. Reliability information pertaining to each endogenous and exogenous variable was derived from each respective correlation matrix or in the article text. If reliability was reported on a daily level but correlations were reported as the average over multiple days (e.g., Sonnentag & Bayer, 2005), the mean reliability value was used because we were interested in the between-person correlations. If data from multiple studies were presented, these results were coded as independent samples (e.g., a Spanish sample and a Dutch sample, Salanova & Schaufeli, 2008). In cases when outcomes were measured several times each day (e.g., exhaustion at work and exhaustion at bedtime; Demerouti, Bakker, Sonnentag, & Fullagar, 2012), we adhered to our coding rule and used the effect size that temporally followed the recovery experience (in this case, exhaustion at bedtime).

Given that the focus of our study is on after-work recovery experiences, our decision rules maintained that the effect size most closely linked in time to the recovery experience was retained. For example, only the measure of exhaustion at bedtime would be used as this would capture exhaustion after evening recovery experiences. We reverse coded when necessary to produce effect sizes with consistent meaning (e.g., "inability to psychologically detach" was reverse coded; Taris, Geurts, Schaufeli, Blonk, & Lagerveld, 2008). Last, only self-reported data are included in this study. Although other-reported recovery experiences (Sonnentag et al., 2010) and resource outcomes (Booth, 2011) were available in one case each, other-reported data were excluded from the present analyses because a lack of data prohibited us from testing other-reported versus self-reported moderating effects. Furthermore, we felt that including these effect sizes could potentially distort the results.

3.3 | Meta-analysis and path analysis procedures

This study calculated the meta-analytic correlation between all variables using the random effects model of meta-analysis (Hunter & Schmidt, 2004), which can correct for artifactual variance and, thus, provide a more conservative effect size estimate (Kepes, McDaniel, Brannick, & Banks, 2013). Independent effect sizes were used to calculate the sample size-weighted mean correlation ($\bar{r}$). Corrections for unreliability in the independent and dependent variables were made using reliability information presented in each primary study. As such, a corrected point estimate (ρ) and standard deviation (σ_ρ) of the population estimate are included, as well as the 95% confidence interval (95% CI) around this corrected correlation. To check that the published literature was not systematically unrepresentative of the population, publication bias analyses were completed using trim-and-fill, Egger's regression, and funnel plot methodologies (Kepes, Banks, McDaniel, & Whetzel, 2012). To test hypotheses and create a comprehensive model of work characteristics, recovery experiences, and outcomes, we used AMOS 22 software (SPSS Inc., 2013) to perform a MASEM using the meta-analytic correlation matrix with corrected correlations and the harmonic mean of the sample size. In this analysis, the harmonic mean of 2,410 is smaller than the average mean of 4,057 and is suggestive of a more conservative approach (Viswesvaran & Ones, 1995). We also followed recent recommendations for these analyses in the organizational sciences (e.g., Bergh et al., 2014; Landis, 2013).

[2]We based this coding decision by reading sample items (e.g., "Today I had conflicts with other people"; Feuerhahn, Sonnentag, & Woll, 2014), and recognizing it was similar to conflict at work.

4 | RESULTS

4.1 | Work-related antecedents of recovery experiences

Table 1 presents the meta-analytic relationships between work-related antecedents and recovery experiences. Hypothesis 1 proposed that challenge demands have a positive relationship with mastery experiences but a negative relationship with all other recovery experiences. As expected, challenge demands have a negative relationship with psychological detachment (ρ = −.37), relaxation (ρ = −.30), and control (ρ = −.28) recovery experiences. For a more rigorous test of hypotheses, we also examined the path weights and 95% CIs from the MASEM. To examine this, we organized the corrected correlations between all variables into a correlation matrix, as shown in Table 2, and created a structural equation model using AMOS 22, as shown in Figure 1. Table 3 presents the meta-analytic regression weights of antecedents and recovery experiences. We focus on regression weights rather than on corrected correlations because correlations examine the singular relationships between two variables, whereas the regression weights provide an effect size accounting for the relationships of all other work characteristics, recovery experiences, and outcomes. Nonoverlapping 95% CIs suggest that the relationships are significantly different. For challenge demands, the negative relationships are the same when examining regression weights. However, challenge demands have no statistical relationship with mastery recovery experiences, as the 95% CI includes zero. Thus, Hypotheses 1a, 1b, and 1d are supported, and 1c is rejected.

Hypothesis 2 proposed a negative relationship between hindrance demands and all recovery experiences. Meta-analytic correlations show that hindrance demands have a negative relationship with psychological detachment (ρ = −.21), relaxation (ρ = −.15), and control (ρ = −.12), but a nonsignificant relationship with mastery experiences (ρ = .02) as the 95% CI includes zero. An examination of the regression weights in Table 3 confirms that hindrance demands have a negative relationship with psychological detachment (β = −.11) and relaxation (β = −.05), supporting H2a and H2b. However, hindrance demands have a positive relationship with mastery experiences (β = .06), and the 95% CI for the relationship between hindrance demands and control experiences includes zero. Thus, both H2c and H2d are rejected.

Hypothesis 3 posited that job resources are negatively related to psychological detachment and relaxation and positively related to mastery and control. As expected, job resources are positively correlated with mastery (ρ = .17) and control (ρ = .21) recovery experiences. Unexpectedly, job resources are also positively related to relaxation (ρ = .08). The relationship with psychological detachment (ρ = .04) is not statistically different from zero (95% CI includes zero). The regression weights in Table 3 confirm that job resources are positively related to evening relaxation, mastery, and control experiences. In addition, job resources have a statistically stronger positive relationship with after-work control and mastery experiences than relaxation. Thus, Hypothesis 3a and 3b are rejected, and 3c and 3d are supported.

4.2 | Outcomes of recovery experiences

Table 4 presents the meta-analytic results of recovery experiences with outcomes. Theoretically, higher evening recovery experiences

TABLE 1 Meta-analytic correlations between work-related antecedents and recovery experiences

						95% CI		80% CR		%	
Antecedents	*k*	*N*	$\bar{r}$	ρ	*SD*ρ	Lower	Upper	Lower	Upper	*SE*	χ^2
Challenge demands											
Psychological detachment	14	3,463	−.30	−.37	.13	−.37	−.24	−.45	−.16	21	66.4*
Relaxation	4	821	−.23	−.30	.19	−.40	−.06	−.44	−.02	14	28.0*
Mastery	4	821	.01	.01	.00	−.03	.05	.01	.01	100	1.5
Control	3	745	−.21	−.28	.11	−.35	−.08	−.35	−.08	25	11.9*
Hindrance demands											
Psychological detachment	11	5,602	−.18	−.21	.07	−.22	−.13	−.25	−.10	38	29.3*
Relaxation	3	4,451	−.12	−.15	.00	−.13	−.11	−.12	−.12	100	0.5
Mastery	3	4,451	.02	.02	.04	−.04	.07	−.03	.06	34	8.9
Control	3	4,451	−.10	−.12	.00	−.12	−.09	−.10	−.10	100	0.7
Job resources											
Psychological detachment	11	5,291	.03	.04	.03	−.01	.06	.00	.06	83	13.2
Relaxation	3	3,065	.06	.08	.00	.05	.08	.06	.06	100	0.6
Mastery	3	3,065	.14	.17	.00	.11	.17	.14	.14	100	2.0
Control	3	3,065	.17	.21	.00	.17	.17	.17	.17	100	0.1

Note. % *SE* is the percentage of variance accounted for by sampling error; 80% CR lower = lower limit 80% credibility interval of the corrected estimate of the population; 80% CR upper = upper limit 80% credibility interval of the corrected estimate of the population; 95% CI lower = lower limit of 95% confidence interval of the corrected estimate of the population; 95% CI upper = upper limit of 95% confidence interval of the corrected estimate of the population; *k* = number of independent effect sizes; *N* = sample size; $\bar{r}$ = mean sample size-weighted correlation; ρ = corrected point estimate of the population (correcting for measurement error); SD_ρ = standard deviation of corrected population point estimate; χ^2 = a chi-square test for the variance remaining unaccounted for.

*$p < .01$.

TABLE 2 Meta-analytic correlation table with work antecedents, recovery experiences, and outcomes

Variable	1	2	3	4	5	6	7	8
1. Challenge demands (ρ)								
2. Hindrance demands (ρ)	.29							
k (*N*)	4 (1,454)							
3. Job resources (ρ)	.03	−.19						
k (*N*)	8 (3,118)	4 (3,907)						
4. Psychological detachment (ρ)	−.37	−.21	.04					
k (*N*)	14 (3,463)	11 (5,602)	11 (5,291)					
5. Relaxation (ρ)	−.30	−.15	.08	.62				
k (*N*)	4 (821)	3 (4,451)	3 (3,065)	11 (2,413)				
6. Mastery (ρ)	.01	.02	.17	.14	.33			
k (*N*)	4 (821)	3 (4,451)	3 (3,065)	9 (2,270)	9 (2,270)			
7. Control (ρ)	−.28	−.12	.21	.41	.65	.39		
k (*N*)	3 (745)	3 (4,451)	3 (3,065)	8 (2,104)	8 (2,104)	8 (2,104)		
8. Fatigue (ρ)	.35	.46	−.24	−.39	−.35	−.18	−.30	
k (*N*)	15 (8,642)	10 (10,083)	19 (13,674)	17 (4,164)	10 (2,135)	9 (2,066)	8 (1,900)	
9. Vigor (ρ)	.19	−.09	.39	.14	.24	.29	.31	−.42
k (*N*)	6 (4,275)	10 (9,161)	15 (10,843)	11 (2,519)	6 (1,663)	5 (1,589)	4 (1,423)	14 (10,883)

Note. *k* = number of independent effect sizes; *N* = combined sample size used to determine meta-analytic correlation between variables; ρ = corrected correlation of the population (correcting for measurement error).

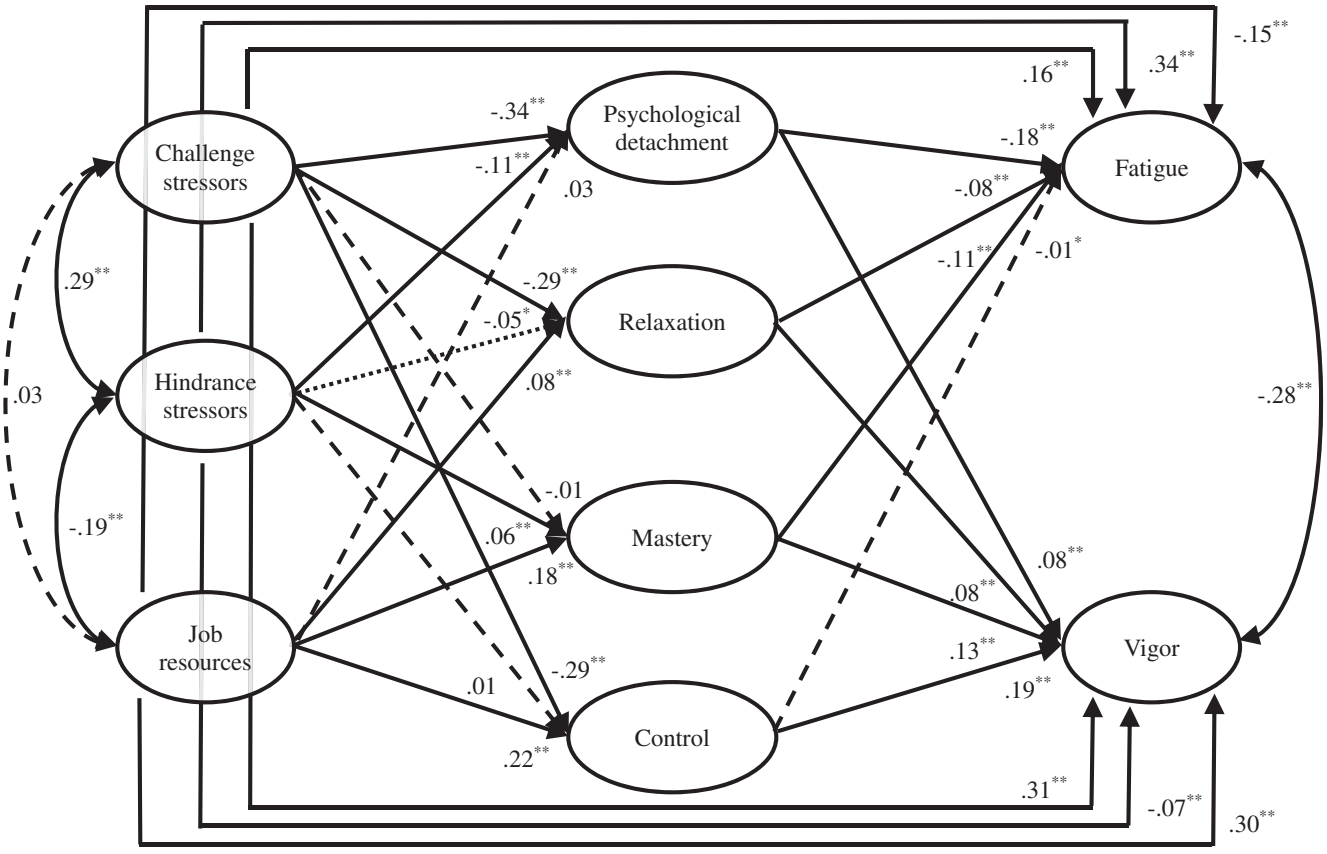

FIGURE 1 Partially mediated meta-analytic structural equation model. Note: Harmonic mean = 2,408. Values represent standardized regression weights. ** (and solid lines) are statistically significant paths at $p < .01$ level, * (and dotted lines) are statistically significant paths at $p < .05$ level. Dashed lines are paths at $p > 0.05$ level. Model includes paths between recovery experiences, but for visual clarity this figure does not include these regression weights

TABLE 3 Meta-analytic regression weights and confidence intervals predicting recovery experiences

	Psychological detachment			Relaxation			Mastery			Control		
		95% CI			95% CI			95% CI			95% CI	
	β	Lower	Upper	β	Lower	Upper	β	Lower	Upper	β	Lower	Upper
Challenge demands	−.34	−.38	−.30	−.29	−.33	−.25	−.01	−.05	.03	−.29	−.33	−.25
Hindrance demands	−.11	−.15	−.07	−.05	−.09	−.01	.06	.02	.10	.01	−.03	.05
Job resources	.03	−.01	.07	.08	.04	.12	.18	.14	.22	.22	.18	.26

Note. 95% CI lower = lower limit of 95% confidence interval; 95% CI upper = upper limit of 95% confidence interval.

TABLE 4 Meta-analytic correlations between recovery experiences and outcomes

						95% CI		80% CR		%	
Outcomes	*k*	*N*	$\bar{r}$	ρ	*SD*ρ	Lower	Upper	Lower	Upper	*SE*	χ^2
Fatigue											
Psychological detachment	17	4,164	−.34	−.39	.20	−.43	−.25	−.26	−.12	10	177.1*
Relaxation	10	2,135	−.30	−.35	.22	−.42	−.19	−.53	−.08	11	89.9*
Mastery	9	2,066	−.15	−.18	.05	−.20	−.10	−.20	−.10	70	12.8
Control	8	1,900	−.26	−.30	.14	−.35	−.16	−.41	−.10	21	38.3*
Vigor											
Psychological detachment	11	2,519	.12	.14	.09	.06	.17	.02	.23	38	29.2*
Relaxation	6	1,663	.21	.24	.08	.14	.28	.12	.29	42	14.3
Mastery	5	1,589	.25	.29	.05	.19	.31	.19	.31	57	14.3
Control	4	1,423	.26	.31	.00	.25	.28	.26	.26	100	0.5

Note. % *SE* is the percentage of variance accounted for by sampling error; 80% CR lower = lower limit 80% credibility interval of the corrected estimate of the population; 80% CR upper = upper limit 80% credibility interval of the corrected estimate of the population; 95% CI lower = lower limit of 95% confidence interval of the corrected estimate of the population; 95% CI upper = upper limit of 95% confidence interval of the corrected estimate of the population; *k* = number of independent effect sizes; *N* = sample size; $\bar{r}$ = mean sample size-weighted correlation; ρ = corrected point estimate of the population (correcting for measurement error); SD_ρ = standard deviation of corrected population point estimate; χ^2 = a chi-square test for the variance remaining unaccounted for.

*$p < .01$.

should be associated with lower fatigue. As expected, all four recovery experiences have a negative correlation with after-work fatigue. However, we also sought to examine whether certain recovery experiences are more negatively associated with fatigue. Hypothesis 4 proposed that (a) psychological detachment and (b) relaxation experiences would have stronger negative correlations with fatigue than would mastery and control experiences. An examination of the corrected correlations (see Table 4) indicates that psychological detachment (ρ = −.39) and relaxation (ρ = −.35) recovery experiences do have stronger relationships than control (ρ = −.30) and mastery (ρ = −.18) experiences. Examining regression weights and 95% CIs in Table 5, we find that psychological detachment has a stronger negative relationship (β = −.18) with fatigue than relaxation and control experiences but shows no statistical difference with mastery. Relaxation experiences do not have a stronger relationship with fatigue than the other recovery experiences. Thus, H4a is partially supported and H4b is rejected.

After-work recovery experiences are also expected to have a positive relationship with vigor. Hypothesis 5 proposed that (a) mastery and (b) control experiences would have a stronger positive correlation with vigor than psychological detachment or relaxation experiences. Results show that control (ρ = .31) and mastery (ρ = .29) experiences present higher corrected correlations with vigor in the evening than relaxation (ρ = .24) and psychological detachment (ρ = .14) experiences. Focusing on regression weights (Table 5), control experiences (β = .19) have 95% CIs that do not overlap with detachment or relaxation, but the CIs of mastery experience overlap with all other recovery experiences. Thus, Hypothesis 5a is rejected and 5b is supported.

TABLE 5 Meta-analytic regression weights predicting well-being outcomes

	Fatigue			Vigor		
		95% CI			95% CI	
	β	Lower	Upper	β	Lower	Upper
Psychological detachment	−.18	−.22	−.14	.08	.02	.14
Relaxation	−.08	−.13	−.03	.08	.03	.13
Mastery	−.11	−.15	−.08	.13	.09	.17
Control	−.01	−.06	.04	.19	.14	.24
Challenge stressors	.16	.13	.20	.31	.27	.35
Hindrance stressors	.34	.31	.37	−.07	−.11	−.04
Job resources	−.15	−.18	−.12	.30	.27	.34

Note. 95% CI lower = lower limit of 95% confidence interval; 95% CI upper = upper limit of 95% confidence interval.

TABLE 6 Tests of mediation

	Fatigue			Vigor		
	Total effect	Direct effect	Indirect effect	Total effect	Direct effect	Indirect effect
Work characteristics						
Challenge demands	.25	.16*	.09*	.20	.31*	−.11*
Hindrance demands	.35	.33*	.02*	−.08	−.07*	−.01
Job resources	−.18	−.15*	−.03*	.37	.30*	.07*
Recovery experiences						
Psychological detachment	−.18	−.18*		.08	.08*	
Relaxation	−.08	−.08*		.08	.08*	
Mastery	−.11	−.11*		.13	.13*	
Control	−.01	−.01		.19	.19*	

*$p < .01$.

4.3 | Comprehensive model

Hypothesis 6 predicted that evening recovery experiences would partially mediate the relationship between work characteristics and after-work outcomes. This model is shown in Figure 1. To test this hypothesis, we used 1,000 bootstrap samples with a 95% CI and examined the statistical significance of indirect paths when the direct paths were also modeled. As shown in Table 6, challenge demands and job resources have statistically significant indirect and direct paths with both fatigue and vigor. Interestingly, challenge demands have a positive direct relationship with vigor, but the total effect is lower because challenge demands also have a negative indirect effect through the negative relationship with most recovery experiences. Hindrance demands have statistically significant direct and indirect paths with fatigue, but only the direct path with vigor is statistically significant. Overall, Hypothesis 6 is mostly supported. In addition, the indirect effects of challenge demands were stronger than were hindrance demands or job resources, mirroring the regression weights showing that challenge demands have stronger associations with psychological detachment and relaxation recovery experiences.

The last main objective of this paper was to examine the additional impact of after-work recovery experiences. Figure 1 shows how both work characteristics and after-work recovery experiences are related to well-being. Figure 2 provides the variance explained in outcomes of a model with just antecedents, a model with just recovery experiences, and then the partially hypothesized model. By adding recovery experiences to the model, there is a 26% increase in variance explained

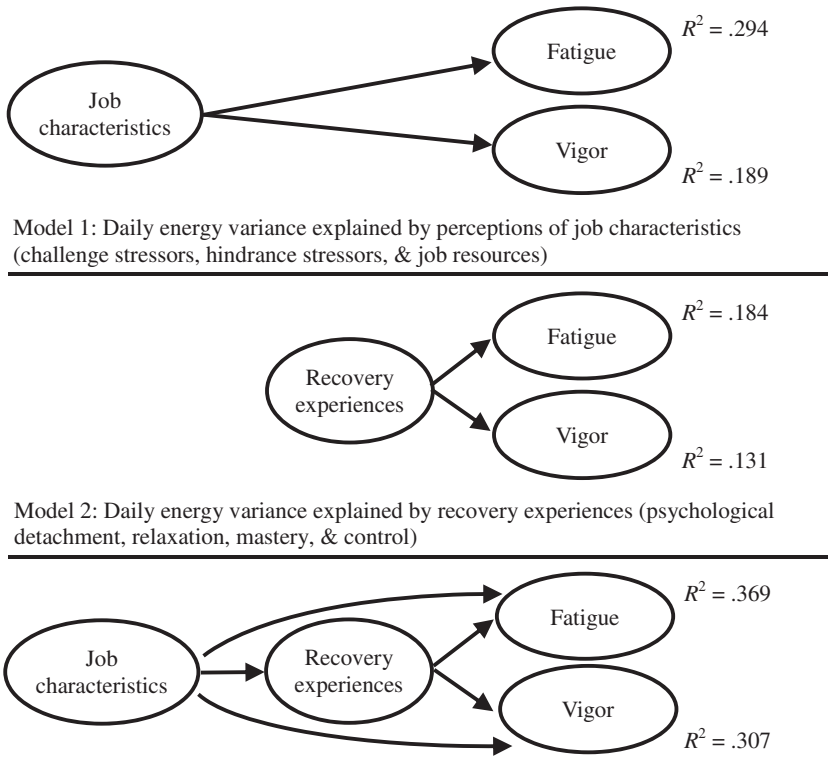

FIGURE 2 Variance explained from models of work characteristics and recovery experiences

in fatigue (ΔR^2 = .08) and a 62% increase in variance explained in vigor (ΔR^2 = .12). Both values are practically and statistically significant.

4.4 | Publication bias analyses

Evidence for publication bias was analyzed using funnel plots, Egger's regression tests, and trim-and-fill techniques when at least 10 effect sizes were presented for a meta-analytic correlation (Kepes et al., 2013). Analyses were conducted according to recommendations for organizational research (Kepes et al., 2012). Table S7 provides a summary of these findings, with additional figures and data available by request from the first author. Egger's regression tests indicate that three relationships potentially have evidence of publication bias: hindrance demands and psychological detachment, job resources and fatigue, and job resources and vigor. The funnel plot and trim-and-fill techniques suggest that only the relationship between hindrance demands and psychological detachment could be smaller in magnitude, but the adjusted effect size is not practically significant ($\Delta\bar{r}$ = .02). When using trim-and-fill techniques and imputing studies on both the left and right sides of the observed effect size, several of the imputations showed that the relationships between variables might be larger rather than smaller. For example, adjusted correlations for the psychological detachment–fatigue and relaxation–fatigue relations are larger than are the values presented in the meta-analytic correlation matrix ($\Delta\bar{r}$ = .07), and thus the value used to create the path model is a more conservative estimate. Only the adjusted effect size of job resources and fatigue has a practically significant smaller value ($\Delta\bar{r}$ = .07) that could indicate the presence of publication bias. However, the direction of this relationship does not change, and given the multitude of other variables in our model, we feel confident that a downward adjustment of this relationship would not impact our overall conclusions regarding recovery experiences in a meaningful way.

5 | DISCUSSION

This paper focused on employee after-work recovery experiences (i.e., psychological detachment, relaxation, mastery, and control experiences; Sonnentag & Fritz, 2007). Whereas previous meta-analyses have focused on work demands and resources with well-being (e.g., Crawford et al., 2010; Halbesleben, 2010; Lee & Ashforth, 1996), our objective was to provide a meta-analytic examination of after-work recovery experiences, extend theory regarding JD-R and recovery experiences (Kinnunen et al., 2011) utilizing the challenge–hindrance framework, and integrate our findings to see how the combination of work characteristics *and* recovery experiences collectively and uniquely influence employee well-being. The antecedents of interest were hindrance demands, challenge demands, and job resources. The outcomes of interest were fatigue and vigor, the vital and proximal outcomes of after-work recovery experiences.

This study provides multiple contributions to scholars and practitioners. First, we created a comprehensive model integrating recovery experiences within models of work characteristics and well-being. The partial mediation model is in line with theory and item wording focusing on recovery experiences occurring in time after the work period. Regarding after-work outcomes, we found that challenge demands and hindrance demands both have a positive relationship with fatigue, whereas hindrance demands have a negative relationship with vigor, and challenge demands have a positive relationship with vigor. More interesting is how these antecedents relate to recovery experiences. Challenge demands have stronger negative relationships with psychological detachment, relaxation, and control recovery experiences than hindrance demands. The unexpected findings that challenge demands have no statistical relationship with mastery experiences and that hindrance demands have a positive relationship with mastery experiences are worthy of future research. We are intrigued that a perceived positive challenge in one domain has no impact on a different domain, yet a hindrance in the work domain potentially creates the need to experience positive challenges at home. Consistent with the latter finding, Petrou and Bakker (2016) found that employees who experienced high job strain during certain workweeks were more likely to engage in leisure crafting during those weeks (i.e., shape their leisure activities in a way that addresses their passions and values). Although challenge demands have a positive direct relationship with vigor, the positive direct relationship with fatigue coupled with stronger negative path coefficients with most recovery experiences indicates that individuals perceiving higher challenge demands may not engage in the recovery experiences associated with lower fatigue. Therefore, we contend that individuals perceiving their work as positively challenging should also be aware of the need to engage in recovery experiences. The finding that hindrance demands have weaker negative relationships with detachment and relaxation than have challenge demands, and show a positive relationship with mastery, indicates that hindrances are associated with nonwork interference differently and that future research should continue to explore these mechanisms (e.g., Wood & Michaelides, 2016).

Second, we addressed inconsistent conclusions in the literature regarding after-work recovery experiences with outcomes. Psychological detachment experiences have a stronger negative relationship with fatigue than relaxation and control. Control experiences have a stronger positive relationship with vigor than detachment and relaxation. Although psychological detachment is the most frequently researched recovery experience (Sonnentag & Fritz, 2015; also see Wendsche & Lohmann-Haislah, 2017, for a meta-analysis), these findings highlight that each recovery experience has a unique relationship with outcomes. We suggest that future research continue to explore how multiple recovery experiences may be used in combination to provide beneficial outcomes, such as high control and relaxation experiences working together to reduce fatigue during a lunch break (Trougakos, Hideg, Cheng, & Beal, 2014).

Third, we assessed the practical value of studying after-work recovery experiences. Adding recovery experiences to a model with work characteristics had a considerable impact on well-being outcomes, as these additional variables in a partial mediation model explain 26% more variance in fatigue (ΔR^2 = .08) and 62% more variance in vigor (ΔR^2 = .12). Clearly, both work characteristics *and* after-work recovery experiences influence employee well-being. Future research should continue to focus on work and after-work experiences collectively.

From a practical perspective, these results provide strong support that recovery experiences during nonwork time are beneficial to employees, and that it is necessary for employees to have different types of recovery experiences. Organizations should consider offering training so that employees can monitor and positively alter their recovery experiences (e.g., Hahn, Binnewies, Sonnentag, & Mojza, 2011). In addition, some companies have started turning off e-mail servers after work hours to help employees psychologically detach from work by limiting work e-mails during nonwork hours (Vasagar, 2013). Further exploration of organizational policies that help individuals engage in recovery experiences would be very interesting from both scholarly and practical perspectives.

5.1 | Limitations and future research

There are several limitations in this study that can lead to future research opportunities. First, all correlations coded from each study are from self-reported evaluations of work, recovery experiences, and outcomes, potentially creating same-source bias. However, an individual evaluation of his or her work and well-being may be more appropriate than asking others to assess the feelings of the target employee. In addition, we only focused on pleasant activation (e.g., vigor) and unpleasant deactivation (e.g., fatigue), but not other aspects of core affect (Yik et al., 2011) that have also been studied in recovery research such as negative activated affect (e.g., anxiety and tension). Second, the mediation model is consistent with theory, daily time use, and item wording, such that an individual has work experiences, then after-work recovery experiences, which both are associated with well-being. Diary studies are perhaps less biased than are regular surveys because the time between the subjective reports and the actual experiences is limited to only a few hours. Unfortunately, very few of the studies included in this analysis had a daily diary design that measured each variable over these different periods, and we were unable to create a true causal model (only 11 of the 36 effect sizes in the correlation matrix contain data from at least one daily diary study). Third, we limited our separation of work characteristics to well-studied categorizations. Future research may explore the separation of work demands into threats, hindrances, and challenges (e.g., Tuckey et al., 2015) along with differentiating resources into job resources and personal resources (Tadić et al., 2015). Fourth, this study modeled between-person differences in recovery experience. Future research should continue to explore within-person variations in well-being from day to day. Last, recent evidence suggests that only some organizational interventions have a practical impact on employee well-being (Maricuţoiu, Sava, & Butta, 2014). Future research should compare both at-work and after-work recovery interventions.

6 | CONCLUSION

This study provides a quantitative summary of after-work recovery experiences and refines existing models of work characteristics to include how recovery experiences are associated with well-being. Results confirm previous relationships of challenge demands, hindrance demands, and job resources with well-being outcomes. However, we found that these work antecedents have unique relationships with after-work recovery experiences. Adding recovery experiences as partial mediators between work characteristics and well-being explains a significant amount of additional variance and, thus, improves our understanding of how individuals can alter their feelings of fatigue and vigor.

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SUPPORTING INFORMATION

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