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What Are the Active Ingredients in Recovery Activities? Introducing a Dimensional Approach

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Although previous research suggests that off-job activities are generally important for recovery from work stress, a profound understanding of which aspects of recovery activities benefit the recovery process and why is still lacking. In the present work, we introduce a dimensional approach toward studying recovery activities and present a taxonomy of key recovery activity dimensions (physical, mental, social, spiritual, creative, virtual, and outdoor). Across four studies (total $N = 908$) using cross-sectional, time-lagged, and a diary design, we develop and validate the Recovery Activity Characteristics (RAC) questionnaire, a multidimensional measure of RAC. Results demonstrate its content validity, high scale reliabilities, and a strong factor structure. With a 10-day diary study involving two daily measurement occasions, we demonstrate the role of RAC for recovery experiences and downstream well-being outcomes. Findings underscore the importance of carefully differentiating the active ingredients of recovery activities as they differentially relate to same evening and next-morning exhaustion and vigor.

Keywords: recovery activity, work stress, employee recovery, scale development

Given the widely recognized detrimental effects of work stress on health and well-being (Ganster & Rosen, 2013; Nixon et al., 2011), scholars are increasingly interested in understanding how individuals can optimally recover from work stress during their nonwork time (for a review, see Sonnentag et al., 2022). In recent years, a wealth of research has documented that the quality of recovery experiences during nonwork time is key to successful recovery from work stress (Sonnentag et al., 2017, 2022). Recovery experiences refer to the psychological states that people experience during their nonwork time such as experiences of psychological detachment, relaxation, mastery, and control (Sonnentag & Fritz, 2007). Evidence on the benefits of these recovery experiences is abundant; it ranges from increased well-being at bedtime, better sleep, low exhaustion, and positive-activated affect the next morning to increased organizational functioning in terms of higher task performance, proactive behaviors, and organizational citizenship behaviors (for a review, see Sonnentag et al., 2022). In addition to these recovery experiences, recovery activities, that is, what people do during their nonwork time (Sonnentag, 2001), are key to successful recovery from work. Recovery activities include but are not limited to engaging in hobbies, physical exercise, or meeting friends (Sonnentag et al., 2022). They are positively related to well-being (e.g., Rook & Zijlstra, 2006; Sonnentag, 2001; Sonnentag & Zijlstra, 2006) and organizational functioning (e.g., de Bloom et al., 2018; ten Brummelhuis & Bakker, 2012), likely because they are proximal antecedents of recovery experiences with the latter referring to "what people are experiencing while performing these activities" (Sonnentag, 2018, p. 171; see also de Bloom et al., 2018; Eschleman et al., 2014; Mojza et al., 2010).

Researchers have repeatedly called for a better understanding of how favorable recovery experiences can be achieved (Sonnentag, 2018; Sonnentag et al., 2017). Considering the close connection between recovery activities and experiences, a comprehensive understanding of recovery activities is a key prerequisite in furthering knowledge on how we can promote recovery experiences. Yet, although recovery activities have a long history in recovery research (e.g., Sonnentag, 2001), surprisingly, a profound understanding of the full range of possible recovery activities and of why and how they differentially shape recovery experiences and well-being is still lacking (cf. Sonnentag et al., 2022). This might, in part, be driven by three key shortcomings in how recovery activities have been conceptualized and operationalized in the literature. First, recovery activities have predominantly been assessed with few, rather broad categories (e.g., physical, social, low-effort activities;

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Sonnentag, 2001; Sonnentag & Zijlstra, 2006; ten Brummelhuis & Bakker, 2012; ten Brummelhuis & Trougakos, 2014), each subsuming a broad range of activities. For instance, the physical activity category subsumes activities as varied as yoga, dancing, cycling, basketball, or hiking. Similarly, the low-effort activity category includes watching TV, sitting on the couch, and reading a book. This category-based approach bears important disadvantages: Some activities fall into multiple categories and are difficult to assign (e.g., a team sport is physical and social). Moreover, very different activities are lumped together and conceptually equated in this category-based approach, although they vary in many respects. For instance, yoga, diving, and basketball all fall into the physical activity category while knitting, reading a book, meditating, and browsing the internet all fall into the low-effort activity category. Yet, the implicit assumption that activities that fall into the same category have a similar impact on recovery outcomes does not likely hold. The use of broad categories may be one of the reasons that previous findings have been inconsistent. For instance, studies have documented positive (Sonnentag, 2001), negative (Rook & Zijlstra, 2006), and no relationship (Sonnentag & Zijlstra, 2006) between low-effort activities and indicators of well-being and successful recovery (see also Sonnentag et al., 2017).

Second, while the category-based approach allows to identify *which* activities foster recovery experiences (e.g., physical activities rather than low-effort activities), it provides limited insights into the underlying mechanisms. The reason is that specific activities can have multiple underlying characteristics. For instance, a team sport is physically effortful and social, while dancing is physically effortful and creative. Moreover, people may watch TV or do yoga on their own or in a group. A low-effort activity or physical activity may thus involve different degrees of social interaction and this can vary from person to person and from day to day. A category-based approach does therefore not allow identifying the different mechanisms driving effects of recovery activities because the underlying mechanisms are masked and difficult to disentangle. We therefore argue that it is not the activity per se that is of interest and should be studied, but rather its standing on multiple underlying characteristics, that is, the degree to which it involves, for instance, social interaction, is physical, is effortful, creative, or spiritual.

Third, considering the wider, non-work-related leisure literature suggests that the range of recovery activities individuals engage in is likely much wider than physical, social, and low-effort activities typically covered in the category-based approach (Hegarty, 2009; K. Korpela & Kinnunen, 2010). For instance, individuals may also engage in spiritual or in creative activities (e.g., handicraft, writing poems), in playing computer games, or being in nature. With few exceptions (e.g., Eschleman et al., 2014; Tuisku et al., 2016), such additional activities have rarely been studied in the recovery literature and systematic knowledge on the extent to which these alternative activities help or hinder recovery experiences and employee well-being is urgently needed (see a recent call by Sonnentag et al., 2022).

To overcome these shortcomings of the traditional category-based approach, a comprehensive dimensional approach is needed that (a) avoids lumping together diverse activities into broad categories, (b) allows mapping the characteristics of recovery activities (e.g., the degree to which an activity is social, physical, creative, spiritual), and (c) addresses the question of *why* certain activities are more powerful than others in promoting recovery.

The goal of the present study is therefore to develop a taxonomy of key recovery activity characteristics (RAC) and a multidimensional measurement tool, the RAC Questionnaire. In developing the taxonomy, we draw from the recovery literature as well as from adjacent fields (e.g., Collins & Cox, 2014; Eschleman et al., 2014; S. Kim et al., 2017; K. Korpela & Kinnunen, 2010; Sonnentag, 2001). Building on this taxonomy, we develop the RAC questionnaire, test its psychometric properties, and explore personality traits as antecedents of RAC. Finally, we illustrate that RAC are differentially related to recovery experiences and downstream well-being outcomes. In doing so, we focus on two indicators of situational employee well-being that are key to the recovery literature, that is, emotional exhaustion and vigor (Bennett et al., 2016; Headrick et al., 2022; Isoard-Gautheur et al., 2018; Sonnentag et al., 2010; ten Brummelhuis & Bakker, 2012; ten Brummelhuis & Trougakos, 2014). While exhaustion is the core component of job burnout, vigor is the core component of work engagement (Maslach et al., 1997; Schaufeli & Bakker, 2003).

The present work makes important contributions to the recovery literature. With the dimensional approach, we introduce a new perspective on recovery activities that focuses on characteristics of recovery activities rather than on (broad) activity categories. In doing so, we also respond to Sonnentag et al.'s (2022) recent call to "broaden the scope of recovery activities" (p. 12.22) by incorporating aspects of leisure activities that have, to date, been largely overlooked (e.g., the spiritual and virtual components). Mapping RAC on recovery experiences and downstream well-being outcomes, the present work will enrich our theoretical understanding of *why* recovery activities differentially relate to recovery experiences and downstream well-being outcomes. The present work also offers a novel, multidimensional tool to reliably assess RAC in a variety of settings, including evenings, work breaks, and weekends (Fritz et al., 2010; S. Kim et al., 2017; Rook & Zijlstra, 2006). It thereby lays the foundations and enables future work into the role of RAC in the recovery process.

A Dimensional Approach to Study Recovery Activities

The dimensional approach rests on the assumption that each recovery activity may be described by its standing on multiple continuous dimensions. For instance, if an individual went for a walk with a friend during leisure time, this activity may score medium on being physically strenuous and high on being social but low on being creative. If an individual went for a walk on their own, pondering about the plot of a short story they are writing, it would score medium on being physically strenuous, low on being social, but high on being creative. This exemplifies that the same activity (going for a walk) can have fundamentally different underlying characteristics, which likely result in different recovery experiences and downstream well-being outcomes. While it is relatively uninformative to know in which specific activities someone engaged in during leisure time (going for a walk, playing squash, doing tai chi or yoga), it is theoretically informative to know to what extent these activities were, for example, physically strenuous, social, or creative. The first goal of the present study is therefore to develop a theoretical taxonomy of key RAC. As such, our specific focus is on characteristics of recovery activities conducted during nonwork time. Characteristics referring to work-related activities or chores conducted during nonwork time will therefore not be included.

A first step in building a model of RAC is to explore the relationships between activity characteristics and other similar constructs. Indeed, the construct bears resemblance to extant constructs such as recovery experiences (Sonnentag & Fritz, 2007) and recovery motivations (Ohly & Latour, 2014; ten Brummelhuis & Trougakos, 2014). This subsection addresses how the current model relates to but differs from each of these constructs by exploring key similarities and distinctions.

A construct closely related to recovery activities is recovery experiences. Recovery experiences are the psychological states that people experience during their nonwork time (Sonnentag & Fritz, 2007). Recovery experiences are described as psychological mechanisms triggered by leisure activities that promote subjective well-being. They are different from RAC in that they are subjective emotions, feelings, and cognitive–affective appraisals that can result from participating in a specific activity (Huta, 2016). In contrast, RAC concern the features of the behaviors and situations that characterize recovery activities themselves.

RAC should also be differentiated from individuals' motives to engage in specific activities (ten Brummelhuis & Trougakos, 2014) and the extent to which they fulfill specific motivational needs (e.g., Tinsley & Johnson, 1984). Motivations to engage in activities refer to the personal reasons, values, and goals behind a person's chosen behaviors (Huta, 2016). For instance, people may pursue leisure to detach or relax. In addition, scholars have categorized activities by the extent to which they fulfill specific needs, such as the need for belonging or self-expression (Tinsley & Eldredge, 1995). However, with RAC, we refer to the actual behaviors and situational characteristics that an individual engages in independent of the motive to do so, the potential to fulfill a specific need, or the feelings during or after the activity.

To develop a multidimensional taxonomy of RAC, we followed a deductive approach by reviewing the work-related recovery literature as well as adjacent fields in order to identify key dimensions that characterize leisure activities and that are relevant to the recovery process. We first extensively searched for existing articles describing models or taxonomies of leisure activities by using the APA PsycInfo database and Google Scholar and by cross-referencing articles. Examples of entered keywords are "leisure activities" AND "taxonomy"; "recovery activities" AND "categories"; "recovery activities" AND "taxonomy"; and "recovery activities" AND "categories". Overall, these studies have either (a) clustered activities based on their similarity in terms of having similar psychological benefits to fulfill individuals' psychological needs (e.g., Tinsley & Eldredge, 1995; Tinsley & Johnson, 1984), (b) categorized activities based on the dominant characteristic (e.g., physical activities; Sonnentag, 2001), or (c) focused on experiences or psychological mechanisms that promote recovery or well-being (e.g., Newman et al., 2014; Sonnentag & Fritz, 2007). Yet, none of them focused on the characteristics of the activities themselves, for an overview, see Table 1. Therefore, in a second step, we extensively searched the literature for articles that studied recovery activities, excluding those that only focused on experiences or motives. We first looked at previous reviews that summarized the recovery activity literature (e.g., Demerouti et al., 2009; Sonnentag et al., 2017) and then searched for additional articles that studied specific recovery activities by using APA PsycInfo and Google Scholar using keywords such as "recovery activities" AND "work". As can be seen in Table 2, recovery activities have initially been studied primarily as off-job activities—focusing on afterwork and weekend periods—whereas, more recently, research on the role of activities in vacations and work breaks is gaining momentum. Based on the different streams of research in this overview and adhering to our definition of RAC as "behaviors and situations that characterize recovery activities," we identified six key dimensions: physical, social, creative, mental, virtual, and outdoor. From the off-job recovery studies, we inferred the physical and social dimensions (e.g., Rook & Zijlstra, 2006; Sonnentag, 2001; Sonnentag & Zijlstra, 2006; ten Brummelhuis & Bakker, 2012). In addition, recently, researchers have identified the role of creative activities in the recovery process (e.g., Eschleman et al., 2014, 2017). Moreover, computer scientists as well as social psychologists have shed light on the impact of digital or virtual activities on recovery and well-being (e.g., Collins & Cox, 2014). The work break recovery literature highlights the importance of cognitive

Table 1
Overview of Leisure/Recovery Models and Taxonomies Discussed in Previous Research

Study	Purpose	Focus	Dimension used/identified	How they came up with these dimensions/categories
Tinsley and Johnson (1984)	Need satisfaction	Needs	Intellectual stimulation, catharsis, expressive compensation, hedonistic companionship, supportive companionship, secure solitude, routine, temporary indulgence, moderate security, and expressive estheticism	Cluster analysis of 34 leisure activities
Tinsley and Eldredge (1995)	Taxonomy of leisure activities based on their need-gratifying properties	Needs	Agency, novelty, belongingness, service, sensual enjoyment, cognitive stimulation, self-expression, creativity, competition, vicarious competition, and relaxation	Cluster analysis of 82 leisure activities
Sonnentag (2001)	Recovery activity categories	Activity categories	Physical, social, low-effort, work-related, and household and childcare activities	Theoretical reasoning
Sonnentag and Fritz (2007)	Recovery experiences	Experiences	Psychological detachment, mastery, relaxation, and control	Theoretical reasoning
Newman et al. (2014)	Psychological mechanisms that promote subjective well-being	Psychological mechanism	Detachment–recovery, autonomy, mastery, meaning, and affiliation	Theoretical reasoning

Table 2
Overview of Recovery Activities Studied in Previous Research

Study	Focus	Activities/categories
Sonnentag (2001)	Off-job	Physical, social, low-effort, work-related, and household and childcare activities
Sonnentag and Natter (2004)	Off-job	Physical, social, low-effort, work-related, and household and childcare activities
Sonnentag and Bayer (2005)	Off-job	Physical, social, low-effort, work-related, and household and childcare activities
Rook and Zijlstra (2006)	Off-job	Physical, social, low-effort, work-related, and household and childcare activities
Sonnentag and Zijlstra (2006)	Off-job	Physical, social, low-effort, work-related, and household and childcare activities
Hecht and Boies (2009)	Off-job	Volunteer activities, memberships activities, sports, recreation, and fitness activities
Trougakos et al. (2008)	Work break	Respite activities and chore activities
Tucker et al. (2008)	Off-job	A list of activities such as working at the workplace, working at home, household work, caring for children/relatives, leisure activities, rest/sleep, spending time for yourself, watching television, and so forth
K. Korpela and Kinnunen (2010)	Off-job	Work-related activities, household activities, low-effort activities, social activities, exercise and being outdoors, activities in natural environments
Mojza et al. (2010)	Off-job	Volunteer activities
Fritz et al. (2011)	Work break	List of 22 micro-break activities (e.g., check email, make a phone call, clean the office)
Park et al. (2011)	Off-job	The use of an array of communication technologies for work-related purposes at home during nonwork hours
van Hooff et al. (2011)	Off-job	Household activities, doing odd jobs in or around the house, doing the groceries, caregiving activities, businesslike (but not job-related) activities, physical activities, creative activities, social activities, and low-effort activities
de Bloom et al. (2012)	Vacation	Work-related, physical, social, and passive activities
ten Brummelhuis and Bakker (2012)	Off-job	Physical, social, low-effort, work-related, and household and childcare activities
Bakker et al. (2013)	Off-job	Work-related activities, physical activities, social activities, and reading
de Bloom et al. (2013)	Vacation	Physical, social, and passive activities
Volman et al. (2013)	Off-job	Work-related activities, household activities and taking care of the children, and physical activities
White et al. (2013)	Off-job	A list of 20 activities participants undertook during their visit to rural or urban places
Eschleman et al. (2014)	Off-job	Creative activity
Collins and Cox (2014)	Off-job	Digital games
Lanaj et al. (2014)	Off-job	Smartphone use for work
Mathiassen et al. (2014)	Work break (laboratory)	Cognitive tasks
Kinnunen et al. (2015)	Work break	Work-related strategies, private micro-break strategies, and physical micro-break strategies
de Vries et al. (2016)	Off-job	Physical activity
Hunter and Wu (2016)	Work break	Less effortful, preferred, and non-work-related activities
Tuisku et al. (2016)	Off-job	Receptive cultural activities (e.g., going to a concert or a theater performance) and creative cultural activities (e.g., playing an instrument, writing)
von Dreden and Binnewies (2017)	Work break	Companionship during lunch break (alone, colleague, or supervisor) and content of conversation during lunch break (work-related topics or private topics)
Eschleman et al. (2017)	Off-job	Work-related activities, household and childcare activities, social activity, low-effort activities, physical activities, and creativity activities
Kim et al. (2017)	Work break	Relaxation, nutrition-intake, social, and cognitive activities
de Bloom et al. (2018)	Off-job	Physical, social, creative, and cultural activities
Garrick et al. (2018)	Off-job	Work-related activity, school-related activity, health promoting activities, socializing, exercise, and hobbies/creative activity
Kim et al. (2018)	Work break	Relaxation, nutrition-intake, social, and cognitive activities
Sianoja et al. (2018)	Work break	Park walks and relaxation exercises
Hyvönen et al. (2018)	Off-job	Outdoor activities in nature
Collins et al. (2019)	Off-job	A digital game and mindfulness app
Zhu et al. (2019)	Work break	Relaxation break activities, nutrition-intake activities, social activities, and cognitive activities
Bennett et al. (2020)	Work break (laboratory)	Manipulation of detachment, relaxation, and work-related activities
Chong et al. (2020)	Work break	Respite activities
Kuykendall et al. (2020)	Off-job	Watching TV, physical leisure activities, creative leisure activities, social leisure activities, or cognitively stimulating leisure activities
Cheng and Cho (2021)	Work break	Social media break activities (social, cognitive, relaxation, and hedonic social media activities) and nonsocial media break activities (social, cognitive, relaxation, hedonic, nutrition-intake break activities)
H. Liu et al. (2021)	Off-job	Cyber activities
Nie et al. (2021)	Work break	Voluntarily respite activities. relaxation, social and cognitive activities, and nutrition-intake activities

activities—non-work-related activities that require exerting mental efforts (e.g., Bennett et al., 2020; S. Kim et al., 2017, 2018).

In addition to the previous six dimensions, leisure research has investigated the importance of a spiritual component such as meditation activities for recovery and well-being (Garrick et al., 2008, as cited in Demerouti et al., 2009). Moreover, this literature suggests that the novelty of an activity may be important for recovery because of its positive relation with positive affect (Aron et al., 2000; Tinsley & Eldredge, 1995). In summary, we therefore propose a framework containing eight dimensions that represent key underlying characteristics of recovery activities: physical, social, creative, mental, spiritual, virtual, outdoor, and novelty.

Physical

The physical dimension represents to what extent an activity includes physical effort. Physical effort reflects any bodily movement produced by skeletal muscles that require energy expenditure (World Health Organization, 2020). Physical effort can enhance the recovery process through both psychological and physiological mechanisms. Neurotransmitters, which have an antidepressant effect, are released during exercise (Deslandes et al., 2009). In addition, completing physically effortful tasks can foster self-efficacy and mastery experiences (Demerouti et al., 2009). The category-based recovery literature therefore suggests that physical activities (e.g., sport, cycling, dancing) lead to positive outcomes. They were positively related to situational well-being before going to bed (Sonnentag, 2001), they negatively related to needs for recovery (Sonnentag & Zijlstra, 2006), and they increased next-morning vigor (ten Brummelhuis & Bakker, 2012). van Hooff et al. (2019) also showed that more strenuous leisure time physical activity was associated with higher recovery compared to less strenuous leisure time physical activity. Therefore, the physical dimension is an important characteristic to consider.

Social

The social dimension refers to the extent to which the activity involves interaction with other people. This is important for recovery because it can provide an opportunity for social support, which buffers or protects individuals from stressful events (Cohen & Wills, 1985). Social support was found to reduce job strain and to moderate the stressor–strain relationship (Viswesvaran et al., 1999). In addition, the social control hypothesis posits that social interactions promote healthy behaviors, which, in turn, lead to long-term positive health outcomes (Umberson, 1987), including cognitive functioning (Kelly et al., 2017). Using the category-based approach, recovery research has provided evidence for the benefits of social activities on employee well-being, relating these to increased situational well-being before going to bed (Sonnentag, 2001), to diminished need for recovery (Sonnentag & Zijlstra, 2006), and to increased next-morning vigor (ten Brummelhuis & Bakker, 2012).

Mental

The mental dimension refers to the extent to which the activity is cognitively demanding and requires the application of cognitive resources for completion. Engaging in non-work-related activities that require exerting mental efforts can facilitate recovery through several mechanisms. First, it can distract people from work-related thoughts and stop them from work-related activities (S. Kim et al., 2017), leading to psychological detachment from work (Bennett et al., 2020). Research shows that the prolonged load reactions caused by extending work-related effort are diminished and fatigue decreases even when individuals engage in effortful tasks (Hockey, 2011). For instance, Bennett et al. (2020) found that fatigue reduced in participants who took a little break from a cognitively demanding task to do another cognitively demanding task. Finally, exerting mental effort on non-work-related activities can build personal resources that benefit recovery from work stress (Demerouti et al., 2009). The micro-break literature documented benefits of activities that require exerting mental effort on non-work-related tasks. For example, S. Kim et al. (2018) found an increase in positive-activated affect and job performance after engaging in cognitively demanding micro-breaks.

Creative

The creative dimension can be described as the extent to which an activity involves inventing and making new things or simply being creative. Similar to the mental dimension, creative engagement requires cognitive efforts but it includes, in addition, producing work that is novel, useful, and generative (Fink et al., 2009; Sternberg & Lubart, 1996). Creative engagement can be beneficial for recovery as it helps acquire new resources when one's resources are depleted due to work stressors, such as self-efficacy (Hobfoll, 1989; Sonnentag, 2003). Furthermore, creative engagement stimulates the pleasure/reward brain center (Winwood et al., 2007) and fosters mastery experience (Demerouti et al., 2009). Although activities involving creativity have received limited attention in the recovery literature, initial evidence suggests that creative engagement is positively associated with recovery experiences and performance outcomes (Eschleman et al., 2014).

Spiritual

The spiritual dimension refers to the extent to which an activity involves spiritual or religious performance or actions. Spiritual involvement can foster positive emotions (Y. Kim et al., 2004), which can be very effective experiences to enhance recovery (Oerlemans et al., 2014). Mindfulness is a good example of spiritual involvement, and ample research suggests that mindfulness meditation promotes recovery experiences and sleep (Hülsheger et al., 2015; Michel et al., 2014). Furthermore, Bostock et al. (2019) found that participants who followed a mindfulness meditation program for 2 months showed significant improvement in their stress level and well-being as compared with the control group. It is important to note that spiritual involvement is not limited to what individuals do when they practice religion or mindfulness but it can be an element of many activities (Creighton-Smith et al., 2017).

Virtual

The virtual dimension reflects the extent to which the activity involves using screens, computers, telecommunication devices, or the internet. A wide range of activities can be performed via screens such as surfing the internet, watching TV, playing video games, and using social media. These activities differ in many aspects but share

the virtual aspect, which has been shown to influence recovery in either a good way or a bad way (Cheng & Cho, 2021; Collins & Cox, 2014). The uses and gratifications theory (Katz et al., 1973) indicates that people engage in virtual activities for different reasons including relaxation, entertainment, to pass time, as well as social interaction (Whiting & Williams, 2013). In contrast, other research asserts that screen time impairs sleep (Hale & Guan, 2015; Lakerveld et al., 2016), and impaired sleep, in turn, impairs the recovery process and decreases next-day work engagement (Barber et al., 2013; Fritz & Crain, 2016; Kühnel et al., 2017). The displacement hypothesis provides a simple explanation for the effect of screen time on sleep. People, who spend more time in front of screens, tend to have less time for sleep (Hale & Guan, 2015). Moreover, bright light from screens can suppress melatonin, the sleep-promoting hormone (Green et al., 2017). A few studies investigated the effects of activities with virtual components on recovery outcomes. For example, watching TV was found to be related to experiencing relaxation (Kuykendall et al., 2020) and video games reduced work-related fatigue, particularly for people who receive less social support (Reinecke, 2009).

Outdoor

The outdoor dimension refers to the extent to which an activity is conducted outdoor or in nature. Being outdoor can enhance recovery by increasing positive affect, energy (Fuegen & Breitenbecher, 2018), relaxation, and various emotional parameters related to stress relief (Corazon et al., 2019). The attention restoration theory (Kaplan, 1995) suggests that being in outdoor environments restores one's cognitive resources by being exposed to fascinating subjects that require effortless brain function. Much evidence indeed suggests that being outdoor is beneficial for recovery. For example, Hyvönen et al. (2018) found that people with high exposure to nature reported higher engagement and lower levels of burnout than people with low exposure. In addition, K. Korpela and Kinnunen (2010) compared the effectiveness of various type of leisure activities and found that exercise while being outdoor and time spent in interaction with nature were the most effective activities for recovery from work stress.

Novelty

The novelty dimension refers to the extent to which the activity is new, original, or unusual. Engaging in novel activities provides pleasure and enjoyment (Tinsley & Eldredge, 1995), and experiencing these feelings plays a crucial role in enhancing recovery from work stress (van Hooff et al., 2011). Novel activities can also enhance positive affect (Aron et al., 2000), which is an indicator of well-being and has been positively related to recovery (Steed et al., 2021). In addition, engaging in novel activities requires active mental processing of the activity throughout the engagement (Fritsch et al., 2005); and it can thereby enhance psychological detachment by distracting the individual from work-related thoughts.

Development of Hypotheses

In the following sections, we first develop hypotheses on how these recovery activity dimensions relate to constructs pertaining to a wider nomological network. Specifically, we focus on personality traits that may play a role in which RAC employees seek out. Subsequently, we delineate how RAC relate to recovery experiences. Finally, we argue that recovery experiences function as key mechanisms linking RAC to employee well-being (i.e., emotional exhaustion and vigor) and propose a number of mediating pathways. We note that with seven[1] recovery activity dimensions, four recovery experiences, and two well-being outcomes, there is a large number of relationships that could potentially be investigated and that might seem intuitively plausible. However, for the sake of brevity and parsimony, we focus only on those hypotheses that have strong theoretical support. A conceptual overview is provided in Figure 1.

Personality Traits as Conceptual Antecedents of RAC

Person-related factors can determine what RAC employees engage in during their nonwork time. We discuss four personality traits, that is, openness to experience, extraversion, need for affiliation, and need for cognition, that are likely to be related to one or more recovery activity dimensions due to conceptual proximity.

Openness to experience refers to "a continuum of individual differences in processing experience" (McCrae & Costa, 1997, p. 826). People high in openness to experience are reflective and thoughtful about the ideas they encounter, and they actively engage in new and varied experiences (McCrae & Costa, 1997). They are intrinsically motivated to engage in creative tasks (Bennett et al., 2020). Research found that participants high in openness to experience tend to spend their leisure time engaging in creative activities (Benedek et al., 2020). We therefore expect that people high in openness to experience tend to engage in activities that involve creativity.

> *Hypothesis 1:* Openness to experience will be positively related to the creative dimension.

Extraversion is a personality trait that includes a variety of characteristics such as sociability, assertiveness, high activity level, positive emotions, and impulsivity (Smelser & Baltes, 2001). Ashton et al. (2002) argued that the core feature of extraversion is the tendency to behave in ways that attract social attention. That is, extroverts engage in activities that involve social interactions to seek social attention. Therefore, it has been found that extroverts are most likely to engage in activities that involve social interaction, such as socializing, partying, and team sport (Wilkinson & Hansen, 2006).

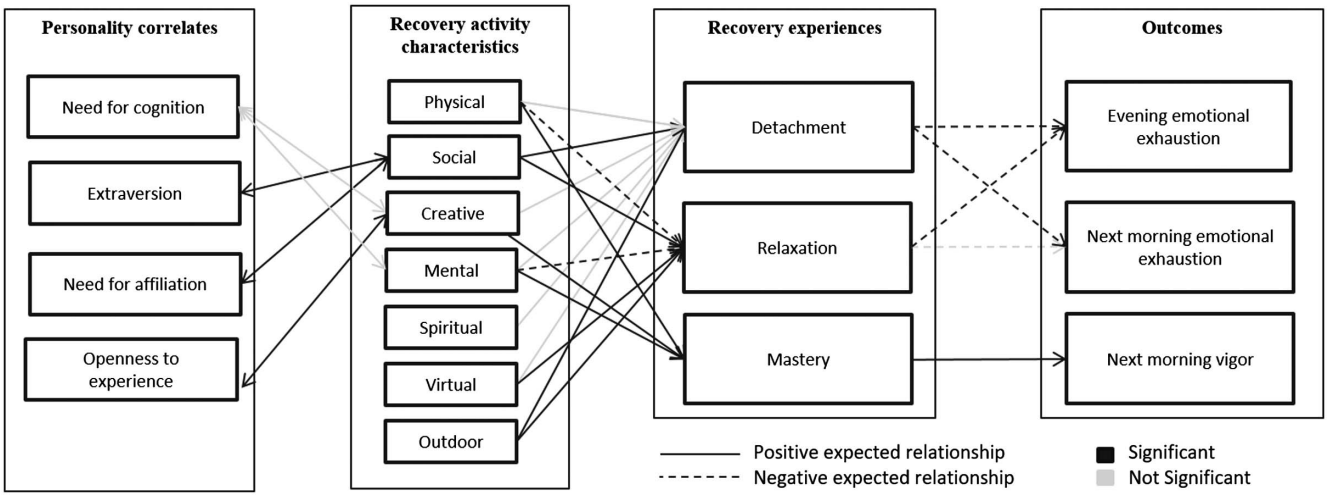
Need for affiliation, which also can be referred to as the need for relatedness or the need for belongingness (Kuykendall et al., 2020; Ryan & Deci, 2000), is defined as the desire to interact socially and to be accepted by others (Heckert et al., 2000). People high in need for affiliation tend to engage in activities that involve social interaction with others (Heckert et al., 2000). Therefore, we expect that people high in extraversion and need for affiliation will engage more in activities that include social interactions.

> *Hypothesis 2:* Both (a) extraversion and (b) need for affiliation will be positively related to the social dimension.

[1] Because the novelty dimension was excluded from the model in the validation phase, for the sake of parsimony, we did not include hypotheses on this dimension.

Figure 1

Overview of Possible Antecedents and Outcomes of Recovery Activity Characteristics



Need for cognition is the tendency to engage in and enjoy effortful thinking and problem solving (Cacioppo & Petty, 1982; Lins de Holanda Coelho et al., 2020). Such a trait can enhance participation in activities that involve mental and creative characteristics. People high in need for cognition tend to engage in creative thinking, problem solving, and the development of novel ideas (Pan et al., 2021). Therriault et al. (2015) found that the higher people score on need for cognition, the more they engaged in cognitively higher load activities compared to cognitively lower load activities during their leisure time. Therefore, we expect that need for cognition will be positively related to both the mental and the creative dimensions.

Hypothesis 3: Need for cognition will be positively related to (a) the mental dimension and (b) the creative dimension.

The Role of RAC for Recovery Experiences

Recovery experiences describe recovery-related psychological states people experience during nonwork time (Sonnentag et al., 2017). Recovery experiences and recovery activities are both important elements of the recovery process, with recovery activities fostering specific recovery experiences, which, in turn, benefit employee well-being (Sonnentag et al., 2017). Four recovery experiences (i.e., psychological detachment, relaxation, mastery, and control; Sonnentag & Fritz, 2007) have been identified to be central in the recovery literature and have been shown to be related to a range of well-being outcomes (Bennett et al., 2018; Steed et al., 2021). In the following, we draw on Sonnentag and Fritz's (2007) recovery experiences framework and delineate how specific RAC relate to specific recovery experiences. In so doing, our focus is on detachment, mastery, and relaxation as these dimensions are theoretically derived outcomes of one or more recovery activity dimension. In contrast, the recovery experience of control is less likely to depend on activity characteristics themselves but rather on the autonomy people have in choosing what activity to pursue in and on their motivation for choosing a certain activity (Sonnentag & Fritz, 2007).

Psychological Detachment

Psychological detachment, mental disengagement from work (Sonnentag & Fritz, 2007), is a crucial recovery experience (Sonnentag, 2012). It is positively related to self-reported physical and mental health, state well-being, and job performance (for meta-analysis, see Wendsche & Lohmann-Haislah, 2017). Psychological detachment is difficult to achieve (Sonnentag & Bayer, 2005), yet participation in leisure activities can help individuals to become distracted from work stressors and foster their experience of being away from work (Kaplan, 1995; Yeung, 1996). The distraction hypothesis suggests that activities can provide cognitive respite or "time out" from worrisome thoughts and daily stressors (Yeung, 1996). This hypothesis was originally formulated for physical exercise, but it applies to other activities that involve creative or mental efforts as well to the extent that such activities require a strong focus on the task and therefore provide opportunities to experience flow (Hegarty, 2009; Jackson & Csikszentmihalyi, 1999). When individuals experience flow, they are intensively engaged in and get fully absorbed by the activity and forget everything around them (Csikszentmihalyi, 1990). Being outdoor can also stimulate a sense of being away from work because the fascinating objects that nature contains distract individuals from work by bringing attention to other elements of life (Kaplan, 1995). Evidence also shows that social activities can help employees to abstain from work-related thoughts during leisure time (ten Brummelhuis & Bakker, 2012). Overall, this evidence suggests that the more engrossing and thought capturing an activity is, the more people will be distracted from work-related thoughts. Therefore, we expect the extent to which individuals engage in all of the activity characteristics' dimensions will be positively related to the experience of psychological detachment from work.

Hypothesis 4: The (a) physical, (b) social, (c) creative, (d) mental, (e) spiritual, (f) virtual, and (g) outdoor dimensions are positively related to psychological detachment.

Relaxation

Relaxation, a state of low activation and high positive affect, is important for recovery because of its potential to reduce prolonged activation and undo negative emotions, resulting from work stressors (Sonnentag & Fritz, 2007). Accordingly, meta-analyses have consistently revealed that relaxation is one of the most powerful recovery experiences (Bennett et al., 2018; Steed et al., 2021). Relaxation can be enhanced by activities that are not demanding, that require little physical or mental energy expenditure, and that have few challenges (Sonnentag & Fritz, 2007; Tinsley & Eldredge, 1995). Activities that require energy expenditure such as physical and mental activities induce a state of high activation. Although these activities can contribute to the relaxation experience in the long run (ten Brummelhuis & Bakker, 2012), we expect that the immediate effect of engagement in these activities is likely to reduce the experience of relaxation.

However, there are other activity characteristics that can be expected to raise the relaxation experience. For example, spiritual engagement involves a sense of calm, peace, meaning, and feeling connected with a higher power, which fosters a relaxation experience (Burke et al., 2017). This is in line with the meditation literature that has discussed the critical role of spiritual engagement in relaxation. For example, Wachholtz and Pargament (2005) found that spiritual meditation led to a greater decrease in anxiety levels and more positive moods than secular meditation. Being outdoor, especially in restorative environments (e.g., nature, historical sites), may also benefit relaxation as outdoor experiences enhance positive affect and reduce stress (K. M. Korpela et al., 2002; Scopelliti et al., 2019). Attention restoration theory (Kaplan, 1995) explains that natural environments reduce fatigue resulting from directed attention. It thereby provides restorative experiences and promotes low activation and positive affect (i.e., relaxation). Empirical studies have supported the role of relaxation as a mediator in the relationship between interaction with nature and recovery from work stress (K. Korpela & Kinnunen, 2010). Finally, activities that mainly include social interactions or virtual engagement are typically nondemanding and pleasurable where people feel at ease with the company they chose or things they watch. Therefore, we expect that engaging in activities with social interaction or with virtual engagement will promote relaxation experiences.

Hypothesis 5: The (a) outdoor, (b) social, (c) virtual, and (d) spiritual dimensions are positively related to relaxation experiences, while the (e) physical and (f) mental dimensions are negatively related to relaxation.

Mastery

Mastery experience refers to the personal experience of success when engaging in leisure activities (Bandura, 1977; Yeh et al., 2019). Recovery research has documented the importance of mastery experience through its negative associations with exhaustion, psychological distress, and physical complaints and positive associations with vigor at work and life satisfaction (Bennett et al., 2018; Steed et al., 2021). Such experiences are fostered by activities that provide opportunities for achievement and growth such as learning something new or engaging in a demanding hobby, which provide feelings of improvement, achievement, and success (Sonnentag et al., 2017; Sonnentag & Fritz, 2007). Engaging in activities that require creative, mental, or physical efforts, such as writing a novel, playing chess, and cycling, can be challenging and provides learning opportunities, which develop individuals' abilities and competencies such as improvement of one's lexicon or body strength (Eschleman et al., 2014; Sonnentag & Fritz, 2007). Therefore, we expect that individuals will experience mastery when they engage in activities that are rich in the physical, creative, or mental characteristics.

Hypothesis 6: The (a) physical, (b) creative, and (c) mental dimensions are positively related to mastery experiences.

The Mediating Role of Recovery Experiences in the Relation Between Recovery Activities and Well-Being Outcomes

As outlined by Sonnentag et al. (2022), recovery activities and recovery experiences form the core of the recovery process. Specifically, recovery activities foster recovery experiences, which, in turn, relate to downstream well-being outcomes (Sonnentag et al., 2010, 2022). Thus, the link of the more tangible and observable recovery activities with well-being outcomes can be explained by the specific psychological recovery experiences they promote. In the context of day-to-day recovery, it is important to investigate immediate (i.e., in the evening) as well as delayed effects (i.e., on the next morning) of afterwork recovery activities and experiences (cf. Sonnentag et al., 2022). These may differ with immediate effects typically being stronger than delayed effects occurring after a restorative night (cf. Sonnentag & Fritz, 2015). In studying relations of RAC with well-being outcomes, we therefore focus on emotional exhaustion both in the evening and in the next morning. Emotional exhaustion captures feelings of being overextended and emotionally and physically depleted (Maslach et al., 2001). It is a key indicator of work strain and core component of burnout (Maslach, 1998) and lends itself to be assessed in the evening and in the morning. In addition, we focus on next-morning vigor, a state capturing the extent to which employees feel energetic toward and look forward to their work (Schaufeli et al., 2006). It is an important indicator of work-related pleasant activation and core component of work engagement (González-Romá et al., 2006). As such, next-morning vigor is of particular relevance as it forms the link to next-day work experiences and behavior (ten Brummelhuis & Bakker, 2012). Having a clear forward-looking and work-related connotation, it is typically assessed in the morning rather than in the evening after work (Clinton et al., 2017; ten Brummelhuis & Bakker, 2012).

Bennett et al. (2018) described two different pathways explaining how recovery experiences relate to well-being outcomes. The first pathway highlights the role of relaxation and detachment in reducing the psychological load from work demands and thereby impeding prolonged load reactions that may otherwise manifest in emotional exhaustion. The second pathway is based on the conservation of resources theory (Hobfoll, 1989) and emphasizes how building up internal resources (skills, competencies, and self-efficacy) through mastery experience fosters resource gain such as vigor (Sonnentag & Fritz, 2007). Therefore, based on the abovementioned mechanisms, we propose mastery experiences as the mediating mechanism between recovery activity dimensions and vigor, and detachment

and relaxation as mediating mechanisms between recovery activity dimensions and exhaustion.

Hypothesis 7: Psychological detachment mediates the negative relationship between the (a) physical, (b) social, (c) creative, (d) mental, (e) spiritual, (f) virtual, and (g) outdoor dimensions and evening exhaustion.

Hypothesis 8: Relaxation mediates the negative relationship between the (a) social, (b) spiritual, (c) virtual, and (d) outdoor dimensions and evening exhaustion and the positive relationship between the (e) physical and (f) mental dimensions and evening exhaustion.

Hypothesis 9: Psychological detachment mediates the negative relationship between the (a) physical, (b) social, (c) creative, (d) mental, (e) spiritual, (f) virtual, and (g) outdoor dimensions and next-morning exhaustion.

Hypothesis 10: Relaxation mediates the negative relationship between the (a) social, (b) spiritual, (c) virtual, and (d) outdoor dimensions and next-morning exhaustion and the positive relationship between the (e) physical and (f) mental dimensions and next-morning exhaustion.

Hypothesis 11: Mastery mediates the positive relationship between the (a) physical, (b) creative, and (c) mental dimensions and next-morning vigor.

Method

Scale Development and Item Generation

To create a valid and reliable measure of RAC, we followed a stepwise approach based on Hinkin (1998).

We started by generating items using a deductive method, that is, based on the theoretical definitions of the proposed constructs described in the theory section (Hinkin, 1995). Fifty-six English items were generated to represent the initial pool for measuring eight dimensions. In addition to these dimensions, we created four items to measure the extent to which activities were work-related. As we are interested in the pure effects of characteristics of recovery activities performed during leisure time, it is important to be able to control for work-related activities during leisure time people might have engaged in. Items were either newly developed or adapted from other existing measures. In developing and adapting items, we followed recommendations to avoid wordy, double-barreled, complicated, and ambiguous formulations (DeVellis, 2016). We also abstained from using reverse-scored items because of their detrimental impact on psychometric properties (Harrison & McLaughlin, 1991).

As a first step of establishing content validity of our initial item pool, we provided 21 experts, researchers in organizational psychology familiar with scale development, a list of RAC, and their definitions. We then asked them to evaluate the constructs and the items and to assign each item to the best-fitting construct (Anderson & Gerbing, 1991). Based on their suggestion, we deleted one item related to the novelty dimension. In addition, two indices—the proportion of substantive agreement (P_{sa}) and the substantive validity coefficient (C_{sv})—were calculated to assess the substantive validity of the each subscale (Colquitt et al., 2019). The P_{sa} represents the proportion of respondents who allocated an item to its intended construct, ranging from 0 to 1, where 1 indicates a very strong substantive validity. The C_{sv} assesses the extent to which respondents assign an item to its intended construct more than to any other construct, ranging from −1 to 1, where 1 again indicates very strong substantive validity (Colquitt et al., 2019). As a result, only one item was removed (related to the creative dimension) because it showed a lack of substantive validity (P_{sa} = 0.38; C_{sv} = −0.19), whereas all other items showed strong to very strong substantive validity, with P_{sa} values ranging from 0.90 to 1, and C_{sv} values ranging from 0.81 to 1 (Colquitt et al., 2019). This pool of 54 items was the starting point of a comprehensive scale validation process encompassing four studies.

Overview of Validation Phases and Associated Studies

Following Hinkin's (1998) recommendations, we first sought to provide further evidence on the content validity of the generated items (Study 1). Subsequently, we took a first step toward establishing the instrument's factor structure and to reduce the number of items to keep the instrument as short as possible (Study 2). To assess psychometric properties (i.e., confirmatory factor analysis [CFA] and reliabilities) of the newly developed questionnaire, assess antecedents and criterion-related validities, we conducted Studies 3 and 4. A brief description of each study is provided below (see also Table 3). All measures used across the four studies can be found in Table 4. The local ethical review committee approved all four studies (codes: ERCPN-FPN-166_07_04_2016 and OZL_231_145_12_2020, Faculty of Psychology and Neuroscience, Maastricht University).

Study 1

The purpose of this study was to assess the content validity of the RAC Questionnaire. This is a crucial step to make sure that the scale content adequately reflects its constructs (Colquitt et al., 2019). We followed Colquitt et al. (2019) recommendations to use the Hinkin and Tracey (1999) approach to assess the content validity. Based on Hinkin and Tracey (1999) recommendations to recruit lay people for this approach, we recruited participants using Prolific (https://www.prolific.co), an online research participant recruitment platform. Participants were asked to indicate how well each newly developed item of the RAC questionnaire matched the construct's definition on a 6-point Likert scale ranging from 1 = *item does an extremely bad job of measuring the bolded concept provided above* to 6 = *item does a very good job of measuring the bolded concept provided above*. Each item had to be evaluated on all dimensions. Items were presented in English. To minimize participant fatigue, each participant rated six to seven items referring to all dimensions of the scale. A total of 263 individuals completed the survey, but only data from 186 individuals were analyzed as 51 individuals either were not employees or failed more than one attention check. Each participant received 1.30 Pound Sterling for their participation. Of the participants, 47.8% were female and 52.2% were male with an average age of 30.51 (SD = 8.81; range = 18–62). The sample consisted for 79.6% of full-time employees and 20.4% were part-time employees with an average 36.83 (SD = 11.46) hr per week, and they had worked 4.35 years in their current position (SD = 8.79). For more information about this sample, see Table 3.

Table 3
Descriptive Statistics per Study

Description of samples	Study 1	Study 2	Study 3	Study 4
Type of study	Cross-sectional	Cross-sectional	Cross-sectional time-lagged design	Diary
Collection method	https://www.prolific.co/	https://www.prolific.co/	https://www.prolific.co/	Snowballing
Initial *N*[a]	237	338	431 (401)	212 (181)
Dropout rate (%)[b]			27%	23%
Excluded[c]	51	37	6	4
Final *N*	186	301	286	135
Gender				
% Female	47.8	39.5	41.6	52.6
% Male	52.2	60.5	57.3	47.4
% Other			1	0
Age				
M	30.51	32.57	32.07	32.27
SD	8.81	8.86	9.72	12.08
Range	18–62	18–63	19.78–68.80	19–72
Work hours per week				
M	36.83	39.69	41.37	38.49
SD	11.46	4.66	6.29	10.11
Range	8–80	20–72	29–70	19–92
Organizational tenure in years				
M	4.35	4.01	5.39	7.40
SD	5.72	4.63	6.29	9.30
Range	0–35	.08–26	.08–37.33	1.17–40.17

[a] The initial *N* represents all participants who started filling out the first/intake surveys. Numbers in (brackets) represent participants who finish the first (intake) survey. [b] Dropout rate includes participants who finish the first/intake survey but failed to participate in the second/any daily surveys. [c] Number of participants excluded from analyses because failed to meet inclusion criteria (e.g., work hours, employees) or failed more than one attention check in Studies 1, 2, and 3.

Study 2

The goal of this study was to determine the final short and long version of the RAC by conducting an exploratory factor analysis (EFA). Following recommendations, we conducted a new study for this purpose and applied EFA for item reduction (e.g., Clark et al., 2020; Hülsheger & Alberts, 2021). A sample of working adults was recruited using Prolific. Participants had to be at least 18 years old and full-time/part-time employees to be eligible to participate in this study. Each participant received 0.90 Pound Sterling for their participation. Participants were asked to answer all 50 items of the initial English version of the RAC questionnaire on a 7-point Likert scale referring to the main activity they performed on that evening. A total of 338 individuals participated in this survey, of which 301 participants were included in the analyses because 37 did not meet the inclusion criteria (e.g., work hours, employees, failing more than one attention check). This study's sample consists of 39.5% female and 60.5% male with an average age of 32.57 (SD = 8.86; range = 18–63). On average, employees worked 39.69 (SD = 4.66) hr per week, and had worked 4.01 years in their current position (SD = 4.63). For more information about this sample, see Table 3.

Study 3

The purpose of this study was to establish the psychometric properties of the RAC Questionnaire and to provide preliminary evidence of the conceptual antecedents of the RAC dimensions. A sample of working adults was recruited using Prolific. To reduce common-method bias concerns (Podsakoff et al., 2003), we used a time-lagged design in which we measured personality correlates directly after work, whereas RAC were measured before going to bed with the final 28-item version of the RAC questionnaire displayed in Table 5. Surveys were presented in English language. RAC items were answered on a 5-point Likert scale using the following instruction: "The statements below describe characteristics of activities that you may have engaged in this evening/after work. Please indicate to what extent the statements below describe your activities."

Participants received 1.00 Pound Sterling after completing the first (afterwork) part and another 1.00 Pound Sterling for completing the second (before-bed) survey. We only recruited participants from Europe in order to limit time differences between countries, and only recruited participants for whom that day was an official workday. A total of 431 individuals signed up for the afterwork survey, of whom 401 completed the measure. Only those participants who completed the afterwork survey were invited for the before-bed survey. The afterwork survey was sent out at 5 p.m. (Greenwich Mean Time, GMT + 1) and the before-bed survey at 9 p.m. (GMT + 1). Participants were asked to answer the afterwork survey just after work was finished for them, and the survey was closed 3 hr before the start of the before-bed survey. A total of 294 participants completed the before-bed survey, of which 286 met the inclusion criteria (e.g., work hours, employees, failing more than one attention check), of which 41.6% were female and 57.3% were male with an average age of 32.07 (SD = 9.72; range = 20–70). They worked 41.37 (SD = 6.29) hr per week and had worked 5.39 (SD = 6.29) years in their current profession. For more sample information, see Table 3.

Study 4

This study aimed to reassess the psychometric properties of the RAC Questionnaire and to establish its criterion-related validity. We used a daily diary design to capture day-to-day variations in the

Table 4
Measures Used per Study, Example Items, and Number of Items

Construct measured and source	Example item	Study	No. of items
Recovery activity characteristics			
Physical	Included vigorous physical activity	3^{bs}, 4^{bs}	4, 2
Social	Involved communicating with others	3^{bs}, 4^{bs}	4, 2
Creative	Allowed you to be creative	3^{bs}, 4^{bs}	4, 2
Mental	Required you to think hard	3^{bs}, 4^{bs}	4, 2
Spiritual	Included spiritual themes such as the meaning of life, death, or religion	3^{bs}, 4^{bs}	4, 2
Virtual	Occurred through digital devices (such as smartphone, computer, tablet)	3^{bs}, 4^{bs}	4, 2
Outdoor	Were performed in a natural environment (e.g., among plants and trees)	3^{bs}, 4^{bs}	4, 2
Work-related	Entailed finishing/working on what you were doing at work	4^{bs}	2
Need for cognition (Lins de Holanda Coelho et al., 2020)	I would prefer complex to simple problems	3	6
Need for affiliation (Heckert et al., 2000)	I spend a lot of time talking to other people	3	5
Extraversion (Donnellan et al., 2006)	Am the life of the party	3	4
Openness to experiences (Donnellan et al., 2006)	Have a vivid imagination	3	4
Detachment (Sonnentag & Fritz, 2007)	I forgot about work	4^{bs}	4
Relaxation (Sonnentag & Fritz, 2007)	I kicked back and relaxed	4^{bs}	4
Mastery (Sonnentag & Fritz, 2007)	I learned new things	4^{bs}	4
Exhaustion (Halbesleben & Demerouti, 2005)	I feel worn out and weary	4^{bs}, 4^{nm}	3
Vigor (Schaufeli et al., 2006)	I look forward to my work	4^{nm}	3

Note. bs = before sleep; nm = next morning.

RAC dimensions and to assess the within-person effects on well-being and downstream recovery-related outcomes. It was an online 10-day diary study involving two measurements per day targeting adults who work at least 19 hr a week and had regular daytime working hours. Participants were recruited using research assistants' personal networks and the snowball sampling technique. As an incentive, they were provided with the opportunity to participate in a lottery. Participants who completed daily questionnaires on 7–10 days were eligible to take part in a lottery of three Amazon vouchers worth 100 euros. Participants who completed daily questionnaires on 4–6 days took part in a lottery of three Amazon vouchers worth 50 euros, and three Amazon vouchers worth 25 euros were for participants who completed daily questionnaires on 1 or 3 days. Upon enrollment, participants could choose to answer the surveys in English, German, or Italian. These parallel versions were created using a translation–back-translation process. RAC, recovery experiences, and exhaustion were measured before going to bed and vigor and exhaustion before work. The link to the evening survey was sent at 21:00 and expired at 3:00 at night. The link to the morning survey was sent out at 7:00 and expired at 12:00. A total of 135 participants were included in the final analysis, of which 52.6% were female and 47.4% male with an average age of 32.27 ($SD = 12.08$; range = 19–72). They worked 38.49 ($SD = 10.11$) hr per week and had worked 7.40 ($SD = 9.30$) years in their current profession. For more information on the sample, see Table 3.

Results

Content Validity

To further explore the content validity of our pool of 54 items, we conducted Study 1 and used Hinkin and Tracey (1999) approach as recommended by Colquitt et al. (2019). Two indices proposed by Colquitt et al. (2019) were calculated to assess the content validity of our items. The Hinkin Tracey correspondence (htc) index assesses how well each scale item corresponds to its intended construct. The second index, Hinkin Tracey distinctiveness (htd), measures to what extent a scale's item correspond more to the definition of the construct it has been assigned to than to the definitions of other orbiting constructs (in our case to the definition of the remaining scales of the RAC questionnaire). We kept items with moderate to good agreement (htc > .84) and distinctiveness (htd > .18). As a result, four items were removed because of weak agreement. The removed items related to the physical, mental, spiritual, and novelty dimensions, resulting in a sample of 50 items.

Item Reduction

Starting with this set of 50 items that displayed satisfactory content validity, we sought to further reduce the item pool to obtain a parsimonious multidimensional measure of RAC using EFA (Hinkin, 1998). In doing so, our goal was to extract four items per dimension for a somewhat more extensive scale and two items per dimension for a shortened version that may later be adapted for the use in diary and experience sampling research. To this end, we performed Study 2 described above (see also Table 3). EFA was conducted using the psych package in R (Luo et al., 2019; Revelle, 2020). We used maximum likelihood extraction with an oblique rotation, specifying eight factors as we reached this stage with and additional factor called novelty. The items representing the novelty construct all showed low factor loadings, and they loaded on the same factor as the creative items. Apparently, participants were not able to differentiate between the creative factor and the novelty factor. We therefore decided to exclude the novelty items from

Table 5
Final Version of the RAC Questionnaire and Factor Loadings From Exploratory Factor Analyses of Study 2

Items	Physical	Social	Creative	Mental	Spiritual	Virtual	Outdoor
Today after work, to what extent did you engage in activities that …							
1. Included vigorous physical activity[a]	.94	.00	−.07	−.01	.04	.01	−.02
2. Were physically demanding[a]	.93	−.01	.03	.03	−.02	.02	.02
3. Required you to be physically active	.89	.00	.02	.00	−.02	−.06	.07
4. Were physical	.86	.00	.03	−.03	−.02	−.08	.09
5. Included social interaction[a]	.02	.93	.04	−.01	−.02	.05	.02
6. Involved communicating with others[a]	.01	.91	−.05	.10	−.02	.03	−.01
7. Involved spending time with others	−.01	.87	−.02	−.03	.05	−.09	−.04
8. Involved socializing with others	.01	.93	.02	−.01	−.01	−.01	.01
9. Allowed you to be creative[a]	−.01	.04	.92	.04	−.03	.00	.01
10. Were creative[a]	.02	.00	.90	.04	−.02	.00	−.02
11. Allowed you to express yourself creatively	.02	.05	.89	−.01	−.01	.01	.02
12. Helped you to explore your creative side	−.06	−.02	.89	.06	.04	−.02	.01
13. Required you to think hard[a]	−.13	−.07	.17	.76	−.01	.06	.07
14. Required you to be mentally active[a]	−.11	.06	−.01	.88	−.01	−.04	.04
15. Required you to concentrate	.13	−.06	.04	.76	.01	−.03	−.17
16. Were mentally demanding	.06	.01	−.09	.82	.12	.07	.02
17. Involved spirituality[a]	−.01	.02	−.01	.04	.85	−.04	.02
18. Included spiritual themes such as the meaning of life, death, or religion[a]	−.13	.01	−.09	.10	.75	.04	.00
19. Addressed your spiritual side	.06	.04	.03	.02	.73	.02	.09
20. Involved meditation, pray, or taking time in other ways to find inner peace	.12	−.07	.12	−.07	.60	.04	.08
21. Occurred through digital devices (such as smartphone, computer, tablet)[a]	−.06	−.09	.05	−.02	−.02	.86	.00
22. Were virtual (using digital technology)[a]	.05	.03	.01	.07	−.02	.79	−.01
23. Included using the internet	.04	.11	.00	.04	.00	.82	−.01
24. Were mediated by a screen	−.19	−.06	−.08	−.06	.05	.71	−.08
25. Were in the fresh air[a]	.05	.06	−.01	.00	−.05	−.06	.85
26. Were performed in a natural environment (e.g., among plants and trees)[a]	−.03	−.04	.01	−.01	.10	−.01	.90
27. Were outdoors	.08	.03	−.02	−.01	−.02	−.06	.81
28. Were in nature	.08	−.05	.01	−.02	−.03	.04	.87

Note. $N = 301$. Only factor loadings of items that were ultimately retained are displayed here. RAC = recovery activity characteristics.
[a] Item included in the two-item RAC questionnaire.

further analysis and reran the EFA extracting seven factors. Factor loadings of the remaining 47 items ranged from .60 to .94 with no cross-loading above .3. From these 47 items, we selected four items per dimension (i.e., 28 in total) for the long version of the RAC questionnaire and two of these (i.e., 14 items in total) for the short version. As all items showed high loadings on the intended factor and low cross-loadings, we selected items based on each items' face validity and centrality for the respective dimension. The final set of items and loadings on the respective factor can be seen in Table 5.

Psychometric Properties of the RAC Questionnaire

Psychometric properties of the final long and short version of the RAC questionnaire were established in Studies 3 and 4. The coefficient α reliability estimates for the different dimensions of the long version ranged from .87 to .92 in Study 3. As recommended for two-item scales (Eisinga et al., 2013), reliabilities of the short version scales were established by calculating the Spearman–Brown coefficient together with standardized coefficient α. Reliability ranged from .76 to .88 in Study 3 and from .75 to .96 in Study 4 (see also Tables 6 and 7).

We used CFA to confirm the seven-factor structure of our measure. Specifically, we performed an ordinary CFA on Study 3 and a multilevel CFA on Study 4 with R using the lavaan package (Huang, 2017). We compared the expected seven-factor model to a single-factor model. Furthermore, given high correlations between the physical and outdoor dimensions (Study 3, $r = .60$, $p < .001$; Study 4 within-person $r = .41$, $p < .001$; Study 4 between-person $r = .51$, $p < .001$) as well as between the creative and mental dimensions (Study 3, $r = .45$, $p < .001$; Study 4 within-person $r = .47$, $p < .001$; Study 4 between-person $r = .82$, $p < .001$), we also ran two alternative six-factor models combining the physical and outdoor factors, respectively, the creative and mental factors. We calculated the models' chi-square χ^2, comparative fit index (CFI), root-mean-square error of approximation (RMSEA), standardized root-mean-square residual (SRMR; Kline, 2016). Results confirmed the proposed seven-factor model for both the long version of the scale (Study 3: CFI = .97, Tucker–Lewis index [TLI] = .97, RMSEA = .04, SRMR = .04) and the short version of the scale (Study 3: CFI = .98, TLI = .97, RMSEA = .05, SRMR = .03; Study 4: CFI = .99, TLI = .98, RMSEA = .03, within SRMR = .03, between SRMR = .06). The seven-factor model was the only model that met the Hu and Bentler (1999) cutoff criteria, suggesting CFI and TLI values reaching or exceeding .95, SRMR values reaching or lower than .08, and RMSEA values reaching or lower than .06 to be indicative of good model fit. Furthermore, the seven-factor structure fit the data

Table 6
Descriptive Statistics, Correlations, and Reliabilities for Constructs in Study 3

Variable	*M*	*SD*	α	1	2	3	4	5	6	7	8	9	10	11
1. Physical	2.0	1.02	.92	—										
2. Social	2.7	1.07	.93	.18**	—									
3. Creative	2.2	1.01	.92	.28***	.26***	—								
4. Mental	2.6	.95	.88	.19**	.27***	.45***	—							
5. Spiritual	1.5	.79	.88	.21***	.13*	.35***	.18**	—						
6. Virtual	3.5	1.03	.87	−.19**	.05	.14*	.39***	.09	—					
7. Outdoor	1.9	.99	.92	.60***	.27***	.25***	.06	.26***	−.32***	—				
8. Need for cognition	3.6	.70	.81	−.06	.15*	.11	.09	.04	.01	.00	—			
9. Need for affiliation	2.8	.75	.71	−.04	.23***	.06	.02	.03	−.07	.05	.12	—		
10. Extraversion	2.8	.97	.84	.03	.25***	.07	.03	.09	−.04	.04	.24***	.53***	—	
11. Openness to experiences	3.8	.76	.72	.07	.10	.27***	.05	.15*	.08	.03	.36***	.05	.26***	—

Note. $N = 286$.
* $p < .05$. ** $p < .01$. *** $p < .001$.

significantly better than the one- or six-factor solutions as established with a chi-square difference test (see Tables 8 and 9).

Personality Traits as Conceptual Antecedents of RAC

To explore the nomological net of RAC, we assessed personality traits as antecedents. We calculated bivariate correlations between the RAC's dimensions and related personality constructs in Study 3 (see Table 6). Openness to experience was positively correlated with the creative dimension ($r = .27$, $p < .001$), which supports Hypothesis 1. Confirming Hypotheses 2a and 2b, extraversion ($r = .25$, $p < .001$) and need for affiliation ($r = .23$, $p < .001$) were positively correlated with the social dimension. Contrary to Hypothesis 3, there were no significant positive relationships of the mental ($r = .09$, $p = .14$) and creative ($r = .11$, $p = .07$) dimensions with need for cognition. Therefore, both Hypotheses 3a and 3b were not supported.

The Role of RAC for Recovery Experiences

We performed multilevel structural equation modeling using Mplus (Muthén & Muthén, 2017) on Study 4 to investigate relations of RAC with recovery experiences (see Table 10). Paths were specified simultaneously at the within- and between-person level to appropriately partition the variance of day-level variables into latent within-person and between-person components. This corresponds to latent person-mean centering and has advantages over observed person-mean centering (Lüdtke et al., 2008). As is customary in recovery research, our focus was on within-person level relations.[2] Respective RAC were entered simultaneously as predictors of psychological detachment, relaxation, and mastery; they were allowed to covary. Furthermore, we controlled for the extent to which afterwork activities were work-related as some RAC (especially the virtual and mental dimensions) might be confounded with work-related activities. Due to the large amount of parameters, models were run separately for psychological detachment and relaxation. As can be seen from Table 10, the physical (estimate = −.02, $p = .57$; Hypothesis 4a), creative (estimate = .07, $p = .14$; Hypothesis 4c), spiritual (estimate = .01, $p = .88$; Hypothesis 4e), and virtual (estimate = −.03, $p = .43$; Hypothesis 4f) dimensions were not significantly related to psychological detachment. Interestingly and contrary to expectations, the mental dimension was negatively related to psychological detachment (estimate = −.10, $p < .05$; Hypothesis 4d). Only the social (estimate = .09, $p < .01$; Hypothesis 4b) and outdoor (estimate = .08, $p < .05$; Hypothesis 4g) dimensions were positively related to psychological detachment. Hypothesis 4 was therefore only partly supported. In addition, the outdoor (estimate = .16, $p < .001$; Hypothesis 5a), social (estimate = .09, $p < .05$; Hypothesis 5b), virtual (estimate = .11, $p < .01$; Hypothesis 5c), and spiritual (estimate = .21, $p < .01$; Hypothesis 5d) dimensions were positively related to relaxation experiences, while the physical (estimate = −0.12, $p < .001$; Hypothesis 5e) and mental (estimate = −.27, $p < .001$; Hypothesis 5f) dimensions were negatively related to relaxation experiences. Therefore, Hypothesis 5 was thus fully supported. As expected, the physical (estimate = .07, $p < .05$; Hypothesis 6a), creative (estimate = .17, $p < .001$; Hypothesis 6b), and mental (estimate = .34, $p < .001$; Hypothesis 6c) dimensions were positively related to mastery experiences, confirming Hypothesis 6 (see Table 11).

Relations of RAC With Well-Being Outcomes via Recovery Experiences

We also sought to examine how RAC relate to well-being outcomes through recovery experiences (Hypotheses 7, 8, 9, 10, and 11). This was tested with multilevel mediation models specifying indirect effects at the within-person level (Preacher et al., 2010). Results are provided in Tables 10–13. Statistical significance of indirect effects was assessed with Monte Carlo bootstrap procedures with 90% confidence intervals around the indirect effect as recommended by Preacher and colleagues (Preacher et al., 2010; see also Y. Liu et al., 2015).

Indirect effects on evening outcomes are displayed in Tables 10 and 12. We found a significant negative indirect effect of the social (estimate = −.01; CI [−.02, −.00]; Hypothesis 7b) and outdoor (estimate = −.01; CI [−.02, −.00]; Hypothesis 7g) dimensions on evening exhaustion through psychological detachment. However, the physical (estimate = .00; CI [−.00, .01]; Hypothesis 7a), creative

[2] Table 7 provides correlations at both the within-person and between-person levels of analysis. The general pattern of relationships is similar at the between-person and within-person levels, although a main difference is that all recovery activity characteristics (excluding virtual) show significant positive correlations with next-morning vigor at the between-person level, but not at the within-person level.

Table 7

Descriptive Statistics, Correlations, and Reliabilities for Constructs in Study 4

Variable	ICC	*M*	*SD*	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Physical	.18	2.09	1.19	.84–.94	.06	.16**	.13*	.04	−.23***	.41***	.03	−.09*	.18***	.04	.04	.00
2. Social	.27	3.22	1.15	.35*	.79–.95	.21***	.27***	.18***	−.08	.23***	.11*	.09*	.14**	−.06	−.01	−.00
3. Creative	.47	2.10	1.09	.48**	.53***	.79–.95	.47***	.15**	.11	.11*	.00	.01	.38***	−.15***	−.04	.03
4. Mental	.37	2.38	1.07	.39**	.41**	.82***	.75–.92	.21***	.29***	−.05	−.16**	−.19***	.48***	.02	.02	−.03
5. Spiritual	.67	1.40	0.82	.30*	.31**	.48***	.44***	.75–.96	−.03	.09*	.01	.11*	.14**	−.05	−.05	−.03
6. Virtual	.32	2.51	1.30	−.10	−.02	.18	.21	.08	.81–.95	−.37***	−.19**	−.03	.13**	−.01	.02	−.10*
7. Outdoor	.37	2.57	1.34	.51***	.47***	.27	.05	.26	−.13	.84–.95	.21***	.20***	.07	−.14**	.08	−.04
8. Detachment	.44	3.71	1.02	.26	.05	−.25	−.31*	−.16	−.23*	.17	.83–.91	.51***	−.02	−.15**	.02	−.13**
9. Relaxation	.38	3.52	0.97	.13	.07	.20	−.01	.02	−.01	−.05	.31*	.83–.92	.01	−.19***	−.01	−.10*
10. Mastery	.50	2.56	1.01	.54***	.15	.74***	.75***	.49***	.17	.16	−.19	.10	.78–.90	−.09	.08	−.04
11. Evening exhaustion	.40	2.36	0.97	−.08	−.18	−.03	.08	.21*	.03	−.25*	−.43***	−.32**	.20	.73–.86	−.10	.28***
12. Next morning vigor	.58	2.83	0.96	.44**	.37**	.36***	.31**	.26**	.21	.46***	.21	.09	.27**	−.42**	.80–.93	−.51***
13. Next morning exhaustion	.46	1.96	0.84	−.07	−.14	.03	.15	.13	.11	−.20	−.62***	−.28*	.10	.76***	−.59***	.60–.87

Note. $N = 127$ with 501–827 observations. Reliability estimates are along the diagonal. Correlations below the diagonal are at the between-person level, correlations above the diagonal are at the within-person level. Spearman–Brown coefficient together with standardized coefficient α was conducted for RAC dimensions because it was recommended to test the reliability of two-item scales. Standardized α and Spearman–Brown have the exact value. ICC = intraclass correlation coefficients; RAC = recovery activity characteristics.
* $p < .05$. ** $p < .01$. *** $p < .001$.

(estimate = −.01; CI [−.02, .00]; Hypothesis 7c), spiritual (estimate = −.00; CI [−.01, .01]; Hypothesis 7e), and virtual (estimate = .00; CI [−.00, .01]; Hypothesis 7f) dimensions were not indirectly related to evening exhaustion through psychological detachment. Contrary to Hypothesis 7d, the mental dimension had a significant indirect positive effect on evening exhaustion through psychological detachment (estimate = .01; CI [.00, .02]; Hypothesis 7d). Therefore, out of the seven dimensions hypothesized in Hypothesis 7, only two dimensions (i.e., social and outdoor dimensions) were negatively related to evening exhaustion through psychological detachment (see Table 10). Concerning Hypothesis 8, a significant negative indirect relationship of the social (estimate = −.01; CI [−.02, −.00]; Hypothesis 8a), spiritual (estimate = −.03; CI [−.05, −.01]; Hypothesis 8b), virtual (estimate = −.02; CI [−.03, −.01]; Hypothesis 8c), and outdoor dimensions (estimate = −.02; CI [−.04, −.01]; Hypothesis 8d) with evening exhaustion via relaxation emerged. Relaxation also mediated the positive relationship between the physical (estimate = .01; CI [.00, .03]; Hypothesis 8e) and mental (estimate = .03; CI [.01, .04]; Hypothesis 8f) dimensions and evening exhaustion.

Indirect effects on next-morning outcomes are displayed in Tables 11 and 13. We found a significant indirect effect of the social (estimate = −.01; CI [−.02, −.00]; Hypothesis 9b) and outdoor (estimate = −.01; CI [−.02, −.00]; Hypothesis 9g) dimensions on next-morning exhaustion through psychological detachment. The physical (estimate = .00; CI [−.00, .01]; Hypothesis 9a), creative (estimate = −.01; CI [−.02, .00]; Hypothesis 9c), spiritual (estimate = −.00; CI [−.02, .01]; Hypothesis 9e), and virtual (estimate = .00; CI [−.00, .01]; Hypothesis 9f) dimensions were, however, not indirectly related to next-morning exhaustion through psychological detachment. Contrary to expectations, the mental dimension had a significant indirect positive effect on next-morning exhaustion through psychological detachment (estimate = .01; CI [.00, .03]; Hypothesis 9d). There were no significant indirect effects of the physical (estimate = −.01; CI [−.01, .00]; Hypothesis 10a), social (estimate = −.01; CI [−.03, .00]; Hypothesis 10b), mental (estimate = −.01; CI [−.02, .00]; Hypothesis 10c), spiritual (estimate = −.01; CI [−.02, .00]; Hypothesis 10d), virtual (estimate = .01; CI [−.00, .02]; Hypothesis 10e), and outdoor (estimate = .01; CI [−.00, .03]; Hypothesis 10f) dimensions on next-morning exhaustion through relaxation. Therefore, Hypothesis 10 was not confirmed. Finally, the positive relationships between physical (estimate = .01; CI [.00, .02]; Hypothesis 11a), creative (estimate = .02; CI [.00, .04]; Hypothesis 11b), and mental (estimate = .04; CI [.01, .08]; Hypothesis 11c) dimensions and next-morning vigor via mastery experiences were significant, supporting Hypothesis 11. An overview of confirmed and not confirmed paths is provided in Figure 1.

Discussion

Research undeniably demonstrates the importance of recovery processes for individual well-being (Sonnentag et al., 2022). In particular, a substantial body of literature has accumulated, emphasizing the importance of recovery experiences for a variety of well-being outcomes (Bennett et al., 2020; Headrick et al., 2022; Steed et al., 2021). However, after 20 years of research, the study of recovery activities has lagged behind, hampered by problematic measurement and piecemeal investigations of RAC (Sonnentag et al., 2022). Advancement of research on recovery activities is critical

Table 8
Results of Confirmatory Factor Analyses for Study 3

Model	$\chi^2(df)$	$\Delta\chi^2$ (Δdf)	CFI	TLI	RMSEA	SRMR
28-item scale						
Seven-factor	504.467 (329)***		.970	.965	.043	.038
One-factor (all combined)	4428.556 (350)***	3924.1 (21)***	.299	.243	.202	.201
Six-factor (creative and mental combined)	997.836 (335)***	493.37 (6)***	.886	.871	.083	.077
Six-factor (physical and outdoor combined)	985.609 (335)***	481.14 (6)***	.888	.874	.082	.056
14-item scale						
Seven-factor	91.951 (56)**		.980	.968	.047	.028
One-factor (all combined)	1269.535 (77)***	1177.6 (21)***	.338	.218	.233	.167
Six-factor (creative and mental combined)	257.922 (62)***	165.97 (6)***	.891	.840	.105	.067
Six-factor (physical and outdoor combined)	239.278 (62)***	147.33 (6)***	.902	.856	.100	.052

Note. $N = 286$. CFI = comparative fit index; TLI = Tucker–Lewis index; RMSEA = root-mean-square error of approximation; SRMR = standardized root-mean-square residual.
** $p < .01$. *** $p < .001$.

because activities are the most direct causal antecedents of recovery experiences that are under volitional control and that can be directly targeted by behavioral interventions (e.g., de Bloom et al., 2018; Sonnentag et al., 2022). Therefore, this work serves as a step toward furthering the research on recovery activities by introducing a dimensional framework of RAC, by validating a psychometrically sound RAC questionnaire, and by investigating the active ingredients that drive relations of recovery activities with recovery experiences and downstream well-being outcomes. Consequently, the results of this work have important theoretical as well as practical implications.

Theoretical Implications

First, this work generates theoretical advancements by introducing a comprehensive multidimensional framework of RAC. While the recovery literature has predominantly focused on grouping activities into broad categories (e.g., de Bloom et al., 2018; Rook & Zijlstra, 2006; Sonnentag, 2001; Sonnentag & Zijlstra, 2006), this approach has the downside that activity groups may include multiple underlying characteristics (e.g., social activities may also be physically active), and therefore, it remains unclear what characteristic actually drives effects on recovery. Based on an extensive review of the literature and factor analysis, we identified a seven-factor dimensional framework of activity characteristics, including physical, social, creative, mental, virtual, spiritual, and outdoor dimensions. The introduction of a comprehensive framework, containing the relevant dimensions of recovery characteristics, makes it possible to disentangle the specific effects of each dimension and control for possible confounds of other dimensions. By also including the non-work-related recovery literature in our review, we incorporate aspects of leisure activities that have, to date, been largely overlooked (e.g., the spiritual, virtual, creative, and outdoor dimension). Our results confirm that these novel dimensions are indeed meaningful predictors of recovery experiences. For instance, the spiritual and virtual dimensions were positively related to evening relaxation and thereby contributed to lower levels of evening emotional exhaustion. The creative dimension was positively related to mastery and thereby promoted next-morning vigor, and the outdoor dimension was positively related to psychological detachment and relaxation and thereby contributed to lower evening and next-morning exhaustion. These features of recovery activities are thus vitally important as they meaningfully contribute to the recovery process.

Second, the current work sought to advance research on recovery processes by the development of a psychometrically sound measure that assesses the multifaceted nature of recovery activities. Following state-of-the-art recommendations on scale development and validation (Colquitt et al., 2019; Hinkin, 1998), we derived and validated the seven-factor activity characteristics questionnaire. Across four studies including cross-sectional, time-lagged, and a diary study encompassing a total sample size of 908 individuals, our analyses demonstrated that the scale has strong content validity, high reliability, and a clear factor structure at both the between- and within-person level of analysis. In addition to the 28-item long version of the RAC questionnaire, we have also developed a 14-item short version for use in diary studies and experience sampling studies. This enables a fine-grained investigation into the effective components of recovery activities at between- and within-person

Table 9
Results of Multilevel Confirmatory Factor Analyses for Study 4

Model	$\chi^2(df)$	$\Delta\chi^2$ (Δdf)	CFI	TLI	RMSEA	SRMR
Seven-factor	169.464 (117)**		.989	.982	.026	$.028^{w}/.055^{b}$
One-factor (all combined)	3177.509 (156)***	3008.1 (39)***	.345	.236	.171	$.188^{w}/.217^{b}$
Six-factor (creative and mental combined)	430.051 (130)***	260.59 (13)***	.935	.909	.059	$.051^{w}/.077^{b}$
Six-factor (physical and outdoor combined)	699.482 (130)***	530.02 (13)***	.877	.827	.081	$.080^{w}/.159^{b}$

Note. $N = 118$ with 664 observations. w = within SRMR; b = between SRMR. 14-item scale was used in Study 4. CFI = comparative fit index; TLI = Tucker–Lewis index; RMSEA = root-mean-square error of approximation; SRMR = standardized root-mean-square residual.
** $p < .01$. *** $p < .001$.

Table 10

Multilevel Path Analysis Results at the Within-Person Level of the Role of Recovery Activity Characteristics on Evening Emotional Exhaustion in Study 4

	Model 1				Model 2[a]			
	Psychological detachment		Evening emotional exhaustion		Relaxation		Evening emotional exhaustion	
Variable	γ	*SE*	γ	*SE*	γ	*SE*	γ	*SE*
Intercept	3.51***	.60	4.36***	.71	3.05***	.58	4.33***	.61
Physical	−.02	.03	.07*	.03	−.10**	.03	.05†	.03
Social	.09**	.03	−.01	.03	.09*	.03	−.02	.04
Creative	.07	.04	−.17***	.05				
Mental	−.10*	.05	.07	.05	−.18***	.04	−.02	.05
Spiritual	.01	.07	−.04	.07	.21**	.07	−.02	.07
Virtual	−.03	.03	−.05	.03	.11**	.03	−.04	.03
Outdoor	.08*	.03	−.10**	.04	.16***	.03	−.10**	.04
Work-related	−.21***	.04	.03	.04	−.15***	.04	.03	.04
Psychological detachment			−.11*	.04				
Relaxation							−.14**	.04

Note. Between-person level $n = 118$; within-person level $n = 664$; γ = unstandardized estimates; recovery activity characteristics were allowed to covary; due to the large amount of parameters, models were run separately for psychological detachment and relaxation. Only within-person level estimates are reported here for the sake of parsimony. *SE* = standard error.

[a] The pattern of results and significance levels remained the same when including all recovery activity characteristics as predictors in the model.

* $p < .05$. ** $p < .01$. *** $p < .001$. † $p < .10$ (two-tailed).

levels. Because the RAC questionnaire enables the measurement of recovery activities using continuous variables in various settings (e.g., evening, work break, and weekend) and the examination of interactions among the different dimensions, we believe that the RAC questionnaire can facilitate research, leading to a more in-depth understanding of how recovery activities enhance recovery from work stress. As part of the validation process and in an endeavor to study relations of RAC dimensions with constructs pertaining to the wider nomological net, we also investigated links with personality traits that might function conceptually as antecedents of RAC. Employees high on need for affiliation and extraversion tended to seek out activities with a social component, while individuals high on openness to experience were drawn toward activities with a creative component. In addition, we found a positive relationship between openness to experience and the spiritual dimension. Although not initially hypothesized, the

Table 11

Multilevel Path Analysis Results at the Within-Person Level of the Role of Recovery Activity Characteristics on Next-Morning Emotional Exhaustion and Vigor in Study 4

	Model 1				Model 2[a]				Model 3[a]			
	Psychological detachment		Next morning exhaustion		Relaxation		Next morning exhaustion		Mastery		Next morning vigor	
Variable	γ	*SE*	γ	*SE*	γ	*SE*	γ	*SE*	γ	*SE*	γ	*SE*
Intercept	3.50***	.59	4.14***	.64	3.04***	.57	3.15***	.59	.35	.38	.92	.61
Physical	−.02	.03	.00	.03	−.10**	.03	.00	.03	.07**	.02	.02	.03
Social	.10**	.03	.01	.04	.09*	.03	.00	.04				
Creative	.06	.04	.06	.05					.17***	.04	−.08	.05
Mental	−.10*	.05	−.05	.05	−.18***	.04	−.04	.05	.34***	.04	.01	.06
Spiritual	.01	.07	−.03	.07	.21**	.07	−.01	.07				
Virtual	−.03	.03	−.10**	.03	.11**	.03	−.09*	.04				
Outdoor	.08*	.03	−.05	.03	.16***	.03	−.05	.04				
Work-related	−.21***	.04	.03	.04	−.15***	.04	.05	.04	−.04	.04	.01	.05
Psychological detachment			−.12**	.05								
Relaxation							−.06	.05				
Mastery											.12*	.06

Note. Between-person level $n = 127$; within-person level $n = 803–827$; γ = unstandardized estimates; recovery activity characteristics were allowed to covary; due to the large amount of parameters, models were run separately for psychological detachment and relaxation. Only within-person level estimates are reported here for the sake of parsimony. *SE* = standard error.

[a] The pattern of results and significance levels remained the same when including all recovery activity characteristics as predictors in the model.

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

Table 12
Within-Person Indirect Effects With Monte Carlo Confidence Intervals

Pathway	Estimate	Monte Carlo 90% CI	
		LL	*UL*
Physical → detachment → evening emotional exhaustion	.00	−.00	.01
Social → detachment → evening emotional exhaustion	−.01[a]	−.02	−.00
Creative → detachment → evening emotional exhaustion	−.01	−.02	.00
Mental → detachment → evening emotional exhaustion	.01[a]	.00	.02
Spiritual → detachment → evening emotional exhaustion	−.00	−.01	.01
Virtual → detachment → evening emotional exhaustion	.00	−.00	.01
Outdoor → detachment → evening emotional exhaustion	−.01[a]	−.02	−.00
Physical → relaxation → evening emotional exhaustion	.01[a]	.00	.03
Social → relaxation → evening emotional exhaustion	−.01[a]	−.02	−.00
Mental → relaxation → evening emotional exhaustion	.03[a]	.01	.04
Spiritual → relaxation → evening emotional exhaustion	−.03[a]	−.05	−.01
Virtual → relaxation → evening emotional exhaustion	−.02[a]	−.03	−.01
Outdoor → relaxation → evening emotional exhaustion	−.02[a]	−.04	−.01

Note. The table shows unstandardized estimates. CI = confidence interval; *LL* = lower limit; *UL* = upper limit.
[a] Significant at α = .05 level based on Monte Carlo 90% CI.

existing literature provides theoretical support for this relationship (e.g., Wink et al., 2007).

Third, we provide novel insights into the relationship between recovery activities and recovery experiences. Although earlier studies have already investigated recovery activities in relation to experiences, these studies have adopted the categorical approach or have focused on single recovery activities and/or experiences (e.g., de Bloom et al., 2018; Mojza et al., 2010; ten Brummelhuis & Bakker, 2012). Using the newly developed dimensional approach, our study provides novel insights as it encompasses a broader range of seven different RAC and informs on their unique relation with three key recovery experiences. The pattern of results shows that the relationship between recovery activities and recovery experiences is more nuanced than previously expected. RAC are differentially related to experiences with specific activity dimensions predicting specific experiences. We found that the social and outdoor dimensions are positively related to psychological detachment, that the outdoor, social, virtual, and spiritual dimensions are positively related to relaxation, and that the physical, mental, and creative dimensions are positively related to mastery. Interestingly and contrary to expectations, we did not find a significant relationship between the physical dimension and psychological detachment. A possible explanation might be that not physical effort per se leads to psychological detachment, but rather recovery occurred when physical activities are performed outdoors. This is also consistent with research from K. Korpela and Kinnunen (2010) who found that exercise while being outdoors is the most effective recovery activity. These results stress the importance of disentangling the effects of the different recovery activity dimensions to identify the unique effects of each dimension on relevant outcomes. Importantly, our results also revealed that activity characteristics cannot be easily classified as either good or bad but that it depends on the recovery experience in question. While the physical and mental dimensions were negatively related to relaxation, they were positively related to mastery.

Fourth, the present study maps the effect of RAC via recovery experiences on downstream well-being outcomes. Analyses of the effects of the recovery activity dimensions on evening emotional exhaustion mediated via psychological detachment and relaxation show that the benefits of the social and outdoor dimensions for psychological detachment translate into lower levels of evening emotional exhaustion. Similarly, the benefits of the social, spiritual, virtual, and outdoor dimensions translate into lower evening exhaustion via increased relaxation. Importantly, however, physical and mental aspects of recovery activities translate into higher levels of evening exhaustion via decreased relaxation.

Our findings also inform the literature on the role of evening recovery activities for next-morning outcomes, which is scarcer than

Table 13
Within-Person Indirect Effects With Monte Carlo Confidence Intervals

Pathway	Estimate	Monte Carlo 90% CI	
		LL	*UL*
Physical → detachment → next-morning exhaustion	.00	−.00	.01
Social → detachment → next-morning exhaustion	−.01[a]	−.02	−.00
Creative → detachment → next-morning exhaustion	−.01	−.02	.00
Mental → detachment → next-morning exhaustion	.01[a]	.00	.03
Spiritual → detachment → next-morning exhaustion	−.00	−.02	.01
Virtual → detachment → next-morning exhaustion	.00	−.00	.01
Outdoor → detachment → next-morning exhaustion	−.01[a]	−.02	−.00
Physical → relaxation → next-morning exhaustion	.01	−.00	.02
Social → relaxation → next-morning exhaustion	−.01	−.01	.00
Mental → relaxation → next-morning exhaustion	.01	−.00	.03
Spiritual → relaxation → next-morning exhaustion	.01	−.03	.00
Virtual → relaxation → next-morning exhaustion	−.01	−.02	.00
Outdoor → relaxation → next-morning exhaustion	−.01	−.02	.00
Physical → mastery → next-morning vigor	.01[a]	.00	.02
Creative → mastery → next-morning vigor	.02[a]	.00	.04
Mental → mastery → next-morning vigor	.04[a]	.01	.08

Note. The table shows unstandardized estimates. CI = confidence interval; *LL* = lower limit; *UL* = upper limit.
[a] Significant at α = .05 level based on Monte Carlo 90% CI.

the literature on same evening outcomes (for exceptions, see ten Brummelhuis & Bakker, 2012; ten Brummelhuis & Trougakos, 2014). Despite the larger temporal distance, the negative indirect relations of the social and outdoor dimensions and the positive indirect relations of the mental dimension on evening emotional exhaustion via detachment were confirmed for next-morning emotional exhaustion. In addition, the physical, creative, and mental dimensions were positively related to next-morning vigor via increased mastery. This is an important finding as mastery is related to vigor (Bennett et al., 2018) and vigor forms the link to next-day work engagement (ten Brummelhuis & Bakker, 2012). Surprisingly, however, little is known about which recovery activities promote mastery. By revealing that engagement in activities that involve physical, creative, and mental engagement promotes mastery, our study addresses this important question. Due to a missing significant relation between relaxation and next-morning emotional exhaustion, however, no indirect relations emerged via relaxation. This is not surprising as relations of recovery experiences with next-morning outcomes are typically weaker and less consistent. For instance, Sonnentag et al. (2008) did not find a link between relaxation and next-morning exhaustion.

Taken together, the differential indirect relations of RAC via psychological detachment and mastery on next-morning outcomes are important as they show that effects of recovery activities are not only short lived but carry over to the next workday and may, in turn, affect work motivation and behavior (ten Brummelhuis & Bakker, 2012). Furthermore, these findings underscore the differential effects of RAC and exemplify that it depends on the outcome in question to what extent they benefit or harm employee well-being. Simply put, is the goal to increase next-morning vigor, recovery activities involving mental effort are recommended, while they are not when the goal is to reduce emotional exhaustion.

Practical Implications

Our research also provides practical implications. First, the dimensional approach generates more specific advice for shaping recovery activities than the previously used categorical approach. Our findings, for instance, suggest that the outdoor and social dimensions are important for detachment. This entails that people do not need to choose different activities in order to benefit optimally from their recovering effects but may instead change specific dimensions of the activities. For instance, by engaging in a chosen activity outside or together with a friend. Moreover, our findings suggest effects for a number of aspects of recovery activities that have previously received only limited attention in the recovery literature. For instance, we find that both the spiritual and the virtual dimensions are positively related to relaxation and that the virtual dimension is negatively related to next-morning exhaustion. While recovery experiences play an important role in the recovery process, employees have limited volitional control over their recovery experiences (de Bloom et al., 2018). Recovery scholars have therefore advised to target recovery activities when seeking to promote successful recovery as these can more readily be influenced (Sonnentag et al., 2022). Using findings of the present study, employees can therefore directly choose the characteristics of activities they want to engage in to foster their recovery experiences and well-being. For instance, they may engage in activities with social and outdoor components to feel detached and relaxed or in activities with physical, mental, and creative components to experience mastery.

Finally, the easy-to-administer fine-grained RAC questionnaire is not only suitable for scientific research but also constitutes an easy-to-administer tool for psychologists, human resources practitioners, and coaches. The short version of the RAC questionnaire assesses seven dimensions (physical, social, creative, mental, spiritual, virtual, and outdoor) with only 14 items. It therefore can be easily administered in a questionnaire or app to generate reports that can provide employees with relevant insight into their recovery activity patterns.

Limitations and Future Research

The present study is not without limitations, which provide relevant questions for future research. First, in line with the recovery and leisure literature, the RAC questionnaire is a self-report instrument because people performing the activity are the best targets to report on it. However, a potential downside may be response bias (Donaldson & Grant-Vallone, 2002). For example, participants may overreport their engagement in the physical dimension as they deem it socially desirable (Warnecke et al., 1997) or they might have a recall bias (Baranowski, 1988). To minimize the effect of recall bias, however, we asked participants to recall only the activities they engaged in in the evening before going to bed as is typical in diary studies in the recovery literature. In order to assess the extent to which self-reports are impacted by biases such as social desirability and recall bias, future research could assess the convergent validity of the RAC with objective measures, such as automatic step counts (physical), screen time (virtual), and GPS location (outdoor).

The use of self-report instruments in our study also introduces the possibility of common-method bias (Podsakoff et al., 2003). In order to mitigate common-method issues, we assessed the predictors and outcomes variables, where possible, at different time moments (e.g., personality correlates and morning outcomes in Studies 3 and 4). In the diary study, the activity characteristics, evening recovery experiences, and evening exhaustion were measured concurrently because these refer to the same time period. Notably, however, focusing on within-person relationships, between-person variance was removed, thereby reducing potential effects of individual response tendencies (Raudenbush & Bryk, 2002).

Second, in developing our initial set of recovery activity dimensions, we applied a deductive, literature-based approach, in contrast to an inductive, qualitative, approach (Hinkin, 1995). Although scattered and disintegrated, the field of recovery characteristics already has a long history, which we could capitalize on to derive this initial set of dimensions. Although we conducted a comprehensive review of the existing literature, we did not follow systematic literature review protocols (e.g., Preferred Reporting Items for Systematic Reviews and Meta-Analyses). Therefore, we cannot fully guarantee the comprehensiveness of the resulting set of dimensions and additional research may bring to light aspects of recovery characteristics that have not yet been considered. In particular, an inductive bottom-up approach, directly tapping into the knowledge of participants as they describe their recovery activities, may be promising in this regard (Spector & Pindek, 2016).

Third, when it comes to the RAC's nomological network, this article explores possible trait-level antecedents for the social, mental, and creative dimensions and focuses on a limited number of

relevant outcome variables. Additional research is needed to extend knowledge on the antecedents of recovery activities both on the between-person level and the within-person level. For instance, previous research suggests that individuals scoring high on openness to experience are more likely to participate in physical (Wilson & Dishman, 2015) and outdoor activities (Kraaykamp & van Eijck, 2005), and there is some indication that neuroticism is positively and conscientiousness is negatively associated with participation in activities with a virtual component (Kuper et al., 2022). On the state level, ego depletion has been positively related to participation in virtual activities (Reinecke et al., 2014) and job stressors negatively related to physical activities (Sonnentag & Jelden, 2009). Moreover, we assessed recovery experiences using the model of Sonnentag and Fritz (2007) as direct outcomes for the RAC dimensions; whereas a more recent iteration of this model, the DRAMMA model by Newman et al. (2014) includes the additional experiences of affiliation and meaning with proven added value for recovery (e.g., Virtanen et al., 2021).

Finally, although this article provides an initial understanding of the underlying mechanisms of recovery activities, the activity dimensions do not occur in isolation. It may actually be the specific combination of dimensions that may drive effects on recovery experiences and downstream well-being outcomes. Some dimensions are likely to co-occur (e.g., physical and outdoor), and day-level as well as interpersonal profiles of recovery activities may explain additional variance in relevant outcome measures. Therefore, a person-centered approach (Chawla et al., 2020), identifying clusters of activity dimensions, can be a fruitful avenue for future research.

Conclusion

In the present work, we introduce a novel dimensional approach toward studying recovery activities that allows identifying the active ingredients of recovery activities. We present the RAC questionnaire, a psychometrically sound, reliable, and valid multidimensional measure of RAC. Our findings revealed that recovery activity characteristics are differentially related to recovery experiences and downstream well-being outcomes and that it depends on the outcome in question whether specific activities are to be considered detrimental or conducive to the recovery process.

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