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Received: 24 October 2024 | Accepted: 8 July 2025

DOI: 10.1111/joop.70047

RESEARCH ARTICLE

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Work-related technology use during nonwork time and its consequences: A resource-oriented perspective

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Funding information
Economic and Social Research Council

Abstract

Employees increasingly use information and communication technologies (i.e., ICTs) to work during nonwork time (e.g., responding to e-mails, taking calls), even when not contractually required. Despite potential work-related benefits, voluntary work-related ICT use can affect employees' recovery and well-being. Drawing on the conservation of resources theory and self-regulation, we argue that engaging in voluntary ICT use during workday evenings is a work-related resource investment, requiring self-regulatory resources. Consequently, employees lack such resources to regulate their attention away from work, thus experiencing reduced psychological detachment. This, in turn, can impede employees' ability to engage in mood repair regarding affective well-being at bedtime and the following morning. We propose that employees can alleviate this process through substituting and replacing self-regulatory resources by having control over their evening and good sleep quality, respectively. Conducting a daily diary study over five consecutive workdays and following mornings with 187 participants, we found negative indirect effects of voluntary ICT use on affective well-being the following morning, via reduced psychological detachment. Feeling in control during nonwork time and sleep quality mitigated these effects. Our study contributes to the conceptual understanding of voluntary ICT use and how this behaviour can be managed more actively by individuals.

KEYWORDS

nonwork time, recovery, resources, well-being, work-related technology use

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Practitioner points

- Employers and employees need to be aware that using information and communication technologies for work during workday evenings can negatively affect employees' well-being at bedtime and the following morning. The likelihood of such spillover effects needs to be addressed as part of organisational policy and well-being training.
- Employees need to know that using information and communication technologies for work during workday evenings can impede detaching from work mentally and, in turn, might lower well-being. Therefore, a mindful and considered approach is necessary to counteract continuous email checking and other work activities during nonwork time.
- The risk of negative effects from using information and communication technologies for work during workday evenings on well-being can be reduced by feeling in control during one's nonwork time and by sleeping well. Employees should consider how they can establish deliberate boundaries for technology use and what helps their sleep hygiene.

INTRODUCTION

Across sectors and organisations, many employees use information and communication technologies (i.e., ICTs) such as laptops or smartphones to remotely engage in work-related activities during nonwork time (e.g., reading and responding to e-mails, writing reports, engaging in calls, etc.). We refer to such behaviours as *voluntary work-related ICT use during nonwork time* (voluntary ICT use, for short; Schlachter et al., 2018). 'Voluntary' characterises non-obligatory behaviour when employees choose to use ICTs to work outside their work hours without contractual obligation (Schlachter et al., 2018; Thörel et al., 2022). Such voluntary behaviours are salient in the context of remote and hybrid work but may affect well-being. Although voluntary ICT use could facilitate achieving work-related goals such as completing unfinished tasks (e.g., Eichberger et al., 2022; Ren et al., 2023), recovery and well-being may be negatively impacted where work-nonwork boundaries become increasingly porous (Farivar et al., 2023; Ollier-Malaterre et al., 2019).

Previous research reports disparate consequences for well-being, recovery from work, work-nonwork balance and work performance (for reviews, see Ďuranová & Ohly, 2016; Kühner et al., 2023; Schlachter et al., 2018). Voluntary ICT use can facilitate control over when and where to work (van Zoonen et al., 2023; Xie et al., 2018), enabling employees to complete unfinished tasks (Eichberger et al., 2022) and enhancing work performance (Kühner et al., 2023; Ren et al., 2023). Yet voluntary ICT use can cause conflicts between work and nonwork domains (Derks & Bakker, 2014; Gadeyne et al., 2018) and impede recovery from work (Eichberger et al., 2021; Jo & Lee, 2022) with a negative impact on well-being (Ohly & Latour, 2014; Xie et al., 2018). Accordingly, work-related ICT use during nonwork is often considered a 'double-edged sword' (e.g., Dén-Nagy, 2014; Diaz et al., 2012): a resource for the work domain and a demand for the nonwork domain, to some extent mitigated by proactive self-management (Farivar et al., 2023; Lang & Jarvenpaa, 2005).

Recent studies identified boundary conditions that reduce the effect of voluntary ICT use on employees' recovery and well-being; control and alignment with personal preferences help mitigate the impact (Mellner, 2016; Thörel et al., 2022; Xie et al., 2018). Yet, other studies have not found empirical support for proposed moderators (Büchler et al., 2020; Eichberger et al., 2021; Van Laethem et al., 2018). Such inconsistent findings might stem from study designs examining between-person, stable boundary preferences and resources. However, voluntary ICT use, recovery and well-being fluctuate on a daily basis (e.g., Jo & Lee, 2022; Podsakoff et al., 2019; ten Brummelhuis et al., 2021), pointing to self-regulatory processes and changes in resources.

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Taking a resource-oriented lens (Hobfoll, 1989) in conjunction with the concept of self-regulation (Karoly, 1993), we examine individuals' daily reactions to voluntary ICT use, considering moderator effects at the within-person level—a gap in extant research (for exceptions see Eichberger et al., 2021, 2022; Gadeyne et al., 2023). Specifically, we investigate daily, within-person processes in voluntary ICT use and its consequences for individuals' psychological detachment and well-being in the evening and the following day by considering two important daily resources: Control during nonwork time and sleep quality.

Our study contributes to the conceptual understanding of voluntary ICT use by identifying boundary conditions for its effect on well-being. Applying the combined perspectives of COR theory and self-regulation (Hagger, 2015), we consider voluntary ICT use neutrally as an active resource investment into work, which may come at a certain cost by draining self-regulatory resources, thus prompting a loss cycle which negatively affects recovery and well-being in the evening and the following morning. Drawing on COR theory, we propose how employees can break such loss cycles through self-regulatory resources at a daily level via processes of resource substitution (i.e., perceived control during nonwork time) and replacement (i.e., sleep quality; Hobfoll, 1989, 2001).

THEORETICAL FRAMEWORK

COR theory is a motivational theory which holds that individuals are active agents who 'strive to retain, protect, and build resources, which can be 'objects, personal characteristics, conditions, or energies' (Hobfoll, 1989, p. 516) to support goal attainment (Halbesleben et al., 2014). Individuals experience stress if resources are threatened, lost, or invested without sufficient gains in return (Hobfoll, 1989; Hobfoll et al., 2018). COR theory holds that resource loss begets loss, which can be offset through coping strategies such as recovery (Halbesleben et al., 2014) and substituting or replacing resources (Hobfoll, 1989, 2001). When resources are reduced, individuals become defensive, lacking the capacity or willingness to invest remaining resources, referred to as *loss spirals* or *loss cycles* (Hobfoll, 2001). Such loss cycles are difficult to break because resources are required to do so (Hobfoll, 1989, 2001; Hobfoll et al., 2018).

Self-regulation or 'voluntary action management' (Karoly, 1993, p. 24) describes dynamic processes to pursue goal-directed activities across time and changing contexts by managing (i.e., regulating) one's own behaviour, cognitions, attentional focus and affect (Kanfer & Ackerman, 1989; Karoly, 1993; Neal et al., 2017). Individuals usually have multiple parallel goals vying for attention and requiring energy for attention shifts (e.g., Karoly, 1993; Neal et al., 2017). For instance, employees may use ICTs during workday evenings to achieve work-related goals (e.g., completing unfinished tasks), yet wish to spend time on leisure activities. Capacity to self-regulate between competing goals is contingent on limited cognitive (i.e., self-regulatory) resources, which can fluctuate due to fatigue or external stressors (Johnson et al., 2018; Kanfer & Ackerman, 1989). Where resources are reduced, individuals are less likely to engage in self-regulatory behaviour (Johnson et al., 2018; Karoly, 1993; Muraven et al., 1998). In order to regain the capacity to self-regulate, employees have to replenish related resources through recovery (Muraven et al., 1998; Tyler & Burns, 2008).

Some overlap in central ideas between COR theory and self-regulation has been highlighted: Hagger (2015) argued that self-regulatory resources are a personal resource in the context of COR theory. Hobfoll et al. (2018) emphasised that individuals make decisions about resources based on self-regulation processes. More specifically, if self-regulatory resources become depleted, the capacity to self-regulate reduces and becomes increasingly effortful, resulting in individuals protecting their remaining resources by avoiding further resource investment into self-regulation (Hagger, 2015). The reduced capacity to self-regulate could help to explain why some individuals enter and remain in loss cycles, while others are able to break them (Halbesleben et al., 2014).

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Caught in a loss cycle: ICT Use, psychological detachment and affective well-being from a resource-oriented perspective

We conceptualise voluntary ICT use neutrally as an active resource investment to achieve work-related goals during nonwork time (Eichberger et al., 2022; Flaxman et al., 2023; Wan et al., 2019): Employees invest resources regarding time, cognitive energy, attention and emotion regulation. Prolonged work-related resource consumption can be beneficial, yet carries energy-related costs impeding recovery processes and energy restoration (Flaxman et al., 2023; Geurts & Sonnentag, 2006; Reinke & Ohly, 2021). Throughout a workday, individuals deplete self-regulatory resources, which require replenishment during nonwork time (Johnson et al., 2018), where continued engagement in voluntary ICT use further reduces self-regulatory resources (Gombert, Konze, et al., 2018; Gombert, Rivkin, & Kleinsorge, 2018; Hur & Shin, 2023).

To counteract this, psychological detachment—a recovery process whereby employees mentally disengage from work (i.e., 'switching off'; Etzion et al., 1998)—can help to replenish drained resources (Sonnentag & Bayer, 2005; Sonnentag & Fritz, 2007) and support well-being (Sonnentag & Fritz, 2015; Steed et al., 2021), which is negatively impacted by working during nonwork time (Agolli & Holtz, 2023; Sonnentag & Fritz, 2015; Wendsche & Lohmann-Haislah, 2017).

We propose an agentic perspective on psychological detachment (Beckmann & Kellmann, 2004; Zijlstra et al., 2014), as an active, attentive and self-regulated process of directing attention away from work. Lacking self-regulatory resources, individuals struggle to suppress unintended, work-related thoughts (Cropley & Collis, 2020; Martin & Tesser, 1996; Muraven et al., 1998). This is consistent with previous research on self-control resources (Germeys & de Gieter, 2018; Koch et al., 2024), trait self-control (Smit & Barber, 2016) and meta-analytic evidence on boundary management techniques to facilitate psychological detachment (Karabinski et al., 2021). We propose that voluntary ICT use, a work-related resource investment, consumes self-regulatory resources, so employees lack the necessary resources to actively regulate their attention away from work to engage in psychological detachment. Consequently, they fail to offset their resource loss and enter a resource loss cycle due to working during their nonwork time (Hobfoll et al., 2018).

A core function of recovery is repairing mood, which has been impaired by work-related demands (Flaxman et al., 2023; Sonnentag & Fritz, 2007). In order to engage in such mood repair, individuals have to regulate affective states by monitoring, evaluating and modifying current arousal levels (Thompson, 1994). Down-regulating arousal levels during workday evenings has been argued to be an essential part of an active recovery process (Zijlstra et al., 2014). If individuals are caught in a loss cycle due to preceding voluntary ICT, they will subsequently lack self-regulatory resources to engage in mood repair, thus failing to regulate their affect at bedtime. Therefore, we propose that affective well-being at bedtime is affected by voluntary ICT use through reduced levels of psychological detachment (Schlachter et al., 2018). This constitutes the first sequence of our proposed serial mediation.

We operationalise affective well-being states based on the c*ircumplex model of affect*, which differentiates between four types of affective states based on a combination of valence (pleasant versus unpleasant) and activation (low versus high), namely, (1) *high-activation pleasant affect* (e.g., enthusiastic), (2) *low-activation pleasant affect* (e.g., calm), (3) *high-activation unpleasant affect* (e.g., anxious) and (4) *low-activation unpleasant affect* (e.g., sad) (J. A. Russell, 1980, 2003; Warr et al., 2014). This differentiation into four quadrants can be relevant from a self-regulation perspective, but is less commonly applied in research, which predominantly focuses on the differentiation between positive and negative affect only. Given the importance of affective arousal regulation in the process of mood repair (Sonnentag & Fritz, 2007; Zijlstra et al., 2014), we consider this more detailed differentiation to warrant further exploration. Consequently, in terms of valence, we propose that psychological detachment is positively associated with pleasant affective states (i.e., both high- and low- activation positive affect), whereas it is negatively associated with negative affective states (i.e., both high- and low- activation negative affect; Sonnentag & Fritz, 2015; Wendsche & Lohmann-Haislah, 2017). We do not propose differing hypotheses regarding activation level but examine if differential effects might be observed.

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We further propose that voluntary ICT use has consequences for one's individual experience the following day. Based on the COR theory's corollary of loss cycles (Hobfoll, 1989, 2001; Hobfoll et al., 2018), we argue that individuals who engage in voluntary ICT use have entered a loss cycle which continues from evening to the following morning as they will be less willing and have less regulatory capacity to invest resources in affect regulation (Firoozabadi et al., 2018). Consequently, negatively affected well-being from the previous evening carries over unregulated to the following morning (Sonnentag & Binnewies, 2013; Tremmel et al., 2019; Tremmel & Sonnentag, 2018).

More specifically, regarding positive affective well-being states, we hypothesise:

> **Hypothesis 1 (a, b):.** Voluntary work-related ICT use during workday evenings has a negative indirect effect on positive affective well-being the following morning (i.e., (a) high-activation pleasant affect, (b) low-activation pleasant affect), mediated by low psychological detachment during that evening and via the corresponding affective well-being at bedtime.

In terms of negative affective well-being states, we propose the following:

> **Hypothesis 1 (c, d):.** Voluntary work-related ICT use during workday evenings has a positive indirect effect on negative affective well-being the following morning (i.e., (c) high-activation unpleasant affect, (d) low-activation unpleasant affect), mediated by low psychological detachment during that evening and via the corresponding affective well-being at bedtime.

Breaking the loss cycle: Moderating the consequences of voluntary ICT use

According to COR theory, individuals cope with resource loss, thus preventing or breaking loss cycles, by offsetting it with resource replacement or substitution (Hobfoll, 1989, 2001). Whereas replacing resources refers to a direct replacement of resources, for instance, through recovery (Halbesleben et al., 2014), resource substituting refers to compensating for lost resources from another resource domain (Hobfoll, 2001).

On the one hand, psychological detachment is an effective way to replace drained resources. On the other hand, engaging in work-related activities keeps the attention on work and thus cognitive systems activated. Due to the energetic resources that are drained by voluntary ICT use, remaining self-regulatory resources are insufficient to refocus attention away from work. We, therefore, propose that psychological detachment is inherently impeded by voluntary ICT use, consistent with previous research finding little evidence for any moderating effects (Kühner et al., 2023; Thörel et al., 2022). Consequently, we suggest focusing on more distal associations along the proposed serial mediation process, where employees can more effectively break loss cycles via moderating effects (i.e., mitigating the indirect effects of this behaviour on affective well-being). Furthermore, we propose to examine resources as loss cycle breakers that are less directly affected by voluntary ICT use.

Substituting lost resources: Perceived control during nonwork time

One way of offsetting resource loss is resource substitution (Hobfoll, 1989, 2001). Feeling in control and self-determined over one's activities is an important resource in the process of recovery and well-being as a protective context for energy-consuming activities (Beckmann & Kellmann, 2004; Gagné & Deci, 2005; Hobfoll, 2001). Beckers et al. (2008), for instance, found that working overtime voluntarily results in lower levels of exhaustion even when not externally compensated. Similarly, Trougakos et al. (2014) found that working during one's lunch break was less fatiguing if performed with a sense of control over one's lunchtime activities. Furthermore, Pingel et al. (2019) found that engaging in proactive work behaviour can be associated with increased irritability, but only if the proactive behaviour is perceived to be externally motivated.

In the context of voluntary ICT use, perceived control has been suggested as crucial for understanding individual consequences of this behaviour (Schlachter et al., 2018). For instance, having an autonomous motivation to engage in work-related ICT use during nonwork time has been associated with a positive appraisal of this behaviour, which in turn, appeared to be beneficial for positive affective well-being (Reinke & Ohly, 2021). As voluntary ICT use takes place during bespoke nonwork time, we propose to examine the experience of feeling in control *during one's nonwork time* as a resource, thus a resource substitution and buffer of the indirect association between voluntary ICT use and affective well-being. Perceiving control during nonwork time has been found to be positively associated with feeling recovered (Headrick et al., 2023; Sonnentag & Fritz, 2007) and psychological well-being (Headrick et al., 2023; Steed et al., 2021).

Consequently, we propose a conditional indirect effect of voluntary ICT use on affective well-being in the morning via psychological detachment and affective well-being at bedtime, mitigated by the perception of being in control during one's nonwork time:

> **Hypothesis 2 (a, b):.** Perceived control during nonwork time that evening moderates the negative indirect effect of voluntary ICT use on positive affective well-being the following morning (i.e., (a) high-activation pleasant affect, (b) low-activation pleasant affect) via psychological detachment and positive affective well-being at bedtime such that the negative indirect effect is weakened when perceived control is high.

> **Hypothesis 2 (c, d):.** Perceived control during nonwork time that evening moderates the positive indirect effect of voluntary ICT use on negative affective well-being the following morning (i.e., (c) high-activation unpleasant affect, (d) low-activation unpleasant affect) via psychological detachment and negative affective well-being at bedtime such that the positive indirect effect is weakened when perceived control is high.

Replacing lost resources: Sleep quality

COR theory states that resource loss can be offset and loss cycles can be broken by replacing lost resources (Hobfoll, 1989, 2001). As argued, psychological detachment would be an effective way to recover resources during workday evenings, but this process is impeded by voluntary ICT use. Individuals, therefore, require other recovery processes to replace lost resources.

Another fundamental recovery process during nonwork time is sleep (e.g., Barnes, 2012), which is associated with recovery and well-being (Fritz et al., 2022; Litwiller et al., 2017) and effective affect regulation (Sonnentag & Binnewies, 2013; Walker & van der Helm, 2009). Replenishment of self-regulatory resources through sleep is a central mechanism here (e.g., Barnes, 2012; Guarana et al., 2021; Liu et al., 2017). Accordingly, sleep quality is a buffer against the various consequences of depleted self-regulatory resources, including negative affect at work transferring over to negative affect at home the following morning (Sonnentag & Binnewies, 2013), the association between emotional dissonance and reduced psychological well-being (Diestel et al., 2015), or the positive association between customer mistreatment and negative mood (Liu et al., 2017). Furthermore, sleep quality buffers the exacerbating effect of voluntary ICT use on the association between self-regulatory demands at work and feeling one's self-regulatory resources depleted, indicating that a good night's sleep replenishes self-regulatory resources despite engaging in voluntary ICT use (Gombert, Konze, et al., 2018).

We, therefore, posit that sleep quality moderates the carry-over of negatively affected well-being at bedtime to the following morning, with a conditional indirect effect of ICT use on affective well-being the following morning, mediated by psychological detachment and affective well-being at bedtime, mitigated by high-quality sleep:

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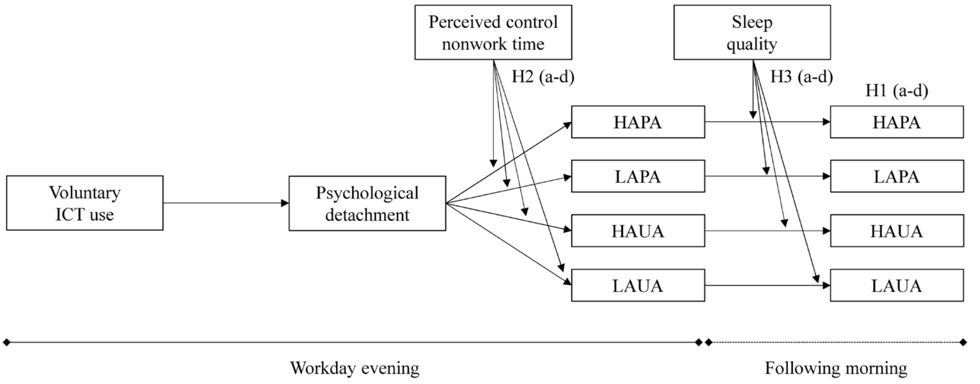

FIGURE 1 Research model. HAPA, high-activation pleasant affect; HAUA, high-activation unpleasant affect; LAPA, low-activation pleasant affect; LAUA, low-activation unpleasant affect.

Hypothesis 3 (a & b):. Sleep quality during the night moderates the negative indirect effect of voluntary ICT use on positive affective well-being the following morning (i.e., (a) high-activation pleasant affect, (b) low-activation pleasant affect) via psychological detachment and positive affective well-being at bedtime such that the negative indirect effect is weakened when sleep quality is high.

Hypothesis 3 (c, d):. Sleep quality during the night moderates the positive indirect effect of voluntary ICT use on negative affective well-being the following morning (i.e., (c) high-activation unpleasant affect, (d) low-activation unpleasant affect) via psychological detachment and negative affective well-being at bedtime such that the positive indirect effect is weakened when sleep quality is high.

Our research model is illustrated in Figure 1.

METHOD

We conducted a daily diary study over five consecutive workdays where participants completed questionnaires in the evening and the following morning. Prior to data collection, the study received a favourable ethical opinion from the University of Surrey ethics committee.

Participants and procedure

We collected data with office-based employees in Germany. We approached participants via (1) an intranet post in the German subsidiaries of a multinational organisation, (2) our professional and personal networks and (3) a German non-commercial scientific panel called SoSci Panels (Leiner, 2016). Participants had to be at least 18 years old, employed in Germany, proficient in German and work predominantly in an office-type setting with the necessary infrastructure to engage in voluntary ICT use. We incentivised participants with a prize draw to win one of five gift vouchers worth 30€ each and, for those participants who completed all diaries, a summary of the study's findings and individual information compared with the whole sample (e.g., level of voluntary ICT use).

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Having received detailed study information and subsequently provided informed consent and demographic data, participants chose a typical workweek to complete the daily diaries[1] and provided a private e-mail address for survey participation, explicitly discouraging them from providing their work e-mail address. In the chosen week starting Monday evening, participants received e-mail invitations during the evening hours to complete the evening diaries around the time they go to bed. On Tuesday morning, they received e-mail invitations during the early morning hours to fill in the morning diaries shortly after awakening. The diaries continued until Saturday morning.

The background questionnaire was completed by 281 individuals, with 241 individuals completing at least one diary. We excluded diaries that were not completed in the correct timeframe (e.g., evening diaries being completed in the morning) and within-person level datasets if participants indicated not having worked that day. We analysed complete evening-morning diary sets only, retaining participants who provided at least two diary sets (Nezlek, 2012b). The final sample consisted of 746 matched evening-morning diary sets of 187 participants (with $M = 3.99$ sets per participant). Participants' average age was 40.2 years ($SD = 10.3$), and 57.8% were female. Participants had 36.9 contractual work hours per week on average ($SD = 5.7$) but reported actual work hours of 41.1 hours per week ($SD = 9.4$). Approximately a third of participants had managerial responsibility (32.6%). Most participants were married, partnered, or cohabiting (70.1%) and had no children under 18 years old living in the household (69.0%).

Measures

If no German scale or existing translation was available, measures were translated into German by the first author and reviewed by the bilingual author team. In order to maintain participants' commitment to the study, the diaries were designed to be as short as possible (Bolger et al., 2003; Ohly et al., 2010). Two-level Cronbach's alpha and omega reliability coefficients were calculated using the approach described by Geldhof et al. (2014).

Voluntary ICT use (evening)

Using ICTs during the evening to perform work-related tasks was operationalised by participant-reported frequency, thus taking a behavioural approach to measuring the extent of voluntary ICT use (Hu et al., 2021). Participants were provided with a list of work-related activities performed with ICTs after leaving work that day (e.g., engaging with work-related e-mails, making work-related calls, using computer software to work on reports), including a definition of what is meant by ‘after work’ (i.e., time that individuals do not consider themselves at work and would not count as work time). They were then asked to rate the frequency of engaging in such activities (or similar activities) on a scale ranging from 1 (*never*) to 5 (*all the time*) during two timeframes: after leaving work before 9 pm and after 9 pm until going to bed. The indicated frequencies for the two timeframes were averaged.[2] A full description of the instructions and measures is provided in the supplemental materials.

[1]‘Typical’ was described as a workweek during which participants spend most of their work time on their employer's premises as usual, have no scheduled days off or days away from the office, and have no contracted on-call hours. We asked participants to avoid workweeks which adjoined to major annual leave (i.e., a full week or more) to avoid pre- and post-vacation biases on well-being (de Bloom et al., 2013; Nawijn et al., 2013).

[2]We chose 9 pm as cut-off time point based on the study by Lanaj et al. (2014), which defined late-night technology use as use after 9 pm. We added the timeframe beforehand to cover the full workday evening, but also leaving the option to analyse the time points separately. Running separate analyses of the model based on the two time points did not change the overall findings and the evaluation of our hypotheses. We, therefore, decided to average the usage frequency over the whole evening.

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Psychological detachment (evening)

Psychological detachment during the evening was measured with four items taken from the *Recovery Experience Questionnaire* (Sonnentag & Fritz, 2007). The items were adapted by Sonnentag et al. (2008) to reflect daily detachment during workday evenings (e.g., 'Tonight, I did not think about work at all'), using a six-point Likert scale ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). Cronbach's alpha was .85 at the within-person level and .98 at the between-person level; within-person omega was .86 and between-person omega was .99.

Momentary affective well-being (evening and morning)

We measured the four quadrants of affective well-being at the time of going to bed and getting up using the *Institute of Work Psychology Multi-Affect Indicator* (Warr et al., 2014). We instructed participants to reflect on their momentary affective well-being. Ratings were given on a scale ranging from 1 (*slightly or not at all*) to 5 (*extremely*). *High-activation pleasant affect* was measured with three items (e.g., 'enthusiastic'; evening: $\alpha_{within} = .68$, $\alpha_{between} = .89$, $\omega_{within} = .69$, $\omega_{between} = .91$; morning: $\alpha_{within} = .68$, $\alpha_{between} = .91$, $\omega_{within} = .68$, $\omega_{between} = .93$)[3] and *low-activation pleasant affect* with four items (e.g., 'relaxed'; evening: $\alpha_{within} = .67$, $\alpha_{between} = .97$, $\omega_{within} = .68$, $\omega_{between} = .97$; morning: $\alpha_{within} = .76$, $\alpha_{between} = .97$, $\omega_{within} = .76$, $\omega_{between} = .97$). Four items were applied to assess *high-activation unpleasant* affect (e.g., 'anxious'; evening: $\alpha_{within} = .72$, $\alpha_{between} = .88$, $\omega_{within} = .72$, $\omega_{between} = .91$; morning: $\alpha_{within} = .61$, $\alpha_{between} = .90$, $\omega_{within} = .63$, $\omega_{between} = .92$) and four items were used to measure *low-activation unpleasant* affect (e.g., 'dejected'; evening: $\alpha_{within} = .76$, $\alpha_{between} = .93$, $\omega_{within} = .78$, $\omega_{between} = .93$; morning: $\alpha_{within} = .68$, $\alpha_{between} = .94$, $\omega_{within} = .69$, $\omega_{between} = .94$).

Perceived control (evening)

We used the *Recovery Experience Questionnaire* (Sonnentag et al., 2008; Sonnentag & Fritz, 2007) to measure perceived control during nonwork time. Participants rated on four items to what extent they felt in control of choosing their activities that evening (e.g., 'Tonight, I felt like I can decide for myself what to do.'), using six-point Likert scales ranging from 1 (*strongly disagree*) to 6 (*strongly agree*). Cronbach's alpha was .81 at the within-person level and .98 at the between-person level; within-person omega was .81 and between-person omega was .98.

Sleep quality (morning)

Sleep quality was measured with one item adapted from the *Pittsburgh Sleep Quality Index* (Buysse et al., 1989; German translation by Hahn et al., 2011). Participants were asked, 'How do you evaluate your last night's sleep?' and could respond on a 5-point scale ranging from 1 (*very poor*) to 5 (*very good*).

Control variables

At the between-person level, we included the collection wave as a binary control variable to account for potential seasonal effects (Golder & Macy, 2011), as some participants completed the

[3]The item 'excited' (German translation: 'aufgeregt'), which was originally part of the high-activation pleasant affect scale, was removed from the scale as an initial confirmatory factor analysis indicated a negative factor loading of this item onto its prescribed factor. It is assumed that the German translation of 'excited' without further context could be interpreted as 'agitated' or 'jittery' in a negative way rather than representing a pleasant affect.

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study in late summer, others during late autumn. At the within-person level, we controlled for day of the week as well-being and recovery had previously been found to vary across weekdays (Rook & Zijlstra, 2006; Sheldon et al., 1996), creating four dummy variables with Monday being the reference day. Furthermore, as work-related stressors have been found to affect psychological detachment and well-being (Sonnentag & Fritz, 2015), we controlled for day-level perceived stress at work with participants rating their experienced stress on a 6-point scale ranging from 1 (*not at all stressful*) to 6 (*very stressful*).

Construct validity

We conducted multilevel confirmatory factor analysis (MCFA) with Mplus 8.11 (L. K. Muthén & Muthén, 1998–2024) to ensure that the focal within-person level measurement scales represent empirically distinct constructs.[4] Based on common standards of model fit (Hsu et al., 2015; L. Hu & Bentler, 1999), the MCFA showed a satisfactory fit of the hypothesised eleven-factor model (χ^2 (1356) = 2103.88, comparative fit index [CFI] = .94, Bayesian information criterion [BIC] = 60715.48, root mean square error of approximation [RMSEA] = .03, standardised root mean residuals $[\text{SRMR}]_{within}$ = .05, $\text{SRMR}_{between}$ = .08). We tested our proposed measurement model against a single-factor model in which all items load on the same factor (χ^2 (1463) = 7326.15, CFI = .56, BIC = 65229.98, RMSEA = .07, SRMR_{within} = .12, $\text{SRMR}_{between}$ = .18). Moreover, we tested it against a model in which the pleasant affect items measured at the same measurement occasion load on one pleasant affect factor, and the unpleasant affect items measured at the same measurement occasion load on one unpleasant affect factor, hence disregarding the differentiation between low and high activation of affect (χ^2 (1423) = 3087.41, CFI = .87, BIC = 61255.83, RMSEA = .04, SRMR_{within} = .05, $\text{SRMR}_{between}$ = .11). Given that our hypothesised model showed a satisfactory and better fit than the alternative models, particularly regarding the models' Bayesian Information Criterion (BIC; Raftery, 1995), we concluded that our within-person level measurement scales represent empirically distinct constructs.

Analysis strategy

Diary data represent repeated measurements which have a hierarchical structure with two levels of analysis: within-person (i.e., day-level) and between-person level (i.e., person-level). The data collected at the within-person level are nested within individuals and, therefore, not independent from each other (Bolger & Laurenceau, 2013; Bryk & Raudenbush, 1992), meaning that variations in outcome variables could be based not only on the participants' daily experiences but also on between-person differences. Violating the assumption of independence of observations has to be factored into the statistical analysis of nested data; otherwise, inferential tests are biased with inflated type I error rates (Hox, 2010; Snijders & Bosker, 2012). Multilevel modelling accounts for the dependent nested structure and enables the partitioning of within- and between-person effects (Snijders & Bosker, 2012) and is thus considered an appropriate statistical analysis technique for diary data (Bolger et al., 2003; Nezlek, 2012a).

We tested our hypotheses using multilevel structural equation modelling (MSEM) in Mplus 8.11 (Muthén & Muthén, 1998–2024). Due to the model's complexity, we used the study variables' means as

[4]To facilitate convergence of this complex measurement model, the following modifications were applied: At the between-person level, we allowed the error variances of the evening well-being items to correlate with the error variance of their morning counterparts (Finkel, 1995). Furthermore, we allowed the error variances of two of the items measuring psychological detachment to correlate, as they are semantically very similar (i.e., 'Tonight, I forgot about work' and 'Tonight, I did not think about work at all'). Finally, at the between-person level, we fixed the error variances of three items to zero as they were negative and non-significantly different from zero to facilitate convergence (Chen et al., 2001; Hox, 2002).

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single indicators for the latent factors to facilitate the model's estimation. In doing so, we adjusted the single indicators' error variances based on their respective sample variance and reliability to account for measurement error (Brown, 2006). Using a single-indicator approach enabled us to partition variables measured at the within-person level and included at the between-person level into latent within- and between-person components (Preacher et al., 2010), as well as to estimate latent interactions (Asparouhov & Muthén, 2021; Zyphur et al., 2019). Drawing on the recommendations by Asparouhov and Muthén (2021) regarding the analysis of multilevel moderated mediations with latent variable interactions, we used Bayesian estimation due to its advantages regarding precision in estimates and ability to handle complex multilevel models (see also Kruschke et al., 2012; Wang & Preacher, 2015). We used Mplus defaults (i.e., non-informative) priors to estimate our model. We report means for point estimates and 95% credibility intervals (CI; specifically, highest posterior density intervals) of the posterior distribution for the relevant parameters (Wang & Preacher, 2015).

We first tested the serial mediation effects without the moderators added to the model (i.e., Model 1; Hypothesis 1). Indirect effects were evaluated by calculating 95% CIs of the indirect effect, with CIs excluding zero indicating significant effects. Subsequently, we added the main effects of the proposed moderators (i.e., daily perceived control during the evening and sleep quality) to the model (i.e., Model 2). For the first two models, we ran 100,000 iterations, of which the first 50,000 iterations were discarded as part of the burn-in phase. Model convergence was indicated by the potential scale reduction being 1.02 (Model 1) and 1.07 (Model 2), respectively (Muthén & Asparouhov, 2012; Zyphur & Oswald, 2015). Lastly, we added the latent interaction terms for daily perceived control during the evening, as well as those for daily sleep quality, to test the hypothesised conditional indirect effects (i.e., Model 3; Hypotheses 2 and 3; Asparouhov & Muthén, 2021). For Model 3, we also ran 100,000 iterations. The potential scale reduction of Model 3 was 1.03, providing support for model convergence (Muthén & Asparouhov, 2012; Zyphur & Oswald, 2015). We calculated the index of moderated mediation based on Hayes (2015) and calculated the conditional indirect effects for low, moderate and high levels of the moderators (i.e., −1*SD*, mean, +1*SD*) to further illustrate these effects. Writing the Mplus codes, we drew on resources provided by Stride et al. (2015). The proposed causal direction of the serial mediation reflects our theoretical framework, which adopts an agentic perspective with voluntary ICT use as the starting point. However, given the study design, alternative causal pathways—including reverse or bidirectional effects—cannot be ruled out.

The following results focus on within-person effects; results of the between-person analyses are available from the corresponding author on request. The code behind this analysis has been made publicly available at the Open Science Framework and can be accessed at https://osf.io/c6dbe/?view_only=357c70548c4649ec8a394f22e0e39534.

RESULTS

Table 1 presents descriptive statistics, intraclass correlation coefficients (ICC1), and zero-order correlations of the study variables. The ICC1 coefficients ranged from .38 to .61, indicating that between 39% and 62% of the total variance in the study variables was accounted for by within-person variance. These values are in line with previously reported amounts of within-person variance in intraindividual constructs in applied research, particularly in terms of affect, sleep and recovery (Podsakoff et al., 2019) and support the necessity for multilevel modelling analysis (Hox, 2010; Snijders & Bosker, 2012).

Test of indirect effects

The results regarding Hypothesis 1, which proposed a serial indirect effect on affective well-being the following morning via psychological detachment and affective well-being the preceding evening, are outlined in Tables 2 and 4 (i.e., Model 1). Voluntary ICT use was negatively associated with psychological

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TABLE 1 Means, standard deviations and correlations among study variables.

Variable	ICC1	*M*	SD_W	SD_B	1	2	3	4	5	6	7
Within-person level											
1. Weekday 1	—	.22	.41	—	—	—	—	—	—	—	—
2. Weekday 2	—	.21	.41	—	−.28***	—	—	—	—	—	—
3. Weekday 3	—	.21	.41	—	−.28***	−.27***	—	—	—	—	—
4. Weekday 4	—	.19	.39	—	−.26***	−.25***	−.25***	—	—	—	—
5. Work-related stress (eve)	—	3.09	1.22	—	.06	.04	−.01	−.08*	—	—	—
6. ICT use (eve)	.44	1.41	.45	.40	.01	−.06	−.06	−.05	.14***	—	−.37***
7. Psychological detachment (eve)	.38	3.77	1.03	.81	−.04	−.00	−.02	.10**	−.32***	−.29***	*.85/.98*
8. Perceived control of nonwork time (eve)	.42	4.52	.76	.64	−.01	−.02	−.02	.12**	−.27***	−.17***	.41***
9. HAPA (eve)	.44	2.08	.62	.55	.04	−.08*	−.03	.06	−.02	−.00	.13***
10. LAPA (eve)	.52	3.11	.55	.57	.09*	−.01	−.09*	.02	−.26***	−.15***	.24***
11. HAUA (eve)	.39	1.47	.44	.35	.02	−.03	.00	−.08*	.23***	.16***	−.23***
12. LAUA (eve)	.44	1.35	.42	.37	−.02	−.01	.00	−.05	.19***	.12**	−.20***
13. Sleep quality (mor)	.38	3.68	.74	.57	−.03	−.07	.01	.11**	−.14***	−.07	.10**
14. HAPA (mor)	.55	2.16	.57	.63	−.08*	−.12**	−.00	.23***	−.10**	−.02	.11**
15. LAPA (mor)	.61	3.14	.54	.67	−.12**	−.14***	−.03	.25***	−.21***	−.08*	.17***
16. HAUA (mor)	.52	1.52	.38	.40	−.09*	.08*	−.01	−.18***	.23***	.13***	−.15***
17. LAUA (mor)	.50	1.29	.33	.33	−.01	.07	−.01	−.12**	.10**	.09*	−.19***
Between-person level											
18. Collection wave	—	1.66	—	.47	—	—	—	—	—	—	—

Variable	8	9	10	11	12	13	14	15	16	17	18
Within-person level											
1. Weekday 1	—	—	—	—	—	—	—	—	—	—	—
2. Weekday 2	—	—	—	—	—	—	—	—	—	—	—
3. Weekday 3	—	—	—	—	—	—	—	—	—	—	—
4. Weekday 4	—	—	—	—	—	—	—	—	—	—	—

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TABLE 1 (Continued)

Variable	8	9	10	11	12	13	14	15	16	17	18
5. Work-related stress (eve)	—	—	—	—	—	—	—	—	—	—	—
6. ICT use (eve)	−.23**	−.02	.01	.15*	.00	−.03	−.01	.01	.05	.01	.06
7. Psychological detachment (eve)	.61***	.21**	.55***	−.61***	−.51***	.21**	.28***	.48***	−.52***	−.46***	.02
8. Perceived control of nonwork time (eve)	*.81/.98*	.14	.46***	−.55***	−.41***	.25***	.15*	.41***	−.45***	−.36***	.00
9. HAPA (eve)	.18***	*.68/.89*	.40***	−.05	−.22**	.12	.82***	.34***	.01	−.18*	−.12
10. LAPA (eve)	.29***	.35***	*.67/.97*	−.56***	−.48***	.36***	.51***	.87***	−.50***	−.47***	−.12
11. HAUA (eve)	−.29***	−.22***	−.56***	*.72/.88*	.75***	−.33***	−.23**	−.56***	.85***	.70***	.04
12. LAUA (eve)	−.22***	−.30***	−.47***	.62***	*.76/.93*	−.37***	−.36***	−.44***	.60***	.94***	.03
13. Sleep quality (mor)	.10**	.05	.08*	−.11**	−.10**	—	.22**	.45***	−.32***	−.43***	−.03
14. HAPA (mor)	.08*	.17***	.14***	−.09*	−.13***	.24***	*.68/.91*	.54***	−.25***	−.34***	−.21**
15. LAPA (mor)	.21***	.11**	.19***	−.19***	−.15***	.28***	.31***	*.76/.97*	−.63***	−.52***	−.19**
16. HAUA (mor)	−.17***	−.10**	−.19***	.32***	.30***	−.25***	−.20***	−.49***	*.61/.90*	.70***	.09
17. LAUA (mor)	−.20***	−.17***	−.26***	.25***	.37***	−.18***	−.29***	−.31***	.46***	*.68/.94*	.04
Between-person level											
18. Collection wave	—	—	—	—	—	—	—	—	—	—	—

Note: $N_B = 187$, $N_W = 746$. Within-person correlations are below the diagonal, and between-person correlations are above the diagonal. Two-level Cronbach's alpha coefficients are reported along the diagonal in italics ($\alpha_{within}/\alpha_{between}$). Weekday 1: Monday compared with Tuesday; Weekday 2: Monday compared with Wednesday; Weekday 3: Monday compared with Thursday; Weekday 4: Monday compared with Friday. Collection wave: 0 = summer, 1 = autumn.

Abbreviations: (eve), measured in the evening; (mor), measured in the morning; HAPA, high-activation pleasant affect; HAUA, high-activation unpleasant affect; ICC1, intraclass correlation coefficient; LAPA, low-activation pleasant affect; LAUA, low-activation unpleasant affect; SD_B, between-person standard deviation; SD_W, within-person standard deviation.

$^*p < .05$. $^{**}p < .01$. $^{***}p < .001$.

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detachment ($\gamma = -.49$, 95% CI [−.73, −.26]), which was, in turn, positively associated with the positive affective well-being measures at bedtime, specifically high-activation pleasant affect ($\gamma = .11$, 95% CI [.05, .17]) and low-activation pleasant affect ($\gamma = .11$, 95% CI [.06, .16]), and negatively with the negative affective well-being measures, namely, high-activation unpleasant affect ($\gamma = -.07$, 95% CI [−.11, −.02]) and low-activation unpleasant affect ($\gamma = -.06$, 95% CI [−.11, −.02]). The indirect effects between ICT use and affective well-being at bedtime via psychological detachment were significant (see Table 3), indicating that voluntary ICT use indirectly reduced affective well-being by reducing psychological detachment. Furthermore, affective well-being measures at bedtime were positively associated with their corresponding affective state the following morning (see Table 4, Model 1), indicating that affective well-being is partially carried over from bedtime to the following morning.

Voluntary ICT use during the evening had a negative serial indirect effect on positive affective well-being measures the following morning, namely, high-activation pleasant affect (estimate = −.010, 95% CI [−.020, −.002]) and low-activation pleasant affect (estimate = −.011, 95% CI [−.022, −.003]), via psychological detachment and the corresponding affective well-being measure the preceding evening. These significant indirect effects support Hypotheses 1a and 1b. These findings indicate that voluntary ICT use reduced positive well-being the following morning by reducing psychological detachment and subsequently positive well-being the previous evening.

Regarding the negative well-being measures the following morning, we found positive serial indirect effects of voluntary ICT use in the evening on high-activation unpleasant affect (estimate = .011, 95% CI [.003, .020]) and low-activation unpleasant affect (estimate = .010, 95% CI [.002, .019]) via psychological detachment and the corresponding well-being measure at bedtime. These findings support Hypotheses 1c and 1d, which proposed that voluntary ICT use in the evening affects affective well-being the following morning by negatively affecting psychological detachment and affective well-being that evening. The serial indirect effects of voluntary ICT use on affective well-being in the morning are summarised in the lower half of Table 3. This indicates that voluntary ICT use increases negative well-being the following morning by reducing psychological detachment, thus subsequently increasing negative well-being the previous evening.

Test of conditional indirect effects regarding perceived control during nonwork time

In addition to the serial indirect effects of voluntary ICT use during the evening on affective well-being the following morning, mediated by reduced psychological detachment and affective well-being at bedtime, we proposed that perceived control would mitigate the paths between psychological detachment and the affective well-being measures at bedtime, thus mitigating the serial indirect effects (Hypothesis 2). As initial support for our proposition, we found significant interaction effects between psychological detachment and perceived control regarding all affective well-being measures at bedtime (see Table 2, Model 3 for details). We then estimated the indices of moderated mediation for the proposed conditional effects and examined the regions of significance for the indirect effects, conditional at the level of perceived control during nonwork time. The indices of moderated mediation are listed in Table 5.

Examining the effect of perceived control on the serial indirect effects between voluntary ICT use and affective well-being measures in the morning via psychological detachment and the corresponding affective state at bedtime, we found significant conditional indirect effects. First, regarding high-activation pleasant affect, the index of moderated mediation indicated a significant conditional indirect effect of voluntary ICT use on morning high-activation pleasant affect (index = .041, 95% CI [.014, .071]). Examining the regions of significance for the indirect effect between ICT use and high-activation pleasant affect (see Figure S1), we found that perceived control weakened the negative indirect effect: the negative indirect effect was only significant and negative for individuals who perceived low to moderate control. If perceived control that evening exceeded −.05 (i.e., with perceived control being mean-centred), the indirect effect became non-significant. In turn, if perceived control further increased and exceeded .50, which is approaching one standard deviation removed from the mean, the

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TABLE 2 Result from Bayesian MSEM for direct path estimates regarding the evening outcomes at the within-person level.

	Dependent variables				
	Model 1				
Independent variables	**PD**	**HAPA (eve)**	**LAPA (eve)**	**HAUA (eve)**	**LAUA (eve)**
Weekday 1	−.05 [−.29, .20]	.01 [−.14, .16]	.10 [−.02, .22]	−.08 [−.18, .02]	−.08 [−.18, .01]
Weekday 2	.01 [−.23, .26]	−.13 [−.28, .02]	−.01 [−.14, .12]	**−.10 [−.21, −.00]**	−.07 [−.17, .03]
Weekday 3	−.05 [−.29, .20]	−.07 [−.22, .08]	−.10 [−.22, .03]	−.07 [−.17, .03]	−.06 [−.16, .04]
Weekday 4	.16 [−.10, .41]	.02 [−.14, .17]	−.03 [−.16, .10]	**−.12 [−.22, −.01]**	−.08[−.18, .02]
Work-related stress (eve)	**−.17 [−.27, −.08]**	.02 [−.04, .08]	**−.06 [−.11, −.01]**	**.07 [.03, .11]**	**.05 [.01, .09]**
ICT use (eve)	**−.49 [−.73, −.26]**	.03 [−.10, .16]	**−.12 [−.24, −.01]**	**.13 [.04, .22]**	.08 [−.01, .17]
PD (eve)		**.11 [.05, .17]**	**.11 [.06, .16]**	**−.07 [−.11, −.02]**	**−.06 [−.11, −.02]**
PC (eve)					
PD × PC (eve)					
Within-person residual variance	.85	.25	.16	.12	.12
Between-person residual variance	.50	.26	.14	.03	.06
Within-person R^2	.01	.08	.17	.18	.13
Between-person R^2	.46	.20	.66	.80	.65
Pseudo R^2_{total}	.18	.13	.42	.42	.36
	Dependent variables				
	Model 2				
Independent variables	**PD**	**HAPA (eve)**	**LAPA (eve)**	**HAUA (eve)**	**LAUA (eve)**
Weekday 1	−.04 [−.28, .20]	−.01 [−.15, .14]	.08 [−.04, .20]	−.06 [−.16, .03]	−.07 [−.17, .02]
Weekday 2	.01 [−.23, .26]	−.14 [−.29, .01]	−.02 [−.14, .10]	−.10 [−.20, .00]	−.06 [−.16, .04]
Weekday 3	−.04 [−.28, .21]	−.08 [−.23, .07]	−.11 [−.23, .01]	−.07 [−.16, .03]	−.05 [−.15, .04]
Weekday 4	.17 [−.09, .42]	.01 [−.17, .14]	−.06 [−.19, .06]	−.09 [−.19, .02]	−.06 [−.16, .04]
Work-related stress (eve)	**−.17 [−.27, −.08]**	.04 [−.02, .10]	−.04 [−.09, .01]	**.06 [.02, .10]**	**.04 [.00, .08]**
ICT use (eve)	**−.51 [−.74, −.28]**	.06 [−.07, .19]	−.10 [−.21, .01]	**.11 [.02, .20]**	.06 [−.02, .15]
PD (eve)		.05 [−.02, .11]	.02 [−.03, .08]	.00 [−.04, .05]	−.00 [−.05, .04]
PC (eve)		**.24 [.14, .33]**	**.28 [.20, .36]**	**−.23 [−.30, −.16]**	**−.20 [−.27, −.13]**
PD × PC (eve)					
Within-person residual variance	.82	.24	.14	.10	.11
Between-person residual variance	.52	.25	.14	03	.05
Within-person R^2	.04	.13	.29	.29	.21
Between-person R^2	.43	.21	.66	.82	.69
Pseudo R^2_{total}	.19	.17	.48	.49	.42
	Dependent variables				
	Model 3				
Independent variables	**PD**	**HAPA (eve)**	**LAPA (eve)**	**HAUA (eve)**	**LAUA (eve)**
Weekday 1	−.02 [−.25, .21]	−.01 [−.16, .13]	.06 [−.05, .17]	−.04 [−.12, .04]	−.05 [−.13, .03]
Weekday 2	.05 [−.18, .30]	**−.15 [−.29, .01]**	−.04 [−.15, .07]	−.08 [−.16, .00]	−.04 [−.12, .04]
Weekday 3	−.00 [−.23, .24]	−.08 [−.22, .07]	**−.13 [−.25, −.02]**	−.03 [−.11, .05]	−.02 [−.11, .06]
Weekday 4	.17 [−.07, .41]	.00 [−.15, .15]	−.06 [−.18, .06]	−.07 [−.15, .01]	−.05 [−.13, .04]
Work-related stress (eve)	**−.16 [−.25, −.07]**	.05 [−.01, .11]	−.00 [−.05, .04]	.01 [−.02, .05]	−.01 [−.04, .03]

(Continues)

TABLE 2 (Continued)

Independent variables	Dependent variables				
	Model 3				
	PD	HAPA (eve)	LAPA (eve)	HAUA (eve)	LAUA (eve)
ICT use (eve)	**−.71 [−.92, −.50]**	.09 [−.04, .23]	−.05 [−.15, .06]	.04 [−.04, .12]	−.01 [−.09, .07]
PD (eve)		.06 [−.01, .14]	**.10[.03, .16]**	**−.08 [−.13, −.03]**	**−.08 [−.14, −.03]**
PC (eve)		**.15 [.04, .26]**	**.16 [.04, .28]**	**−.13 [−.25, −.02]**	−.11 [−.23, .00]
PD × PC (eve)		**−.30 [−.41, −.20]**	**−.49 [−.58, −.40]**	**.55 [.47, .63]**	**.55 [.47, .63]**
Within-person residual variance	.78	.22	.08	.02	.03
Between-person residual variance	.65	.26	.18	.05	.06
Within-person R^2	.09	.21	.57	.85	.78
Between-person R^2	.29	.21	.57	.66	.65
Pseudo R^2_{total}	.17	.21	.57	.78	.72

Note: $N_B = 187$, $N_W = 746$. Unstandardised estimates reported represent the mean of the point estimates of the posterior distribution. Significant estimates based on the Bayesian 95% CI are marked in bold. Weekday 1: Monday compared with Tuesday; Weekday 2: Monday compared with Wednesday; Weekday 3: Monday compared with Thursday; Weekday 4: Monday compared with Friday. Collection wave: 0 = summer, 1 = autumn.

Abbreviations: (eve), measured in the evening; CI, credibility interval (reported in square brackets); HAPA, high-activation pleasant affect; HAUA, high-activation unpleasant affect; LAPA, low-activation pleasant affect; LAUA, low-activation unpleasant affect; PC, perceived control during nonwork time; PD, Psychological detachment.

indirect effect even became significantly positive. This conditional indirect effect supports Hypothesis 2a.

Second, the index of moderated mediation for morning low-activation pleasant affect indicated a conditional indirect effect as well (index = .092, 95% CI [.045, .143]). Examining the regions of significance for the indirect effect between voluntary ICT use and low-activation pleasant affect (i.e., Figure S2), the negative indirect effect was only significant and negative for individuals who perceived low to moderate control. If perceived control that evening exceeded .05, the indirect effect became non-significant. In turn, if perceived control further increased and exceeded .35, the indirect effect even became significantly positive. This supports Hypothesis 2b regarding the mitigating effect of perceived control during nonwork time.

Regarding the negative affective well-being measures, we found conditional indirect effects in the opposite direction. For both the indirect effects of voluntary ICT use on high-activation unpleasant affect and low-activation unpleasant affect, the index of moderated mediation indicated significant conditional indirect effects based on the values of perceived control ($index_{HAUA} = −.139$, 95% CI [−.196, −.086]; $index_{LAUA} = −.133$, 95% CI [−.185, −.083]). Examining the regions of significance for these indirect effects (see Figures S3 and S4), we found that the indirect effects of voluntary ICT use on both measures of negative well-being in the morning were positive for low to moderate perceived control. If perceived control exceeded .05 regarding both measures of negative affect, the indirect effects became non-significant. If perceived control, in turn, exceeded .30 regarding both measures of negative affect, the indirect effects became significantly negative. These patterns support the proposed mitigating effect (Hypotheses 2c and 2d) of perceived control during nonwork time on the positive indirect effect of voluntary ICT use on negative affective well-being measures the following morning.

Test of conditional indirect effects regarding sleep quality

Hypothesis 3 proposed that sleep quality would mitigate the path between affective well-being in the evening and affective well-being the following morning. Partially supporting our proposition, we found significant interaction effects between affective well-being measures at bedtime and sleep quality during that night for high-activation pleasant and unpleasant affect, as well as low-activation unpleasant affect,

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TABLE 3 Within-person (serial) indirect effects based on Bayesian MSEM with credibility intervals.

		Bayesian 95% CI	
	Estimate	**LL**	**UL**
Indirect effects of ICT use on affect at bedtime via psychological detachment			
ICT use ➔ PD ➔ HAPA (evening)	**−.056**	−.098	−.018
ICT use ➔ PD ➔ LAPA (evening)	**−.053**	−.089	−.019
ICT use ➔ PD ➔ HAUA (evening)	**.032**	.008	.058
ICT use ➔ PD ➔ LAUA (evening)	**.031**	.008	.057
Serial indirect effects of ICT use on affect in the morning via psychological detachment and affect at bedtime			
ICT use ➔ PD ➔ HAPA (evening) ➔ HAPA (morning)	**−.010**	−.020	−.002
ICT use ➔ PD ➔ LAPA (evening) ➔ LAPA (morning)	**−.011**	−.022	−.003
ICT use ➔ PD ➔ HAUA (evening) ➔ HAUA (morning)	**.011**	.003	.020
ICT use ➔ PD ➔ LAUA (evening) ➔ LAUA (morning)	**.010**	.002	.019

Note: Unstandardised estimates reported. Significant estimates based on the Bayesian 95% CI are marked in bold.

Abbreviations: CI, credibility interval; HAPA, high-activation pleasant affect; HAUA, high-activation unpleasant affect; LAPA, low-activation pleasant affect; LAUA, low-activation unpleasant affect; LL, lower limit; UL, upper limit.

but not for low-activation pleasant affect (see Table 4, Model 3 for details). Estimating the indices of moderated mediation (see Table 5), we found no conditional indirect effects between voluntary ICT use and the positive affective well-being measures in the morning based on values of sleep quality ($\text{index}_{HAPA} = .010$, 95% CI [−.003, .029]; $\text{index}_{LAPA} = .007$, 95% CI [−.006, .022]). Consequently, Hypotheses 3a and 3b were not supported, as sleep quality did not mitigate the negative indirect effect of voluntary ICT use on positive affect the following morning.

Regarding the negative affective well-being measures the following morning, we found significant indices of moderated mediation, indicating conditional indirect effects based on the values of sleep quality ($\text{index}_{HAUA} = -.015$, 95% CI [−.030, −.002]; $\text{index}_{LAUA} = -.016$, 95% CI [−.030, −.003]). Examining the regions of significance (see Figures S5 and S6), we found that the indirect effects of voluntary ICT use on high-activation and low-activation unpleasant affect the following morning were positive for low to moderately high sleep quality. If sleep quality exceeded .70 regarding both unpleasant affect measures, which represent one standard deviation above the mean, the indirect effects became non-significant. These patterns support Hypotheses 3c and 3d about the mitigating effect of sleep quality on the positive indirect effect of voluntary ICT use on negative affective well-being in the morning.

DISCUSSION

Drawing on COR theory and self-regulation, we proposed that the negative impact of voluntary work-related ICT use on employees' recovery and well-being can be alleviated through substituting and replacing self-regulatory resources. We found a negative indirect effect of voluntary ICT use during workday evenings on positive affective well-being the following morning and a positive indirect effect on negative affective well-being, both (serially) mediated via reduced levels of psychological detachment that evening and affective well-being at bedtime (Hypotheses 1a-d). Daily perceived control during non-work time and sleep quality moderated such indirect effects: Perceived control mitigated the indirect associations between voluntary ICT use and affective well-being in the morning (Hypotheses 2a-d). Sleep quality mitigated the indirect associations between this behaviour and *negative* affective well-being the following morning only, offering partial support for Hypothesis 3 (i.e., Hypotheses 3c and 3d). We now discuss the findings in the light of a more nuanced understanding of ICT use as a volitional activity.

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TABLE 4 Result from Bayesian MSEM for direct path estimates regarding the morning outcomes at the within-person level.

Independent variables	Dependent variables			
	Model 1			
Independent variables	**HAPA (mor)**	**LAPA (mor)**	**HAUA (mor)**	**LAUA (mor)**
Weekday 1	−.07 [−.20, .06]	**−.22 [−.35, −.10]**	.08 [−.01, .17]	−.02 [−.09, .06]
Weekday 2	−.09 [−.22, .05]	**−.23 [−.36, −.11]**	**.10 [.01, .19]**	.04 [−.04, .11]
Weekday 3	.02 [−.11, .16]	−.10 [−.22, .03]	.03 [−.06, .12]	−.02 [−.10, .05]
Weekday 4	**.26 [.12, .40]**	**.16 [.03, .29]**	−.08 [−.17, .01]	−.07 [−.15, .00]
Work-related stress (eve)	−.05 [−.10, .01]	**−.06 [−.11, −.01]**	.02 [−.02, .05]	−.01 [−.04, .02]
ICT use (eve)	−.00 [−.12, .12]	−.02 [−.13, .09]	.04 [−.04, .12]	.01 [−.06, .07]
PD (eve)	.03 [−.03, .08]	.04 [−.02, .09]	.00 [−.04, .04]	**−.04 [−.07, −.00]**
HAPA (eve)	**.18 [.08, .29]**			
LAPA (eve)		**.21 [.92, .33]**		
HAUA (eve)			**.34 [.25, .43]**	
LAUA (eve)				**.33 [.25, .41]**
SQL (mor)				
SQL (mor) × respective affect (eve)				
Within-person residual variance	.20	.18	.06	.05
Between-person residual variance	.08	.11	.04	.01
Within-person R^2	.17	.21	.29	.30
Between-person R^2	.82	.79	.79	.90
Pseudo R^2_{total}	.53	.57	.55	.60
	Dependent variables			
	Model 2			
Independent variables	**HAPA (mor)**	**LAPA (mor)**	**HAUA (mor)**	**LAUA (mor)**
Weekday 1	−.07 [−.20, .06]	**−.22 [−.34, −.10]**	.08 [−.01, .16]	−.02 [−.09, .06]
Weekday 2	−.07 [−.21, .07]	**−.22 [−.34, −.09]**	.09 [−.01, .18]	.03 [−.04, .11]
Weekday 3	.02 [−.11, .16]	−.10 [−.22, .02]	.03 [−.06, .12]	.02 [−.10, .05]
Weekday 4	**.24 [.10, .38]**	**.14 [.01, .26]**	−.07 [−.16, .02]	−.06 [−.14, .01]
Work-related stress (eve)	−.04 [−.09, .02]	**−.05 [−.10, −.00]**	.01 [−.02, .05]	−.02 [−.04, .01]
ICT use (eve)	.01 [−.11, .12]	−.01[−.12, .10]	.04 [−.04, .11]	.00 [−.06, .07]
PD (eve)	.02 [−.04, .07]	.03 [−.03, .08]	.01 [−.03, .04]	**−.03 [−.06, −.00]**
HAPA (eve)	**.18 [.08, .28]**			
LAPA (eve)		**.24 [.12, .35]**		
HAUA (eve)			**.33 [.23, .42]**	
LAUA (eve)				**.34 [.27, .42]**
SQL (mor)	**.17 [.10, .24]**	**.18 [.11, .24]**	**−.11 [−.15, −.06]**	**−.07 [−.10, −.03]**
SQL (mor) × respective affect (eve)				
Within-person residual variance	.18	.17	.06	.05
Between-person residual variance	.07	.10	.04	.01

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TABLE 4 (Continued)

Independent variables	Dependent variables Model 2 HAPA (mor)	LAPA (mor)	HAUA (mor)	LAUA (mor)
Within-person R^2	.22	.29	.34	.34
Between-person R^2	.83	.82	.80	.90
Pseudo R^2_{total}	.56	.61	.58	.62

Independent variables	Dependent variables Model 3 HAPA (mor)	LAPA (mor)	HAUA (mor)	LAUA (mor)
Weekday 1	−.07 [−.20, .06]	**−.22 [−.34, −.10]**	.08 [−.01, .16]	−.01 [−.09, .06]
Weekday 2	−.07 [−.21, .06]	**−.22 [−.34, −.09]**	**.10 [.01, .18]**	.04 [−.04, .11]
Weekday 3	.02 [−.11, .15]	−.10 [−.22, .03]	.03 [−.06, .11]	−.02 [−.09, .05]
Weekday 4	**.23 [.09, .37]**	**.13 [.01, .26]**	.07 [−.16, .02]	−.06 [−.14, .02]
Work-related stress (eve)	−.04 [−.09, .02]	−.05 [−.10, .00]	.01 [−.02, .05]	−.01 [−.04, .02]
ICT use (eve)	.01 [−.10, .13]	−.02 [−.13, .09]	.04 [−.04, .12]	.00 [−.06, .07]
PD (eve)	.04 [−.02, .10]	.04 [−.02, .09]	.00 [−.04, .04]	**−.03 [−.06, −.00]**
HAPA (eve)	**.19 [.09, .29]**			
LAPA (eve)		**.26 [.15, .38]**		
HAUA (eve)			**.36 [.27, .45]**	
LAUA (eve)				**.34 [.27, .42]**
SQL (mor)	**.14 [.06, .22]**	**.17 [.10, .24]**	**−.08 [−.13, −.03]**	**−.05 [−.09, −.01]**
SQL (mor) × respective affect (eve)	**−.24 [−.44, −.03]**	−.10 [−.28, .08]	**−.26 [−.41, −.12]**	**−.26 [−.40, −.12]**
Within-person residual variance	.18	.17	.05	.05
Between-person residual variance	.08	.11	.04	.01
Within-person R^2	.25	.29	.41	.40
Between-person R^2	.80	.79	.77	.93
Pseudo R^2_{total}	.56	.59	.60	.66

Note: $N_B = 187$, $N_W = 746$. Unstandardised estimates reported represent the mean of the point estimates of the posterior distribution. Significant estimates based on the Bayesian 95% CI are marked in bold. Weekday 1: Monday compared with Tuesday; Weekday 2: Monday compared with Wednesday; Weekday 3: Monday compared with Thursday; Weekday 4: Monday compared with Friday. Collection wave: 0 = summer, 1 = autumn.

Abbreviations: (eve), measured in the evening; (mor), measured in the morning; CI, credibility interval (reported in square brackets); HAPA, high-activation pleasant affect; HAUA, high-activation unpleasant affect; LAPA, low-activation pleasant affect; LAUA, low-activation unpleasant affect; PD, Psychological detachment; SQL, sleep quality.

Theoretical contributions

We combine COR theory with the concept of self-regulation to examine how potential loss cycles resulting from voluntary ICT use could be halted on a daily, within-person level. By examining within-person moderators that represent daily processes for self-regulatory resource replacement and substitution, we introduced two effective breaking points at different stages of loss cycles following voluntary ICT use, namely, perceived control and, partially, sleep quality. Psychological detachment can decrease with insufficient self-regulatory resources in the context of voluntary ICT use. Lacking self-regulatory

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TABLE 5 Index of moderated mediation based on Bayesian MSEM with credibility intervals.

		Bayesian 95% CI	
	Index	**LL**	**UL**
Conditional indirect effects of ICT use on affect at bedtime via psychological detachment, moderated by perceived control during nonwork time			
ICT use ➔ PD ➔ HAPA (evening)	**.214**	.121	.310
ICT use ➔ PD ➔ LAPA (evening)	**.348**	.235	.469
ICT use ➔ PD ➔ HAUA (evening)	**−.387**	−.512	−.266
ICT use ➔ PD ➔ LAUA (evening)	**−.389**	−.51	−.266
Serial conditional indirect effects of ICT use on affect in the morning via psychological detachment and affect at bedtime, moderated by perceived control during nonwork time (at mean levels of sleep quality)			
ICT use ➔ PD ➔ HAPA (evening) ➔ HAPA (morning)	**.041**	.014	.071
ICT use ➔ PD ➔ LAPA (evening) ➔ LAPA (morning)	**.092**	.045	.143
ICT use ➔ PD ➔ HAUA (evening) ➔ HAUA (morning)	**−.139**	−.196	−.086
ICT use ➔ PD ➔ LAUA (evening) ➔ LAUA (morning)	**−.133**	−.185	−.083
Serial conditional indirect effects of ICT use on affect in the morning via psychological detachment and affect at bedtime, moderated by sleep quality (at mean levels of perceived control during nonwork time)			
ICT use ➔ PD ➔ HAPA (evening) ➔ HAPA (morning)	.010	−.003	.029
ICT use ➔ PD ➔ LAPA (evening) ➔ LAPA (morning)	.007	−.006	.022
ICT use ➔ PD ➔ HAUA (evening) ➔ HAUA (morning)	**−.015**	−.030	−.002
ICT use ➔ PD ➔ LAUA (evening) ➔ LAUA (morning)	**−.016**	−.030	−.003

Note: $N_B = 187$, $N_W = 746$. Unstandardised estimates reported. Significant estimates based on the Bayesian 95% CI are marked in bold.
Abbreviations: CI, credibility interval; HAPA, high-activation pleasant affect; HAUA, high-activation unpleasant affect; LAPA, low-activation pleasant affect; LAUA, low-activation unpleasant affect; LL, lower limit; PD, Psychological detachment; UL, upper limit.

resources to detach from work and recover negatively affects mood repair, an essential function of recovery (Flaxman et al., 2023; Sonnentag & Fritz, 2007), and therefore, affects affective well-being.

Based on our theoretical framework, we examined two alternative coping strategies to halt the loss cycles triggered by voluntary ICT use: Perceiving control during one's nonwork time was effective for substituting resources lost due to voluntary ICT use and subsequent failure to detach from work. This is in line with Schlachter et al. (2018), who argued for self-managed, autonomous ICT use. Sleep quality had to be relatively high to mitigate a loss cycle triggered the previous evening, and even then, it only mitigated the positive indirect effects of voluntary ICT use on negative affective well-being the following morning. This supports COR theory's corollary that downward spirals of loss cycles require more resources to break the deeper the spiral goes (Hobfoll et al., 2018), which necessitates early intervention. Sleep quality did not mitigate the negative indirect effects of voluntary ICT use on positive affect, but was strongly associated with positive affect directly.

To examine the indirect consequences of voluntary ICT use on well-being, we used the circumplex model of affect (J. A. Russell, 1980, 2003), which captures well-being by considering valence and level of activation. Although this differentiation is supported by both theory and our confirmatory factor analysis, the results did not vary substantially based on the two circumplex axes: Both positive and negative affect, as well as high and low levels of activation, were similarly indirectly affected by voluntary ICT use via reduced psychological detachment. We conclude from this that voluntary ICT use has a comprehensive impact on affective states during nonwork time, emphasising its potential role as a loss cycle starting point.

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Our neutral perspective on voluntary ICT use as an active resource investment for work during nonwork time could explain the double-edged nature of this behaviour, namely, that it is beneficial for work-related goals, at least short-term, but that it can negatively affect recovery from work and well-being (cf. Flaxman et al., 2023; Michaelides et al., 2024). We emphasised employees as active agents (Farivar et al., 2023), in contrast to previous framings as passive work-related demands impeding recovery and well-being (Schlachter et al., 2018; Thörel et al., 2022).

Psychological detachment has traditionally been conceptualised as a passive recovery process that occurs automatically when individuals disengage from work and engage in nonwork activities (Karabinski et al., 2021; Sonnentag & Niessen, 2020). This perspective aligns with the *effort-recovery model* (Meijman & Mulder, 1998), which posits that recovery begins once work demands cease, allowing the psychophysiological system to return to baseline. In contrast, we adopt a more active perspective, considering psychological detachment as a self-regulatory process in which individuals deliberately shift attention away from work (Beckmann & Kellmann, 2004; Sonnentag & Niessen, 2020; Zijlstra et al., 2014). While psychological detachment serves as an effective coping strategy for resource loss, it requires self-regulatory resources, which may be depleted after investing them in voluntary ICT use. This active perspective is a more recent development in recovery research based on COR theory, proposing active resource replenishment through resource investment (Karabinski et al., 2021). Both perspectives are complementary, not mutually exclusive, with contextual and individual factors affecting the effort required to detach (Karabinski et al., 2021; Sonnentag & Niessen, 2020).

Limitations and future research

First, all study variables were measured through self-report measures as appropriate for the operationalised constructs. However, they could be affected by same-source bias, which we partially counteracted by using differing response formats for independent and dependent variables (Podsakoff et al., 2003). Future research could measure ICT use by objective technological means, such as tracking applications installed on devices, provided the practicalities of varying devices and operating systems can be addressed.

Second, we acknowledge the German research setting marked by a work ethic of 'work hard, play hard', where individuals tend to work productively and then enjoy their nonwork time undisturbed by work-related matters (e.g., Bader et al., 2018; Eurofound, 2017). The large majority of employees in Germany do not expect to be available for work during their nonwork time and are rarely contacted (Arnold et al., 2015; Brauner et al., 2022). Indeed, the frequency of voluntary ICT use was relatively low, yet significant associations between voluntary ICT use, recovery and well-being on a daily, within-person level as well as moderators of these effects were extant, indicating identifiable effects even for a sample with low ICT use. Future replication in a different context with more salient ICT use expectations during nonwork time or different work cultures would be a strong test of the research model.

Although our diary approach enabled us to investigate the dynamics of voluntary ICT use, recovery and well-being at a daily level, most of the data was collected at the same time point (i.e., when going to bed), meaning that reverse causal or bidirectional relationships are possible and cannot be ruled out with this present study design. Given that self-regulation is a dynamic process with regulatory resources being continuously invested and replenished, it is challenging to empirically pinpoint the starting point of a resource loss cycle. In this paper, we addressed the loss cycle starting from the act of voluntary ICT use. However, it should be considered that engaging in ICT use could itself be a consequence of depleted self-regulatory resources. For instance, Heissler et al. (2022) argued and empirically found that voluntary ICT use is the behavioural consequence of a lack of psychological detachment as a means of finding closure for work-related thoughts and completing unfinished tasks (Heissler et al., 2022; Weigelt & Syrek, 2017). Our theoretical argument, drawing on COR theory and self-regulation, coupled with the theoretical argumentation by Heissler et al. (2022), could be considered jointly, pointing towards an intertwined, self-perpetuating relationship between voluntary ICT use and psychological detachment: Engaging in voluntary ICT use drains self-regulatory resources required for psychological detachment. Lacking resources to detach could, in turn, result in the inability to resist engaging in work-related activities by using ICTs. Furthermore, an inability to detach from work could also be the result of manifold work-related demands, which have drained employees' self-regulatory resources throughout the workday, not just voluntary ICT use during nonwork time (Germeys & de Gieter, 2018; Koch et al., 2024; Sonnentag & Fritz, 2015).

Another avenue for future research is the valence of psychological detachment, given that previous studies have differentiated between positive and negative ways to think about work during nonwork time with varied consequences for recovery and well-being (e.g., Meier et al., 2016; Querstret & Cropley, 2012). Affective rumination (i.e., thinking about work in a way that is negatively loaded; Cropley & Zijlstra, 2011) could be the consequence of drained self-regulatory resources and negatively affect well-being (Martin & Tesser, 1996). Problem-solving pondering (i.e., thinking about work with a problem-focused lens that can be perceived positively; Cropley & Zijlstra, 2011) could be a further resource investment that might result in positive work-related experiences, such as completing a work-related task, thus supporting recovery and well-being (Eichberger et al., 2022; Weigelt & Syrek, 2017).

Practical implications

We argue for a balanced perspective where voluntary ICT can even be beneficial for employees if enacted consciously, self-managed and in moderation (Farivar et al., 2023; Ren et al., 2023). We thus caution against legislative and policy efforts through managed ICT mandates by organisations and governments which undermine individuals' flexibility and control over when and where to engage in work, thus blocking its potential benefits (Agolli & Holtz, 2023).

Organisational training programmes and awareness raising could strengthen a mindset of active control through reflective exercises, self-observation and other methods to develop more intentional and considered ICT crafting behaviours to pre-empt loss cycles, establishing personal boundaries and mechanisms such as separate devices for work and nonwork. Doing so would allow cognitive as well as spatial boundaries (Kreiner et al., 2009; Thornton et al., 2014).

While individuals are ultimately responsible for managing their own voluntary ICT use, this also requires organisational support. Ollier-Malaterre et al. (2019), for instance, stressed that individuals need to acquire 'digital cultural capital' (p. 427); that is, skills for technology management at work, supported through organisational training programs including digital etiquette and communicating expectations and availability (Agolli & Holtz, 2023; Russell et al., 2024). Organisations should establish a culture that emphasises individuals' decision latitude over how to engage in voluntary ICT use, where line managers thoughtfully manage expectations and social norms (Kühner et al., 2023; Piszczek, 2017) to protect work-nonwork boundaries (Park et al., 2020; Piszczek, 2017).

Finally, the findings stress the need for good sleep quality, which can be improved by good sleep hygiene, including routinely early bedtimes, avoiding caffeine in the evening and having a cool-temperate bedroom (Barnes, 2011) and mindfulness practice (Hülsheger et al., 2015).

CONCLUSION

Although work-related ICT use during nonwork time is voluntary for many employees and a potential resource investment into work, this behaviour drains self-regulatory resources required for psychologically detaching from work, thus impeding recovery and affective well-being through resource loss cycles. These need to be halted and resource balance restored to enable work- and nonwork-related functioning. Taking a resource perspective and using a daily diary design, we examined these mechanisms as well as two breaking points for loss cycles, namely, perceived control during nonwork time and sleep

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quality. Combining daily self-regulatory processes in the context of voluntary ICT use, recovery and well-being with within-person approaches to substituting and replacing self-regulatory resources has enabled us to identify two possible ways of mitigating loss cycles, thus enabling individuals to engage in voluntary ICT use when needed while buffering negative impacts on well-being.

AUTHOR CONTRIBUTIONS

Svenja Schlachter: Conceptualization; investigation; funding acquisition; writing – original draft; methodology; visualization; writing – review and editing; formal analysis; project administration; data curation; resources. **Ilke Inceoglu:** Conceptualization; methodology; supervision; resources; project administration; writing – original draft; writing – review and editing. **Almuth McDowall:** Conceptualization; methodology; supervision; resources; project administration; funding acquisition; writing – original draft; writing – review and editing. **Mark Cropley:** Conceptualization; methodology; project administration; resources; supervision; writing – review and editing.

ACKNOWLEDGEMENTS

This work was supported by the Economic and Social Research Council [grant number ES/J5000148/1]. This study is based on parts of Svenja Schlachter's doctoral dissertation. Part of the data was presented at the 13th European Academy of Occupational Health Psychology Conference 2018, Lisbon, Portugal. Open access funding is enabled and organised by Projekt DEAL.

CONFLICT OF INTEREST STATEMENT

None of the authors has a conflict of interest to disclose.

DATA AVAILABILITY STATEMENT

The data used in this research is not readily available, as the participants have not been asked for consent to share the data publicly. Requests to gain access to the data should be directed to the corresponding author.

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Data S1.

How to cite this article: Schlachter, S., Inceoglu, I., McDowall, A., & Cropley, M. (2025). Work-related technology use during nonwork time and its consequences: A resource-oriented perspective. *Journal of Occupational and Organizational Psychology*, *98*, e70047. https://doi.org/10.1111/joop.70047

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