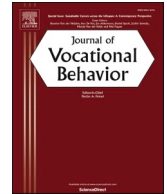




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journal homepage: [www.elsevier.com/locate/jvb](http://www.elsevier.com/locate/jvb)Technology-assisted supplemental work: A meta-analysis<sup>☆</sup>Clara Kühner<sup>a,b,\*</sup>, Cort W. Rudolph<sup>c</sup>, Daantje Derks<sup>d</sup>, Melina Posch<sup>a</sup>, Hannes Zacher<sup>a</sup><sup>a</sup> Wilhelm Wundt Institute of Psychology, Leipzig University, Germany<sup>b</sup> Department of Media and Communication, Ludwig-Maximilians-Universität München, Germany<sup>c</sup> Department of Psychology, Wayne State University, United States of America<sup>d</sup> Department of Psychology, Education & Child Studies, Erasmus University Rotterdam, the Netherlands

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## ABSTRACT

Due to the increasing digitalization and connectivity of work, more and more employees engage in technology-assisted supplemental work (TASW). TASW refers to the performance of work-related tasks after regular work hours with the aid of technological tools. Based on a conceptual model of TASW, we present a comprehensive meta-analysis of potential antecedents and outcomes of TASW ( $K = 89$  independent samples,  $N = 39,085$  employees). Results showed that TASW is associated with social normative work context characteristics, such as availability expectations after work ( $\bar{\rho} = 0.45$ ), and work characteristics, such as job demands ( $\bar{\rho} = 0.32$ ). Associations were also found between TASW and person characteristics, such as work identity ( $\bar{\rho} = 0.35$ ) and segmentation preference ( $\bar{\rho} = -0.20$ ). Moreover, TASW is related to important employee outcomes, including recovery-related outcomes, such as psychological detachment ( $\bar{\rho} = -0.38$ ); well-being outcomes, such as job strain ( $\bar{\rho} = 0.12$ ); nonwork-related outcomes, such as work nonwork conflict ( $\bar{\rho} = 0.32$ ); as well as attitudinal and performance-related outcomes, such as organizational commitment ( $\bar{\rho} = 0.16$ ) and work performance ( $\bar{\rho} = 0.27$ ). We also found TASW to be related to certain demographic characteristics, such as male gender ( $\bar{\rho} = 0.11$ ) and job-level ( $\bar{\rho} = 0.23$ ). Exploratory moderator analyses further revealed that gender moderated the relationship between job demands and TASW, such that the relationship was weaker for samples with a higher percentage of females. We conclude by discussing potential directions for future research to advance the understanding of TASW.

## 1. Introduction

Due to greater digitalization and higher connectivity, engaging in work-related activities at home after regular work hours has become common for a large part of the workforce (Đuranová & Ohly, 2015). According to the sixth European Working Conditions Survey (Eurofound, 2017), 20 % of European employees work during their free time several times a month to meet work demands. In response to these ever-increasing prevalence rates, the construct *technology-assisted supplemental work* (TASW) has gained growing

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\* Corresponding author at: Department of Media and Communication, Ludwig-Maximilians-Universität München, Akademiestraße 7, 80799 Munich, Germany.

E-mail address: [clara.kuehner@ifkw.lmu.de](mailto:clara.kuehner@ifkw.lmu.de) (C. Kühner).

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attention in vocational behavior research and practice (Ďuranová & Ohly, 2015; Schlachter et al., 2018). TASW has been defined as the performance of “role-prescribed tasks at home after regular work hours with the aid of technological tools” (Fenner & Renn, 2010, p. 63). This definition includes work conducted via communication devices such as smartphones and laptops, as well as via technologies such as e-mail, instant messaging services, and video conference tools. TASW can either be initiated by oneself (e.g., checking e-mails before bedtime) or by others (e.g., accepting an incoming call during dinner). Numerous different construct labels and operationalizations of TASW exist (Eichberger & Zacher, 2021), for instance the highly similar phenomena of “daily work related smartphone use during off-job time” (Derks et al., 2016, p. 1045) and “working through information and communication technologies after hours” (Ma et al., 2016, p. 48). As TASW is a well-established concept in the literature and in empirical studies (Ďuranová & Ohly, 2015), we use this term to avoid construct proliferation. However, we included all studies assessing constructs that met the TASW definition in our meta-analysis, regardless of their specific labeling or operationalization.

TASW can be differentiated from similar, yet distinct constructs. Because TASW is limited to work performed with the assistance of technology (Fenner & Renn, 2010), the construct differs from the concept of *supplemental work* (Venkatesh & Vitalari, 1992), which may include performing work tasks without technological tools (e.g., marking paper-and-pencil exams). Due to the increased digitization of work in multiple professions, most knowledge work is now conducted via technology, which is why the number of studies dealing with TASW outnumber studies on supplemental work by far. However, to ensure the comprehensiveness of this meta-analysis, we included studies dealing with supplemental work as part of supplemental analyses. TASW further differs from *extended availability requirements*, such as on-call work (Bamberg et al., 2012) or organizational expectations to be available after-hours (Dettmers et al., 2016). Whereas these constructs represent an experience and must not necessarily result in action (e.g., because employees are not contacted), TASW clearly entails an actual behavior (i.e., the performance of work-related tasks after regular work hours). TASW can also be distinguished from *telecommuting*, which is defined as performing a part of usual work hours away from the workplace, typically from home, via ICTs (Allen et al., 2015). Whereas telecommuting takes place during “typical work hours” (Allen et al., 2015, p. 44), TASW is performed “after regular work hours” (Fenner & Renn, 2010, p. 63). Finally, TASW also differs from *long working hours* or *overtime*. Overtime is a broader construct that also covers commuting, work-related travel, and working late in the office (Wong et al., 2019).

There are meta-analyses on constructs similar to, but distinct from, TASW, including telecommuting (Gajendran & Harrison, 2007), extended availability (Thörel et al., 2022), and overtime (Wong et al., 2019). The current meta-analysis informs vocational behavior research beyond the findings of these prior meta-analyses. First, none of the prior meta-analyses considers potential antecedents of the constructs under investigation. By including various antecedents of TASW in our conceptual model and meta-analysis, we contribute to the literature that seeks to predict work-related behaviors shown outside of regular work hours and locations. Second, because TASW differs from telecommuting, extended availability, and overtime in various aspects, different relationships with potential outcomes can be expected. For example, telecommuting has been found to be associated with lower work-family conflict and less perceived stress.

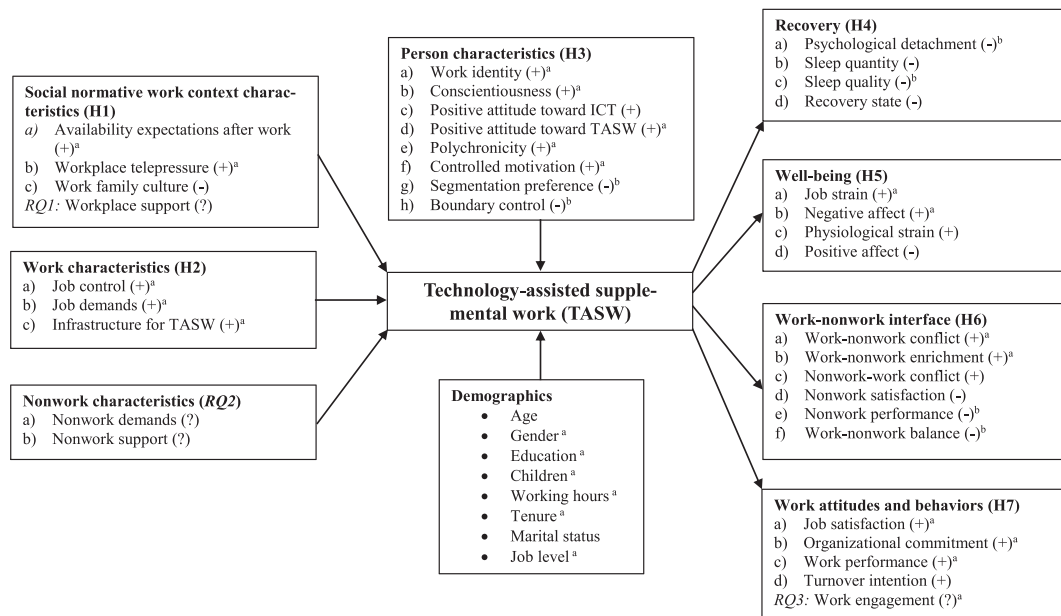


Fig. 1. Conceptual model.

Note. The hypothesized directions of the relationships between TASW and the respective correlates are indicated in parentheses: (+) = positive relationship hypothesized; (-) = negative relationship hypothesized; (?) = direction of relationship not specified for research questions. We did not formulate hypotheses for demographic variables. Meta-analytic results are indicated via subscript letters (a = significant positive relationship; b = significant negative relationship). Variables without a subscript letter were not significantly related to TASW. Coding of demographics: gender: 0 = female, 1 = male; marital status: 0 = not married, 1 = married. Age, education, children, working hours, tenure, and job level are coded such that higher values indicate higher levels of the respective variable.

Whereas telecommuting is conducted *during* regular work hours, TASW takes place *outside* of regular work hours. Thus, TASW is more likely to cause interferences with nonwork life and stress. Additionally, technology-use has been associated with impaired recovery via blue-light emission (e.g., [Chellappa et al., 2013](#)). Relationships with recovery and well-being outcomes, respectively, might thus be stronger for TASW than for overtime, which does not necessarily include technology-use. Overall, a meta-analysis on the most important conceptual antecedents and outcomes of TASW constitutes an important addition to the literature on the work-nonwork interface.

Two earlier *qualitative* literature reviews summarized studies on TASW ([Ďuranová & Ohly, 2015](#); [Schlachter et al., 2018](#)). However, a considerable amount of research on the topic was conducted after these two reviews were published. In fact, 36 of the 77 studies included in the current meta-analytic review were published between 2018 and 2022. Studies on potential antecedents and outcomes of TASW have accumulated over the last decade, and TASW has also gained increasing attention in legislation (e.g., [European Parliament, 2021](#)) and organizational policy making ([Eurofound, 2021](#)). The strong scientific and societal interest in antecedents and outcomes of TASW highlights the importance of an integrative overview of the current state of research. The overarching goal of this paper, therefore, is to provide such an overview. The theoretical foundation for our conceptual model ([Fig. 1](#)) is an integrative conceptual framework on voluntary work-related technology use during nonwork-time, based on theoretical and empirical arguments presented by [Schlachter et al. \(2018\)](#).

We aim to contribute to vocational behavior research and practice in several meaningful ways. First, we quantitatively synthesize empirical evidence across studies and disciplines to identify associations between TASW and both relevant and commonly investigated potential antecedents and outcomes. Second, we extend the model on work-related technology use during nonwork-time by [Schlachter et al. \(2018\)](#). Specifically, we add categories of conceptual antecedents (i.e., nonwork characteristics) and outcomes (i.e., work attitudes and behaviors) of TASW to the model and meta-analytically examine these relationships. Additionally, we test relationships between several demographic variables and TASW. Third, based on our meta-analytic results, we identify directions for future research on TASW and make several suggestions on how to advance understanding of this topic. Fourth, as meta-analytic techniques enable us to estimate the true magnitude of relationships more accurately, specific recommendations for organizational practice can be formulated. Specifically, information on those potential antecedents and outcomes that have the strongest associations with TASW allows for the design of effective interventions and policies and can guide organizations in deciding which interventions are worth investing in.

## 2. Theoretical background and hypothesis development

In their conceptual framework, [Schlachter et al. \(2018\)](#) call their key construct “voluntary work-related technology use during nonwork-time” (p. 825). The attribute “voluntary” is not part of [Fenner and Renn’s \(2010\)](#) conceptualization of TASW, which we use in this meta-analysis. Rather, TASW involves all work-related behaviors after regular work hours regardless of the degree of voluntariness. [Schlachter et al. \(2018\)](#) define their key construct as “ICT [information and communication technology] use outside regular work hours and away from regular work premises with the purpose of performing work-related tasks and communications” (p. 826). Because this mirrors our understanding of TASW, we consider their conceptual framework a good starting point for hypothesis development. [Schlachter et al. \(2018\)](#) consider three potential antecedent categories of ICT use, namely (a) social normative context variables, (b) job-related characteristics and work processes, and (c) person characteristics. Additionally, they categorize potential outcomes in three groups, namely, (a) work-life interface, (b) well-being, and (c) recovery processes.

Our preregistered conceptual model largely reflects the model by [Schlachter et al. \(2018\)](#). However, there are also three minor differences (see [Fig. 1](#)). First, we added nonwork characteristics as potential antecedents of TASW. Engaging in TASW is a form of boundary-crossing behavior in the sense of boundary theory ([Allen et al., 2014](#)), as it is an activity from the work domain performed in the nonwork domain. Therefore, characteristics from both domains, work and nonwork, are likely to relate to TASW behavior.

Second, we included work attitudes and behaviors as potential outcomes of TASW. We did so because previous research repeatedly showed that work-related thinking during recovery periods, which is a mandatory part of TASW, is significantly associated with work behaviors like job performance and work engagement (e.g., [Liu et al., 2020](#); [ten Brummelhuis & Bakker, 2012](#)). During our literature search, we found a considerable body of research on the relationships between TASW and both, nonwork characteristics and work attitudes and behaviors.

Third, in accordance with other meta-analyses dealing with work-nonwork boundary phenomena (e.g., [Wendsche & Lohmann-Haislah, 2017](#)), we considered eight demographic variables as potential correlates of TASW as part of exploratory analyses.

We conceptually organized the constructs investigated in this meta-analysis into 17 antecedents and 19 outcomes of TASW (see [Fig. 1](#)). While we theoretically assume causal effects, we cannot test them empirically because most studies used for this meta-analysis rely on cross-sectional designs. Consistent with best methodological practice ([Rudolph et al., 2020](#)), we only included constructs that were investigated in three or more independent samples. Please note that we preregistered our model, hypotheses, and methods in the Open Science Framework (OSF).<sup>1</sup>

### 2.1. Social normative work context characteristics (H1)

As for social normative work context characteristics, we expect availability expectations after work and workplace telepressure to be positively related to TASW and work family culture to be negatively associated with TASW. High expectations from within the

<sup>1</sup> Available at <https://osf.io/52jbk/>.

organization regarding availability after work might pressure employees into engaging in TASW (Derks et al., 2015). Relatedly, high workplace telepressure, which is defined as the “combination of a strong urge to be responsive to people at work through messages-based ICTs with a preoccupation with quick response times” (Barber & Santuzzi, 2015, p. 172), could make employees feel obliged to engage in TASW. In line with social learning theory (Bandura, 1986), employees are likely to observe high responsiveness and after-hours availability among their colleagues and will probably comply with the group norm by engaging in TASW. These assumptions are supported by research finding a positive association between availability expectations after work and workplace telepressure, respectively, and TASW (e.g., Barber & Santuzzi, 2015). Furthermore, the organizational culture regarding the compatibility of work and family might influence employees’ TASW behavior. In case of an organization with supportive work-family culture (e.g., supporting employees in separating work and family domains), employees might feel encouraged to “switch off” their ICTs after-hours. In fact, research has found that the organizational resources supplied to enable separation of life domains were negatively related to TASW (e.g., Derks et al., 2014).

We propose a research question regarding the association between workplace support and TASW because there is no clear theoretical rationale for the direction of the relationship, as well as mixed empirical evidence. Yet, we consider it important to gain clarity because a better understanding of how workplace support is related to TASW allows for the implementation of more specific interventions. According to the job demands-resources model (Bakker & Demerouti, 2007), workplace social support is an important job resource that fosters work motivation. Highly motivated employees, in turn, might be more likely to invest extra time into work by engaging in TASW. On the other hand, when experiencing high workplace support, employees might rely on their colleagues in helping them to finish tasks, which, in turn, would prevent them from investing extra time into work via TASW. Previous research presents mixed results regarding the relationship between workplace support and TASW (e.g., Senarathne Tennakoon, 2011).

**Hypothesis 1.** (a) Availability expectations after work and (b) workplace telepressure are positively, and (c) work-family culture is negatively related to TASW.

**Research Question 1.** How is workplace support related to TASW?

## 2.2. Work characteristics (H2)

We expect job control and job demands to be positively related to TASW. Employees who have more influence on when, where, and how to conduct their work (i.e., high job control), should be more likely to work outside the temporal or spatial boundaries of the office, thus engaging in TASW. Schlachter et al. (2018) suggest that when employees feel in control over their work, they are more open to engage in TASW. This is in line with broader research suggesting that job control is a job resource that fosters work motivation (Bakker & Demerouti, 2007). Regarding job demands, employees facing high demands (e.g., high workload, time pressure) might try to get ahead of things by engaging in TASW. This is in line with research showing that job demands can release motivational energy (Kühnel et al., 2012). When demands are low, however, they can be met during “normal” working hours, making additional work after regular work hours unnecessary. Several studies have provided evidence for positive relations between job control (e.g., Xie et al., 2018) and job demands (e.g., Gadeyne et al., 2018), respectively, and TASW.

We expect infrastructure for TASW to be positively related to TASW. Organizations differ in terms of the technical and digital infrastructure provided for working outside the workplace. This includes adequate technological equipment, remote access to organizational networks, and the distribution of ICTs by the employer. We propose that the lower the practical barriers for TASW (i.e., the better the infrastructure), the more likely employees will engage in TASW. Consistent with this proposition, research has found positive relationships between different aspects of TASW infrastructure and TASW (e.g., Richardson & Benbunan-Fich, 2011).

**Hypothesis 2.** (a) Job control, (b) job demands, and (c) infrastructure for TASW are positively related to TASW.

## 2.3. Nonwork characteristics (RQ2)

It is theoretically and empirically unclear how nonwork characteristics are associated with TASW. We therefore propose research questions regarding the associations between nonwork demands and nonwork support, respectively, and TASW. Dealing with high nonwork demands (e.g., household activities, childcare) deprives employees of resources (e.g., time and energy resources in the sense of conservation of resources theory; Hobfoll et al., 2018). As a result, employees can probably mobilize fewer resources to engage in TASW. On the other hand, high nonwork demands could come with more interruptions during working hours (e.g., incoming calls from family members), leaving employees with more unfinished tasks at the end of the working day (Baethge & Rigotti, 2013). In turn, employees might feel the need to engage in TASW to accomplish their tasks. Empirical evidence is mixed as well. For example, Chen and Karahanna (2014) found a positive association between nonwork load and TASW, whereas there was no significant association between home demands and TASW in a study by Gadeyne et al. (2018).

Nonwork support is an important resource (Hobfoll et al., 2018) that, in line with the motivational path of the job demands-resources model (Bakker & Demerouti, 2007), can encourage extra work efforts. Thus, when experiencing high nonwork support, employees could be more motivated to engage in TASW. Additionally, high nonwork support (e.g., help with household activities), might provide employees with more opportunities to engage in TASW because others (e.g., spouse) cover their nonwork obligations. Alternatively, employees experiencing high nonwork support might feel obliged to reciprocally support their nonwork environment and might therefore dedicate after-hours time to family and friends instead of TASW. Empirical results on these associations are mixed. There is evidence for a positive association between family support and TASW (Wang et al., 2017), but no significant relationship was

detected between general social support and TASW (Eichberger et al., 2021).

**Research Question 2.** How are (a) nonwork demands and (b) nonwork support related to TASW?

#### 2.4. Person characteristics (H3)

We expect work identity and conscientiousness to be positively related to TASW. Schlachter et al. (2018) argue that employees who identify strongly with their work (i.e., high work identity; Kossek et al., 2012), might engage in TASW to show commitment and get ahead in their career. As for conscientiousness, people scoring high on this trait are described as reliable (McCrae & John, 1992). Meta-analytic evidence further suggests that conscientiousness is especially important for the accomplishments of work tasks and vocational achievement (Barrick & Mount, 1991). Thus, people with high levels of conscientiousness may engage in TASW because it is congruent with their tendency to be reliable and ambitious. There is empirical evidence for positive links between work identity and conscientiousness, respectively, and TASW (Barber & Santuzzi, 2015).

We expect positive attitudes toward ICT, positive attitudes toward TASW, and polychronicity to be positively associated with TASW. Albeit widespread, ICTs are not considered as equally useful by all employees. Building on the technology acceptance model (TAM; Davis, 1989), a theory explaining user acceptance of information systems, the attitude toward TASW might be an important antecedent of TASW (Fenner & Renn, 2010). More specifically, when employees have a positive attitude toward ICTs in general and TASW in particular, they will have stronger intentions to use this technology and, in turn, engage in TASW more often (Schlachter et al., 2018). As for polychronicity, which is an individual's preference to perform several tasks simultaneously (Bluedorn et al., 1999), employees with higher levels are more likely to blur boundaries between work and leisure time (Benabou, 1999). They may therefore engage in TASW more often because it matches their preferences (e.g., checking emails while having dinner). There is empirical evidence for positive relationships between positive attitudes toward ICT (Fenner & Renn, 2010), positive attitudes toward TASW (Schmoll, 2019), and polychronicity (Richardson & Benbunan-Fich, 2011), respectively, and TASW.

We expect controlled motivation for TASW to be positively related to TASW. According to self-determination theory (Ryan & Deci, 2000), motivation for certain behaviors can be classified on a continuum ranging from autonomous (i.e., engaging in activities because it is pleasant or personally important) to controlled motivation (i.e., engaging in activities because of external threats or standards). We propose that employees who feel high external pressure to engage in TASW (i.e., controlled motivation) are more likely to engage in TASW. This is supported by studies reporting a positive association between controlled motivation and TASW (Ohly & Latour, 2014; Reinke & Ohly, 2021).

We expect segmentation preference and boundary control, respectively, to be negatively related to TASW. According to boundary theory, employees differ in their preference for segmenting or integrating work and nonwork domains (Ashforth et al., 2000; Clark, 2000). Employees with a high segmentation preference prefer to separate work and nonwork aspects (Kreiner, 2006). Thus, they will be less likely to integrate work into nonwork life by engaging in TASW. Boundary theory further states that employees create psychological, physical, and behavioral boundaries to prevent blurring the lines between work and nonwork domains (Ashforth et al., 2000; Clark, 2000). Research suggests that the higher an employee's boundary control (i.e., "psychological interpretations of perceived control over one's boundary environment"; Kossek et al., 2012, p. 114), the less work-nonwork boundary crossings (e.g., engaging in TASW) occur (Park & Jex, 2011). Accordingly, there is evidence for negative links between segmentation preference (Park et al., 2011) and boundary control (Mellner, 2016), respectively, and TASW.

**Hypothesis 3.** (a) Work identity, (b) conscientiousness, (c) positive attitude toward ICT, (d) positive attitude toward TASW, (e) polychronicity, and (f) controlled motivation are positively, and (g) segmentation preference and (h) boundary control are negatively related to TASW.

#### 2.5. Recovery (H4)

As for recovery outcomes, we expect that TASW is negatively related to psychological detachment and recovery state. Psychological detachment is a state of mentally distancing oneself from job-related thoughts during nonwork time (Sonnentag & Fritz, 2015). According to the stressor detachment model, engaging in TASW is a job stressor that hinders detachment (Sonnentag & Fritz, 2015), because it extends the mental preoccupation with work-related issues during nonwork time and, in turn, limits employees' capacity to "switch off." There is a notable body of research reporting a negative association between TASW and psychological detachment (e.g., Derks et al., 2014). According to the effort-recovery model (Meijman & Mulder, 1998), mentally detaching from work during recovery periods is essential to replenish resources that were depleted by the job. The model further states that recovery can only occur when employees are not exposed to work-related demands during nonwork time. In case demands are continually present (e.g., by engaging in TASW), no recovery can take place. Engaging in TASW interferes with this recovery process by preventing detachment and cutting time for relaxation and recovery activities (e.g., physical exercise, cultural activities; de Bloom et al., 2018). Consistently, TASW has been found to be negatively related to recovery states (Derks & Bakker, 2014).

We expect negative associations between TASW and sleep quantity and quality. Cognitive activation theory (Ursin & Eriksen, 2004) and the allostatic load model (McEwen & Stellar, 1993) suggest that mentally, physically, and emotionally calming down is essential to enable restful sleep. Because engaging in TASW is associated with mental and emotional activation, the behavior could extend sleep latency. Employees might borrow time from sleep to meet work demands via TASW (Barnes et al., 2011), thereby cutting sleeping time. Blue-light emitted by technological devices not only prevents employees from falling asleep, but also suppresses the maintenance of sleep (Chellappa et al., 2013). Moreover, mentally switching off has been found to be associated with higher sleep quality (Hülshager et al., 2014). Because engaging in TASW prohibits switching off and might even trigger unpleasant work-related thoughts, it could further hamper sleep



quality. Indeed, TASW has been found to be negatively related to sleep quantity (Eichberger et al., 2022) and quality (Barber & Jenkins, 2014).

**Hypothesis 4.** TASW is negatively related to (a) psychological detachment, (b) sleep quantity, (c) sleep quality, and (d) recovery state.

## 2.6. Well-being (H5)

We expect that TASW is positively related to job strain. According to the job demands-resources model (Demerouti et al., 2001), job demands are associated with job strain reactions like perceived stress, exhaustion, and burnout. Engaging in TASW can be considered a job demand because it requires mental engagement with work during leisure time and impairs recovery. In turn, it can be associated with more exhaustion and perceived stress, which is also supported by empirical evidence (e.g., Xie et al., 2018).

We further assume that TASW is positively related to negative affect and negatively related to positive affect. According to the stressor-detachment model (Sonnentag & Fritz, 2015), low detachment is associated with more negative affect and less positive affect. Because engaging in TASW impairs psychological detachment, it can be expected to harm affect. Additionally, when spending after-hours with TASW, employees have less opportunities to experience positive emotions during leisure activities. Instead, engaging in TASW might lead to further negative emotions (e.g., reminder of high workload, receiving unpleasant messages). Consistently, research has found a positive relationship between TASW and negative affect (Eichberger et al., 2021) and a negative relationship between TASW and positive affect (Minnen et al., 2021).

We expect TASW to be positively associated with physiological strain. Engaging in TASW inhibits the replenishment of physiological resources (e.g., impairing sleep) and can further trigger psychological stress, which is known to have a negative impact on physical health (American Psychological Association, 2018). Additionally, prolonged ICT use has been associated with physical symptoms such as headaches (Li et al., 2020). There is empirical evidence for a positive relationship between TASW and physiological strain (Minnen et al., 2021).

**Hypothesis 5.** TASW is positively related to (a) job strain, (b) negative affect, and (c) physiological strain, and negatively related to (d) positive affect.

## 2.7. Work-nonwork interface (H6)

Because TASW is a type of boundary-crossing behavior, we expect TASW to be positively related to work-nonwork conflict.<sup>2</sup> Work-family conflict is defined as “a form of interrole conflict in which the role pressures from the work and family domains are mutually incompatible in some respect” (Greenhaus & Beutell, 1985, p. 77). Engaging in TASW during leisure time produces interferences between conflicting roles (i.e., work and nonwork roles). This, in turn, can result in time-based (e.g., time spent on TASW is not available for participation in nonwork roles like quality time with family) and strain-based (e.g., increased tension due to TASW may spill into nonwork life) conflict (Gadeyne et al., 2018). There are many empirical studies identifying a positive relationship between TASW and work nonwork conflict (e.g., Derks et al., 2015).

We further expect TASW to be negatively related to nonwork performance, nonwork satisfaction, and work-nonwork balance. When employees spend leisure time with TASW, they might fail to meet nonwork obligations and miss out on leisure activities. As a result, they could feel less content with their nonwork performance and less satisfied with their nonwork life. Additionally, when leisure time is cut by additional work after regular work hours, this will challenge work-life balance. Studies revealed negative associations between TASW and nonwork performance (Chen & Karahanna, 2014), nonwork satisfaction (Bauwens et al., 2020), and work-nonwork balance (Belkin et al., 2020).

We expect TASW to be positively related to work-nonwork enrichment (i.e., “the extent to which experiences in one role improve the quality of life in the other role.”; Greenhaus & Powell, 2006, p. 73). The model of work-family enrichment (Greenhaus & Powell, 2006) states that resources gained in one role can be associated with high performance in another role. Although TASW can be associated with resource loss (e.g., time), it is conceivable that it is also associated with resource gain (e.g., having a comforting conversation with a colleague), which, in turn, might lead to beneficial crossover effects for nonwork life. Consistently, research found TASW to be positively related to work-nonwork enrichment (Vayre & Vonthron, 2019).

Finally, we expect TASW to be positively related to nonwork-work conflict. When engaging in TASW, disturbances of the working process by nonwork demands are possible. For example, when employees answer emails at home and get interrupted by their children, this may be associated with perceived nonwork-work conflict. Indeed, there is evidence for a positive relationship between TASW and nonwork-work conflict (Senarathne Tennakoon, 2011).

**Hypothesis 6.** TASW is positively related to (a) work-nonwork conflict, (b) work-nonwork enrichment, and (c) nonwork-work conflict, and negatively related to (d) nonwork satisfaction, (e) nonwork performance, and (f) work-nonwork balance.

<sup>2</sup> Different terms have been used to contrast work and nonwork domains (e.g., work-family, work-life, work-home). For this paper, we pool those labels as work-nonwork.

## 2.8. Work attitudes and behaviors (H7)

We expect TASW to be positively related to work performance. [Đuranová and Ohly \(2015\)](#) describe TASW as a “means of goal attainment” (p. 76) that enables “additional work at leisure time” (p. 82). Engaging in TASW extends working hours, which gives employees more time to complete work tasks. [Schlachter et al. \(2018\)](#) further argue that working after regular work hours via ICTs allows employees to use their time more efficiently by dedicating formerly unproductive time to do work (e.g., on the commute). Several studies support a positive relationship between TASW and work performance (e.g., [Heissler et al., 2022](#)).

We further expect TASW to be positively related to organizational commitment and job satisfaction. Organizational commitment is defined as a “psychological state that binds the individual to the organization” ([Allen & Meyer, 1990](#), p. 14). Prolonged connectedness to work-related issues and colleagues via TASW could intensify this state. As for job satisfaction, engaging in TASW increases employees’ flexibility and opportunities to finish tasks and achieve goals, which, in turn, could positively influence their job satisfaction ([Diaz et al., 2012](#)). In line with these assumptions, research has found TASW to be positively related to organizational commitment ([Ferguson et al., 2016](#)) and job satisfaction ([Diaz et al., 2012](#)).

However, we also expect TASW to be positively related to turnover intentions. As outlined, TASW can be associated with negative outcomes (e.g., increased work-nonwork conflict, poor recovery). As a consequential effect, employees might intend to leave their job to find a less demanding work arrangement that allows them to switch off after-hours. [Ferguson et al. \(2016\)](#), for example, found TASW to be associated with increased turnover intentions.

We propose a research question regarding the association between TASW and work engagement because there is no clear theoretical rationale for the direction of the relationship and mixed empirical evidence (e.g., [Carvalho et al., 2021](#); [Vayre & Vonthron, 2019](#)). Work engagement is “a positive fulfilling, affective-motivational state of work-related well-being that is characterized by vigor, dedication, and absorption” ([Bakker et al., 2008](#), p. 187). According to the job demands-resources model ([Bakker & Demerouti, 2007](#)), work engagement can fluctuate over time as a function of job demands and resources. Engaging in TASW can be either perceived as a demand (e.g., threat to work life balance, increased stress) or a resource (e.g., increased flexibility, means to complete unfinished tasks). As a result, it could be negatively or positively related to work engagement, depending on individual perception. Empirical evidence is also mixed.

**Hypothesis 7.** TASW is positively related to (a) job satisfaction, (b) organizational commitment, (c) work performance, and (c) turnover intention.

**Research Question 3.** How is TASW related to work engagement?

## 3. Method

### 3.1. Inclusion criteria

We followed best-practice recommendations ([Wilson, 2019](#)) and defined inclusion criteria in five categories prior to conducting our literature search (see online supplemental material S1). Category “A” specifies the empirical relationships of interest. Because there exist different construct labels and operationalizations of TASW ([Eichberger & Zacher, 2021](#)), we defined two criteria for the operationalizations of work-related activities after regular work hours that had to be met for study inclusion. First, the measure had to assess the actual performance of work-related tasks, either initiated by oneself (e.g., checking e-mails) or by others (e.g., accepting an incoming phone call). Second, TASW had to take place after regular work hours or outside of regular work hours. In cases of mixed scales where only some items fulfilled these two criteria (i.e., actual performance of work and after regular work hours), the respective study was excluded.<sup>3</sup> Besides the alignment with our definition of TASW, studies had to include at least one substantive or demographic variable from our model to qualify for inclusion.

We only included studies based on correlational designs (i.e., either cross-sectional or diary/longitudinal designs) that were either journal articles, book chapters, dissertations or master’s theses, conference papers, or unpublished manuscripts (Category “B”). To avoid double counting, we excluded studies in which authors used the same data set and reported the same correlations in more than one published study (e.g., [Bowen et al., 2018](#)).

We only included studies investigating samples of employed adults (Category “C”) and reporting zero-order correlations between TASW and at least one correlate of our conceptual model (Category “D”). In cases where articles did not provide zero-order correlations or statistics that allow for transformation into zero-order correlations, we contacted the corresponding author. Regarding the time-frame of included studies (Category “E”), we did not specify a start date for our data base searches, but rather searched all available entries in each data base (e.g., starting 1900 in the case of Web of Science). Because the COVID-19 pandemic brought significant changes to working conditions in general and the work-nonwork boundary in particular, we only included studies that were based on data collected before March 2020 to ensure comparability of studies.

### 3.2. Literature search

We conducted a systematic and iterative literature search according to the guidelines outlined by the PRISMA statement

<sup>3</sup> Table S2 of the online supplemental material lists construct labels, definitions, and operationalizations of TASW and related phenomena for all studies included in the meta-analysis.

(Moher et al., 2009). Fig. 2 presents an overview of the literature search process. We started by scanning the reference lists from two narrative reviews on TASW for relevant articles (Duranová & Ohly, 2015; Schlachter et al., 2018). Next, we conducted a supplemental keyword search for non-overlapping studies in the electronic data bases PsychInfo, Web of Science, and ProQuest (see online supplemental material S3). Additionally, we ran a supplemental four-step search in Google Scholar. In step one, we searched for articles with “supplemental work” in the title. In step two, we conducted forward searches to find articles citing the two review papers on TASW (Duranová & Ohly, 2015; Schlachter et al., 2018). In step three, we applied the function “similar articles” to detect articles associated with the two reviews. In the final step, we searched for articles including related German keywords in the title (e.g., supplemental work, work after regular work hours). To supplement our initial literature search efforts, we cross-referenced all proceedings that were available online from the European Association of Work and Organizational Psychology Congress (2007–2019), the Society for Industrial and Organizational Psychology Annual Conference (2005–2019), and the Academy of Management Annual Meeting (1999–2021). We screened all hits obtained by title and excluded 12,525 studies due to thematic misfit. The remaining items were scanned by abstract and full text. These literature search processes took place between January and June 2021.

We contacted 108 authors researching the topic of work-nonwork boundaries to provide full-texts or additional information concerning studies we had obtained via our literature search (e.g., zero-order correlations). Moreover, we asked these authors for additional studies and unpublished manuscripts and sent a call for unpublished studies to professional mailing lists (e.g., APA Occupational Health Psychology List). We received answers from 62 authors, which resulted in another 14 non-redundant studies. Furthermore, we subscribed to a Google Scholar alert for all items containing “technology-assisted supplemental work,” which yielded another six articles. Please note that our literature search was not restricted to technologically conducted work only, but also detected studies considering supplemental work. We considered these studies in supplemental meta-analytic analyses (see results section). Our final meta-analytic database contained 77 publications with  $K = 89$  independent samples, representing  $N = 39,085$  employees. Of these publications, 60 are published articles, 10 are dissertations or master’s theses, 5 are conference papers, and 2 are unpublished manuscripts. For further details of the literature search process, please see the PRISMA chart (Fig. 2) and S4 of the supplemental materials. All articles included in the meta-analysis are listed in S13 of the supplemental materials.

### 3.3. Measures of constructs

Consistent with best practice recommendations for the conduct of meta-analysis (e.g., Rudolph et al., 2020), we included correlates that appeared in at least three independent samples. When overlapping variables were not available in at least three samples, we logically combined them into a typology of synthetic construct groupings, which were established a priori. We did not form synthetic constructs for six of the 36 constructs linked to TASW in our conceptual model (i.e., workplace telepressure, conscientiousness, polychronicity, controlled motivation, sleep quantity, and turnover intention), as these constructs were consistently labeled across studies. Table S5 in the online supplemental material displays the 30 synthetic construct groupings along with an example operationalization for every construct.

### 3.4. Meta-analytic procedures

Following the literature search, the first author coded the studies in accordance with the a priori developed coding protocol (see online supplemental material S6). To determine interrater reliability of coding, the fourth author coded a random sample of 21 of the 77 studies (27 %). The second coder received training during a pilot training session with 5 studies to familiarize herself with the coding protocol. Interrater agreement was very high for zero-order correlations (95.47 %). The few disagreements were due to misunderstandings of the coding direction (e.g., omitting the reverse sign of the relationship between TASW and gender in cases where a higher dummy code was indicative of males in the respective study). All coder disagreements were reconciled via consensus discussions until agreement was reached.

We further coded reliability estimates for TASW and its correlates, represented as constructs in our model, as well as zero-order/between-person correlation coefficients as measures of effect sizes to represent these relations. For diary studies (e.g., Cambier et al., 2019), we only considered aggregated (i.e., between-person) associations. For the one longitudinal study in our pool (i.e., Schlachter, 2018), we included relationships based on time one data only. We standardized the direction of correlation coefficients between studies to produce consistent meanings of effect sizes. For instance, associations of TASW to inverse measures of psychological detachment (e.g., affective rumination) were reverse coded. When an article reported results obtained from multiple independent samples, each sample was included separately in the meta-analysis (e.g., Becker et al., 2021 report two independent samples).

In cases where multiple associations between constructs of interest were reported (e.g., correlations with multiple measures of TASW, for example smartphone use and laptop use; Gadeyne et al., 2018), we calculated composite effect sizes by using the composite formula 10.6 by Schmidt and Hunter (2015, p. 442) and computed composite reliabilities applying the Mosier formula (Mosier, 1943). The procedure of forming composite measures is necessary because non-dependency of effect sizes is required for effect size pooling (Borenstein et al., 2021).

We corrected for sampling and measurement error in TASW and its correlates, represented as constructs in our model, following random-effects procedures described by Schmidt and Hunter (2015). Sampling error was corrected by calculating sample size weighted correlations  $r$ . Measurement error was corrected by using the appropriate reliability estimates from each sample where possible (i.e., for multi-item scales). In most cases, we coded Cronbach’s alpha as the reliability measure. An exception, for example, was the study by Heissler et al. (2022) who reported McDonald’s Omega. Because no reliability estimates were provided for demographic variables and single-item measures in any of the studies, we assumed these reliabilities were 1.00. All analyses were



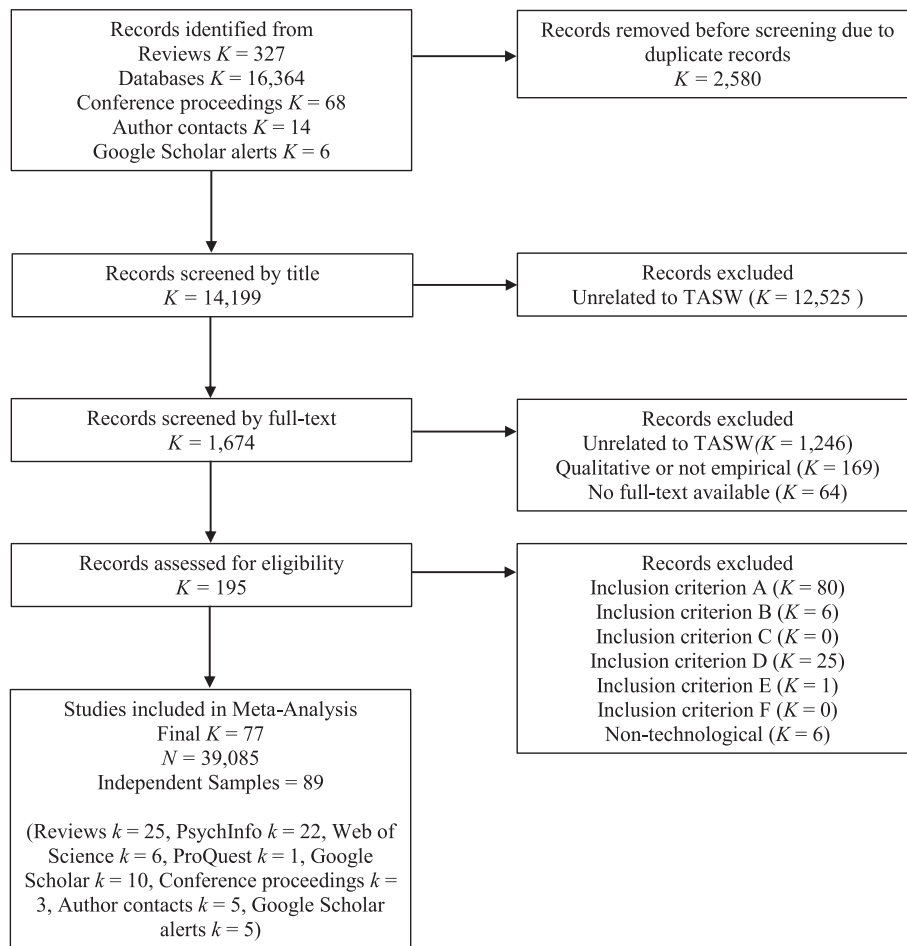


Fig. 2. PRISMA flowchart.

Note. Studies excluded because supplemental work was not or not explicitly conducted via technological devices ( $K = 6$ ) were included in exploratory analyses.

conducted using the packages `psychmeta` (Dahlke & Wiernik, 2019) and `metafor` (Viechtbauer, 2010) for the R statistical computing environment. The R code and dataset to reproduce these analyses are available on OSF.<sup>4</sup>

## 4. Results

Meta-analytic results for relationships between TASW and the other variables in our model are summarized in Table 1 and Fig. 1. Statistical significance at  $p < 0.05$  (two-tailed) is established when the 95 % confidence interval (CI) around the effect size does not overlap with zero. Please note that the calculation of the presented 80 % credibility intervals (CR) is based on  $SD_{\bar{\rho}}$ . Thus, in case  $SD_{\bar{\rho}}$  is zero (i.e., there is no uncertainty in the population that cannot be attributed to artefactual variance), the CR is equivalent to the calculated value for  $\bar{\rho}$ . In these cases, we report the 95 % CI as a proxy for the CR.

### 4.1. Antecedent variables

Regarding social normative work context characteristics (H1), availability expectations after work ( $\bar{\rho} = 0.45$ ) and workplace telepressure ( $\bar{\rho} = 0.27$ ) were positively related to TASW. Work family culture was not significantly associated with TASW ( $\bar{\rho} = -0.13$ ) and neither was workplace support ( $\bar{\rho} = -0.01$ ). These findings support Hypotheses 1a and 1b, whereas Hypothesis 1c was rejected and no definite answer was found for Research Question 1.

Concerning workplace characteristics (H2), job control ( $\bar{\rho} = 0.20$ ), job demands ( $\bar{\rho} = 0.32$ ), and infrastructure for TASW ( $\bar{\rho} = 0.28$ ) were positively related to TASW, supporting Hypotheses 2a, 2b, and 2c. As for Research Questions 2a and 2b, we did not find sig-

<sup>4</sup> Available at <https://osf.io/rswt4/>.

**Table 1**  
Meta-analytic estimates of the antecedents, outcomes, & demographic correlates of technology-assisted supplemental work (TASW).

Variable	<i>k</i>	<i>N</i>	$\bar{r}$	<i>SD<sub>r</sub></i>	<i>SD<sub>res</sub></i>	$\bar{\rho}$	<i>SD<sub>r<sub>c</sub></sub></i>	<i>SD<sub>ρ</sub></i>	95 % CI	80 % CR	%Var
<b>Antecedents</b>											
Social normative work context characteristics (H1)											
Availability expectations after work	20	7,355	0.40	0.12	0.11	0.45	0.14	0.12	[0.39, 0.52]	[0.30, 0.61]	23.28
Workplace telepressure	5	914	0.23	0.06	0.00	0.27	0.07	0.00	[0.18, 0.35]	[0.18, 0.35]	139.26
Work family culture	11	4,770	-0.11	0.19	0.18	-0.13	0.22	0.21	[-0.28, 0.01]	[-0.42, 0.16]	6.82
Workplace support (RQ1)	5	1,957	-0.01	0.09	0.08	-0.01	0.11	0.09	[-0.15, 0.12]	[-0.15, 0.13]	29.36
Work characteristics (H2)											
Job control	15	13,715	0.17	0.11	0.10	0.20	0.12	0.12	[0.13, 0.27]	[0.04, 0.35]	10.45
Job demands	26	13,267	0.27	0.11	0.10	0.32	0.13	0.12	[0.27, 0.37]	[0.17, 0.47]	19.48
Infrastructure for TASW	6	1,309	0.26	0.20	0.19	0.28	0.21	0.20	[0.05, 0.50]	[-0.02, 0.58]	10.87
Nonwork characteristics (RQ2)											
Nonwork demands	8	4,061	0.06	0.10	0.09	0.06	0.11	0.10	[-0.03, 0.15]	[-0.08, 0.20]	19.86
Nonwork support	4	1,030	0.09	0.11	0.09	0.10	0.12	0.10	[-0.09, 0.29]	[-0.06, 0.26]	33.71
Person characteristics (H3)											
Work identity	7	1,837	0.30	0.12	0.10	0.35	0.14	0.12	[0.22, 0.48]	[0.18, 0.52]	25.97
Conscientiousness	6	1,520	0.11	0.06	0.00	0.13	0.07	0.00	[0.06, 0.21]	[0.06, 0.21]	111.20
Positive attitude toward ICT	5	1,410	0.20	0.23	0.23	0.23	0.28	0.27	[-0.11, 0.58]	[-0.17, 0.64]	6.79
Positive attitude toward TASW	10	3,100	0.33	0.15	0.14	0.37	0.16	0.15	[0.25, 0.49]	[0.16, 0.58]	14.31
Polychronicity	3	2,601	0.20	0.03	0.00	0.23	0.03	0.00	[0.16, 0.30]	[0.16, 0.30]	194.64
Controlled motivation	5	2,284	0.27	0.04	0.00	0.30	0.05	0.00	[0.24, 0.35]	[0.24, 0.35]	128.45
Segmentation preference	26	6,305	-0.17	0.18	0.17	-0.20	0.21	0.20	[-0.28, -0.11]	[-0.46, 0.07]	11.78
Boundary control	16	6,392	-0.15	0.11	0.10	-0.18	0.13	0.11	[-0.25, -0.11]	[-0.33, -0.03]	21.54
<b>Outcomes</b>											
Recovery (H4)											
Psychological detachment	30	10,274	-0.33	0.13	0.12	-0.38	0.15	0.14	[-0.43, -0.32]	[-0.56, -0.19]	14.85
Sleep quantity	4	4,606	-0.05	0.08	0.07	-0.06	0.08	0.08	[-0.19, 0.08]	[-0.18, 0.07]	13.99
Sleep quality	9	11,486	-0.08	0.06	0.06	-0.10	0.08	0.07	[-0.15, -0.04]	[-0.19, -0.00]	20.30
Recovery state	4	2,077	0.01	0.06	0.04	0.01	0.07	0.05	[-0.10, 0.12]	[-0.07, 0.09]	49.51
Well-being (H5)											
Job strain	30	15,074	0.10	0.09	0.08	0.12	0.10	0.09	[0.08, 0.15]	[0.00, 0.23]	26.18
Negative affect	13	7,434	0.07	0.09	0.08	0.08	0.10	0.09	[0.02, 0.14]	[-0.04, 0.20]	21.90
Physiological strain	6	952	0.08	0.12	0.09	0.10	0.14	0.10	[-0.05, 0.24]	[-0.06, 0.25]	42.98
Positive affect	6	2,156	0.04	0.09	0.07	0.05	0.10	0.08	[-0.06, 0.15]	[-0.07, 0.16]	34.93
Work-nonwork interface (H6)											
Work-nonwork conflict	40	18,336	0.29	0.10	0.09	0.32	0.12	0.11	[0.28, 0.36]	[0.18, 0.46]	19.20
Work-nonwork enrichment	6	1,979	0.10	0.04	0.00	0.12	0.05	0.00	[0.07, 0.17]	[0.07, 0.17]	182.63
Nonwork-work conflict	3	961	0.08	0.21	0.21	0.09	0.24	0.23	[-0.52, 0.69]	[-0.35, 0.53]	6.91
Nonwork satisfaction	10	2,246	-0.04	0.15	0.14	-0.04	0.17	0.15	[-0.16, 0.08]	[-0.25, 0.17]	19.17
Nonwork performance	11	1,963	-0.12	0.15	0.13	-0.13	0.17	0.15	[-0.25, -0.01]	[-0.34, 0.08]	23.47
Work-nonwork balance	5	3,672	-0.25	0.10	0.09	-0.27	0.11	0.10	[-0.41, -0.14]	[-0.43, -0.12]	14.22
Work attitudes and behaviors (H7)											
Job satisfaction	8	1,687	0.06	0.06	0.00	0.07	0.06	0.00	[0.02, 0.12]	[0.02, 0.12]	156.34
Organizational commitment	5	1,651	0.14	0.09	0.07	0.16	0.10	0.08	[0.03, 0.29]	[0.03, 0.28]	38.79
Work performance	6	1,189	0.25	0.16	0.15	0.27	0.18	0.16	[0.09, 0.46]	[0.03, 0.51]	17.84
Turnover intention	4	1,285	-0.01	0.08	0.06	-0.01	0.09	0.07	[-0.15, 0.14]	[-0.11, 0.10]	47.78
Work engagement	11	6,788	0.12	0.10	0.09	0.13	0.11	0.10	[0.06, 0.20]	[-0.01, 0.26]	17.61

(continued on next page)

Table 1 (continued)

Variable	<i>k</i>	<i>N</i>	$\bar{r}$	$SD_r$	$SD_{res}$	$\bar{\rho}$	$SD_{r_c}$	$SD_{\rho}$	95 % CI	80 % CR	%Var
<b>Demographics</b>											
Age	41	20,213	0.03	0.10	0.09	0.03	0.11	0.10	[-0.01, 0.06]	[-0.10, 0.16]	18.60
Gender (0 = female, 1 = male)	48	24,484	0.11	0.11	0.10	0.11	0.11	0.10	[0.08, 0.15]	[-0.02, 0.25]	16.82
Education	10	10,758	0.11	0.07	0.06	0.12	0.07	0.06	[0.07, 0.17]	[0.03, 0.21]	21.38
Children	23	12,105	0.05	0.06	0.04	0.06	0.06	0.04	[0.03, 0.08]	[0.00, 0.11]	57.37
Working hours	24	18,564	0.22	0.13	0.13	0.23	0.14	0.14	[0.17, 0.29]	[0.05, 0.41]	7.43
Tenure	11	7,768	0.05	0.05	0.03	0.06	0.05	0.03	[0.02, 0.09]	[0.01, 0.10]	59.97
Marital status (0 = not married, 1 = married)	17	9,826	0.04	0.08	0.07	0.04	0.09	0.08	[-0.01, 0.08]	[-0.06, 0.14]	25.81
Job level	17	13,077	0.22	0.07	0.06	0.23	0.07	0.06	[0.20, 0.27]	[0.15, 0.32]	27.17

Note. RG = Research Question; *k* = number of independent samples; *N* = cumulative sample size;  $\bar{r}$  = mean observed correlation;  $SD_r$  = observed standard deviation of *r*;  $SD_{res}$  = residual standard deviation of *r*;  $\bar{\rho}$  = mean true-score correlation;  $SD_{r_c}$  = observed standard deviation of corrected correlations ( $r_c$ );  $SD_{\rho}$  = residual standard deviation of  $\rho$ ; CI = confidence interval around  $\bar{\rho}$ ; CR = credibility interval around  $\bar{\rho}$ ; %Var = variance attributable to sampling error and statistical artifacts. Correlations corrected using artifact distributions. Age, education, children, working hours, tenure, and job level are coded such that higher values indicate higher levels of the respective variable.

nificant associations between nonwork demands ( $\bar{\rho} = 0.06$ ) and nonwork support ( $\bar{\rho} = 0.10$ ), respectively, and TASW.

Regarding person characteristics (H3), work identity ( $\bar{\rho} = 0.35$ ), conscientiousness ( $\bar{\rho} = 0.13$ ), positive attitude toward TASW ( $\bar{\rho} = 0.37$ ), polychronicity ( $\bar{\rho} = 0.23$ ), and controlled motivation ( $\bar{\rho} = 0.30$ ) were positively associated with TASW. Segmentation preference ( $\bar{\rho} = -0.20$ ) and boundary control ( $\bar{\rho} = -0.18$ ) were both negatively related to TASW. There was no significant relationship between positive attitude toward ICT and TASW ( $\bar{\rho} = 0.23$ ). These findings supported Hypotheses 3a, 3b, 3d, 3e, 3f, 3g, whereas Hypothesis 3c was rejected.

#### 4.2. Outcome variables

As for recovery outcomes (H4), TASW was negatively related to psychological detachment ( $\bar{\rho} = -0.38$ ) and sleep quality ( $\bar{\rho} = -0.10$ ). Hypotheses 4a and 4c, therefore, were supported. We did not find significant relationships between TASW and sleep quantity ( $\bar{\rho} = -0.06$ ) and recovery state ( $\bar{\rho} = 0.01$ ), respectively, thus providing no support for Hypotheses 4b and 4d.

In terms of well-being outcomes (H5), TASW was positively associated with job strain ( $\bar{\rho} = 0.12$ ) and negative affect ( $\bar{\rho} = 0.08$ ). We found no significant associations between TASW and physiological strain ( $\bar{\rho} = 0.10$ ) and positive affect ( $\bar{\rho} = 0.05$ ), respectively. Therefore, Hypotheses 5a and 5b were supported, whereas Hypotheses 5c and 5d were not.

With respect to the work-nonwork interface (H6), TASW was positively related to work-nonwork conflict ( $\bar{\rho} = 0.32$ ) and work-nonwork enrichment ( $\bar{\rho} = 0.12$ ), and negatively related to nonwork performance ( $\bar{\rho} = -0.13$ ) and work-nonwork balance ( $\bar{\rho} = -0.27$ ). There was no significant association between TASW and nonwork-work conflict ( $\bar{\rho} = 0.09$ ) and nonwork satisfaction ( $\bar{\rho} = -0.04$ ), respectively. Overall, we found support for Hypotheses 6a, 6b, 6e, and 6f, but not for Hypotheses 6c and 6d.

Concerning work attitudes and behaviors (H7), TASW was positively associated with job satisfaction ( $\bar{\rho} = 0.07$ ), organizational commitment ( $\bar{\rho} = 0.16$ ), and work performance ( $\bar{\rho} = 0.27$ ). TASW was not significantly related to turnover intention ( $\bar{\rho} = -0.01$ ). Thus, Hypotheses 7a, 7b, and 7c were supported, whereas we found no support for Hypothesis 7d. Regarding [Research Question 3](#), TASW was positively related to work engagement ( $\bar{\rho} = 0.13$ ).

#### 4.3. Exploratory analyses

##### 4.3.1. Demographic variables

We conducted exploratory analyses investigating the relationships between various demographic variables and TASW. Because studies differed in their approach of measuring demographic variables, we built synthetic constructs for age, children, working hours, and tenure (see online supplemental material S5). For example, although most studies conceptualized age chronologically, some applied age categories (e.g., [Frizzell, 2015](#)). All demographic variables were coded such that a positive relationship with TASW would indicate “higher” levels of a given measure. Results of the correlations between TASW and demographic variables are presented in [Table 1](#). We found positive associations between TASW and gender ( $\bar{\rho} = 0.11$ ), education ( $\bar{\rho} = 0.12$ ), children ( $\bar{\rho} = 0.06$ ), working hours ( $\bar{\rho} = 0.23$ ), tenure ( $\bar{\rho} = 0.06$ ), and job level ( $\bar{\rho} = 0.23$ ). TASW was not significantly associated with age ( $\bar{\rho} = 0.03$ ) and marital status ( $\bar{\rho} = 0.04$ ).

##### 4.3.2. Moderators

As part of exploratory analyses, we considered several moderators of the relationships between TASW and the variables of our model (i.e., type of measurement of TASW, device used for TASW, time of TASW, publication status, country, sample composition, age, and gender). For matters of space and in line with common practice (e.g., [Rudolph et al., 2017](#)), we only report results for the five “highest k” relationships with TASW. Additional results of moderator analyses are presented in the supplemental material S7. For the five “highest k” relationships, we only detected moderation effects for the correlate “job demands.” Specifically, average sample age and percentage of females were found to moderate the strength of the job demands-TASW relationship. The slope for average sample age was positive ( $B_{\text{age}} = 0.03$ ), suggesting that the strength of the job demands-TASW relationship increases as a function of age. The slope for percentage of females was negative ( $B_{\text{female}} = -0.004$ ). This suggests that the strength of the job demands-TASW relationship decreases as a function of the percentage of females represented in each sample. Fig. S7 in the online supplemental material illustrates these moderation effects. Furthermore, we found that the confidence interval for the job demands-TASW relationship in published studies [0.31, 0.44] did not overlap with the confidence interval for relationships in unpublished studies [0.16, 0.26], suggesting that the effect was significantly stronger in published studies.

##### 4.3.3. Supplemental work

We conducted additional exploratory meta-analyses adding six studies to our sample, in which supplemental work was not, or at least not exclusively, conducted by means of technological devices. S8 in the online supplemental material lists these six studies and shows a comparison of our focal and the exploratory analysis. There were no differences in the significance of effect sizes except for the outcome variable “physiological strain.” However, the  $N$  for the TASW-physiological strain relationship was 952 in our focal analyses and 58,187 in the exploratory analyses, so that this result needs to be interpreted with caution.

#### 4.4. Sensitivity analysis

We ran sensitivity analyses for the five most frequently represented relationships in the sample (i.e., highest  $k$ ) to further examine the robustness of our results (i.e., cumulative meta-analysis, “leave-one-out” analysis, inspection of forest and funnel plots). In

summary of our findings, considering the five “highest  $k$ ” correlates of TASW, we found no substantive evidence that publication bias is affecting our conclusions for those relationships. Results for these three sets of analyses are presented in the online supplemental materials S9, S10, S11, and S12.

## 5. Discussion

### 5.1. Summary and interpretation of findings

Drawing from the conceptual model by [Schlachter et al. \(2018\)](#), our meta-analysis synthesizes the literature on TASW and its correlates, which has grown substantially over the past years. Regarding antecedents of TASW, 12 of the 14 hypothesized relationships were significant. In terms of effect sizes, six of these relationships were large and positive (i.e., availability expectations after work, job demands, infrastructure for TASW, work identity, positive attitude toward TASW, controlled motivation), four were medium-sized and positive (i.e., workplace telepressure, job control, conscientiousness, polychronicity), and two were medium-sized and negative (i.e., segmentation preference, boundary control). This classification is based on benchmarks developed by [Bosco et al. \(2015\)](#), who suggest classifying uncorrected correlations involving behavioral variables between  $|r| = 0.10$  and  $0.25$  as medium-sized. Because TASW is a behavior, this benchmark applies to all relationships under investigation in this meta-analysis. Regarding outcomes of TASW, 11 of the 18 hypothesized relationships with TASW were significant. One of these relationships was large and positive (i.e., work nonwork conflict) and one was large and negative (i.e., psychological detachment). Four relationships were medium-sized and positive (i.e., job strain, work nonwork enrichment, organizational commitment, work performance), and two were medium-sized and negative (i.e., nonwork performance, work nonwork balance). Finally, two relationships were small and positive (i.e., negative affect, job satisfaction), and one was small and negative (i.e., sleep quality). These results suggest that TASW is a double-edged sword: it is associated with negative well-being and, at the same time, with certain favorable outcomes. Although we cannot draw conclusions regarding causality and temporal ordering, our findings raise the possibility that TASW is not inherently bad. This challenges the prevailing scientific focus on negative outcomes of TASW and offers first ideas on potential benefits of TASW.

Regarding [Research Question 1](#), workplace support was not significantly associated with TASW. This relationship could depend on the specifications of workplace support ([Mathieu et al., 2019](#)), such as type of support (emotional vs. instrumental), source of support (supervisor vs. coworker), and the support scale type (received vs. available). Regarding [Research Questions 2a and 2b](#), neither nonwork demands nor nonwork support were significantly related to TASW. A possible explanation might be that various kinds of nonwork support and demands are related to TASW differently. While especially time and energy consuming demands such as volunteer work (e.g., being involved in politics or refugee aid) might leave employees to exhausted to work after regular work hours, other more routinized demands such as childcare or household activities might allow employees to allocate additional resources to work once the nonwork demands are met (e.g., children have gone to bed). As for nonwork support, childcare or household support (e.g., a nanny or domestic help) or spouses career support could enable and encourage employees to perform TASW, high family cohesion could prevent employees from engaging in TASW due to frequent family activities. Regarding [Research Question 3](#), TASW was significantly and positively related to work engagement. This is an interesting result because previous research on this relationship has been mixed. The finding implies that TASW is rather a resource than a demand in the sense of the job demands-resources model ([Bakker & Demerouti, 2007](#)). However, we should note that work engagement could also be an antecedent of TASW such that more engaged employees more willingly work after regular work hours.

### 5.2. Limitations and future research

Based on the results and limitations of this study, we propose several directions for future research on TASW at the theoretical, empirical, and methodological levels. First, definitional clarity of TASW was a challenging issue in the current meta-analysis that needs to be addressed in future research. There exist several construct labels, definitions, and measurement methods for TASW ([Eichberger & Zacher, 2021](#)). Accordingly, we identified many potentially relevant studies and carefully considered study inclusion. This was at times challenging because not all studies provided detailed information on construct definition and operationalization (see Table S2 in the online supplemental material). Our search protocol was purposefully inclusive, and we developed strict inclusion criteria ensuring a shared understanding of TASW. Yet, we cannot fully rule out the possibility of missing relevant studies or guarantee the comparability of included studies.

We suggest that it is time for “construct clean-up” regarding TASW. Future research needs to adopt a critical perspective on the most appropriate label, conceptualization, and operationalization for TASW. Based on our reflections of the topic, we recommend the consistent use of the term *technology-assisted supplemental work* and, in line with the definition by [Fenner and Renn \(2010\)](#), following the definition applied in this meta-analysis (i.e., performance of work-related tasks after regular work hours with the aid of technological devices). Furthermore, a unified method to operationalize TASW should be developed, especially because some studies apply partly mixed scales that interfuse different constructs. We recommend comparing the validity of existing measures of TASW using large-scale samples to detect the best operationalization or facilitate the development of alternative scales. A clear operational definition of TASW is key to enable future theorizing on the topic. Furthermore, a unified definition and operationalization of TASW allows for a clearer differentiation between TASW and related constructs such as telecommuting, overtime, and availability requirements. A large-scale validation study collecting data on these constructs could identify the overlapping and unique aspects of each construct via correlation and factor analyses.

Overall, the definition and measurement of TASW will continue to remain a challenging endeavor, especially because the COVID-19 pandemic accelerated changes toward more remote work, higher work-life integration, and flexible work schedules. In turn, the meaning



of the term “after regular work hours” (p. 63) applied by Fenner and Renn (2010) becomes blurrier. To meet this challenge, we recommend future research on TASW to clearly report their understanding of “after regular work hours” in their specific study (e.g., after a specific time of day, time that was originally reserved for leisure) and provide this definition to study participants to guarantee a shared understanding of the term. Thereby, the definition might depend on the target group under investigation (e.g., employees working for large corporations with core working hours vs. self-employed people) and the research object (e.g., recovery on evenings vs. recovery on weekends).

Second, we suggest an extended version of the model by Schlachter et al. (2018) as a conceptual framework for understanding and investigating TASW in future research. The Schlachter et al. (2018) model considers antecedent and outcome categories that are, although elaborated with some examples, rather unspecific. Based on the significant correlates of TASW detected in our meta-analysis, we propose to substantiate and complement these categories with concrete variables. For example, the person characteristics category could be supplemented with constructs found to be significantly correlated with TASW (e.g., segmentation preference, work identity, conscientiousness). We further suggest adding work attitudes and behaviors as important correlates of TASW, as we found significant correlations with job satisfaction, organizational commitment, work performance, and work engagement. Additionally, future research might further extend the framework by investigating relationships between TASW and constructs that were not, or only rarely, explored in previous TASW literature. For example, it might be interesting to explore how TASW is related to organizational segmenting practices, organizational citizenship behavior, or counterproductive work behavior.

Third, we made no conceptual differentiation between TASW initiated by oneself (e.g., working on a presentation) and by others (e.g., accepting an incoming call from a colleague) or between voluntary and involuntary TASW. Such a differentiation was not possible because primary studies mainly rely on mixed measures of TASW not considering the initiator of the behavior or the degree of voluntariness. However, in line with broader research indicating a positive association between job autonomy and employee well-being (e.g., Park & Searcy, 2012), it is conceivable that other-initiated and involuntary TASW (i.e., low autonomy) is more harmful for employee well-being and recovery than self-initiated and voluntary TASW (i.e., high autonomy). This is also supported by literature on telework, suggesting that involuntarily working from home is positively associated with negative well-being outcomes (e.g., Lapierre et al., 2016). Future research needs to clarify whether the degree of voluntariness and the initiator of TASW form definable sub-dimensions of TASW, for example via large-scale factor analysis studies. On that basis, differences in the outcomes of self-initiated and voluntary as opposed to other-initiated and involuntary TASW could be explored systematically.

Fourth, the results of our meta-analysis regarding the outcomes of TASW were mixed. Although TASW was associated with lower psychological detachment and more work family conflict, it was also associated with more work-nonwork enrichment and job satisfaction. Furthermore, no significant relationships with sleep quantity, recovery states, physiological strain, or positive affect were detected. This pattern of results suggests that mediators and moderators account for positive or negative effects of TASW. So far, research on such variables is rather scarce and more attention should be focused on the mechanisms and boundary conditions of the association between TASW and well-being. Regarding mediators, it might be worthwhile to explore how various work-related thoughts (e.g., affective rumination, problem-solving pondering; Cropley & Zijlstra, 2011) differently account for the relationship between TASW and well-being. As for moderators, personality traits like segmentation preference (Kreiner, 2006) or attitude toward TASW (Fenner & Renn, 2010) might qualify the relationship between TASW and well-being, such that it would be negative for high segmentation preference and negative attitudes toward TASW. Additionally, future research might consider TASW in the specific context of the COVID-19 pandemic (Calderwood et al., 2022). We are currently aware of two studies based on data assessed during the pandemic (i.e., Cambier, 2021; van Zoonen et al., 2022). Effect sizes in these two studies resembled the ones obtained in our analyses in direction and size. Once more studies based on data assessed during the COVID-19 pandemic become available, it would be interesting to compare effect sizes of relationships between TASW and relevant correlates before, during, and after the pandemic.

Fifth, future research needs to consider TASW in the context of the gig economy, which provides opportunities to easily contract short-term engagements (Ashford et al., 2018). As a result, prevalence rates of employees holding multiple jobs (i.e., a primary job and so-called side hustles) are increasing (Sessions et al., 2021). This reality, however, is not mirrored in current TASW research. Although the studies included in this meta-analysis did not specify whether TASW was related to employees' primary or secondary job, we assume that most of the research on TASW implicitly focused on full-time employees holding one job. Future research needs to explore whether TASW conducted for secondary side jobs is related to relevant outcomes in the same way as TASW conducted for one's main job. For example, TASW conducted for a side job might be more intrinsically motivated and therefore less harmful for employee well-being.

Sixth, primary studies included in this meta-analysis almost exclusively used single-source self-report measures for TASW and its correlates. Due to this limitation, we cannot rule-out the potential of common method bias (Podsakoff et al., 2003) and subjective distortions in our study. Clearly, future research needs to consider multi-source ratings and more objective measures. Whereas the measurement of recovery and well-being outcomes inherently relies on introspection and therefore self-reports, the assessment of organizational and home-related antecedents and outcomes of TASW could benefit from additional rating sources in terms of reducing bias. For example, supervisors could rate work performance and colleagues work family culture, while spouses and other family members could inform on work-nonwork conflict and nonwork performance. Furthermore, more objective measures of TASW are needed because self-assessments might lead to a gap between subjectively reported and actual TASW. For instance, in addition to self-reported TASW extent, after-hours working behavior could be tracked electronically via an app. This would also allow the investigation of potential differences in well-being outcomes of subjectively perceived and objective TASW intensity. Furthermore, outcome variables such as physiological strain or sleep quality could be measured more precisely by using technological-aided measurement methods, such as smart watches tracking heart rate variability (Chalmers et al., 2022) or sleeping behavior (Alfeo et al., 2018).

Finally, we cannot draw conclusions regarding the causality of the investigated relationships because we had to rely on cross-sectional data. It is therefore possible that reverse or reciprocal effects exist. Primary studies prioritizing longitudinal studies and

intervention designs are necessary to reproduce the temporal and causal order of TASW and its correlates. For example, diary studies assessing TASW and related outcomes at multiple time points per evening could shed light on dynamic within person processes. Longitudinal studies across several weeks or even months could further provide clarification regarding the cumulative long-term effects of regular TASW. We did not detect significant relationships between TASW and recovery state and physiological well-being, respectively. Lost recovery time from one evening might be compensated during other evenings or through micro-breaks (Zacher et al., 2014), and one-time engagement in TASW might not immediately hamper physical well-being. However, it seems plausible that cumulated engagement in TASW over several weeks or even months harms recovery state and yields physiological symptoms. This could be further investigated in longitudinal studies. One possibility for the conduct of such studies could be the application of measurement burst designs (Stawski et al., 2015) that combine elements of longitudinal and experience sampling designs. Technological tools like app-based diaries might assist these approaches and help to integrate studies into TASW workflows. For example, “event contingent” diary studies could use an app that asks employees to answer a survey every time they engage in TASW (i.e., the event).

### 5.3. Practical implications and conclusion

Our meta-analytic findings suggest that TASW is a double-edged sword. While it seems to have potential bright sides (e.g., higher work-nonwork enrichment), engaging in TASW might also constitute a threat to recovery and well-being. Consequently, organizations, leaders, and employees need to find a balance between benefitting from the bright sides and, at the same time, preventing and mitigating the potentially harmful effects of TASW. Possible measures organizations could take to achieve such a balance might involve encouraging employees to reflect their current TASW behavior, communicating openly about the risks and benefits of TASW, and empowering employees to create boundaries around TASW. The latter measure is especially important because the COVID-19 pandemic contributed to a blurring of boundaries between work and nonwork due to an increase in days when employees were working from home.

We further suggest that supervisors act as role models and coaches for their employees when it comes to TASW. They should not only exemplify a healthy approach to TASW, recovery, and well-being, but also actively address TASW and recovery in one-on-one meetings. That way, they can identify employees who lack recovery due to frequent TASW behavior and work on solutions with them. Sensitivity for employees' individual needs is especially important because our results suggest a personal component of TASW behavior. Our results further imply that availability expectations after work and job demands are important antecedents of TASW. Therefore, leaders should communicate their availability expectations and help employees navigate their workload so that it can be managed during regular work hours.

At a more general level, organizations could offer training and interventions to support recovery processes among their employees. Boundary management tactics and sleep interventions have been found to be especially effective in promoting recovery (Karabinski et al., 2021). Application based interventions like mindfulness exercises and sleep apps could further help employees to recover (Sonntag et al., 2022), even when engaging in TASW from time to time. Thereby, organizations should be careful with one-size-fits-all solutions because our study suggests TASW to be associated with contextual and individual circumstances. Overall, a differentiated approach to TASW in organizational practice seems important because rigidly avoiding TASW is rather unrealistic considering the increasing digitalization and boundarylessness of the workplace.

Our meta-analytic results highlight the importance of a sound understanding of TASW because it is significantly related to important employee outcomes regarding well-being, work attitudes and behaviors, and the work-nonwork interface. Importantly, engaging in TASW seems not to be inherently bad for employees. This challenges the prevailing scientific focus on potential negative outcomes of TASW and underlines the necessity of exploring potential moderators and mediating mechanisms, especially because we find that TASW takes place in a complex structure of organizational and individual variables. With this meta-analysis, we hope to encourage researchers to further investigate TASW as an important part of vocational behavior.

### CRediT authorship contribution statement

**Clara Kühner:** Conceptualization, Methodology, Investigation, Software, Formal analysis, Data curation, Writing – original draft, Visualization, Project administration. **Cort W. Rudolph:** Software, Formal analysis, Writing – review & editing. **Daantje Derks:** Conceptualization, Writing – review & editing. **Melina Posch:** Validation, Writing – review & editing. **Hannes Zacher:** Conceptualization, Writing – review & editing, Supervision.

### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Data availability

Data are available on OSF (<https://osf.io/rswt4>).

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