



Full length article

Private smartphone use during worktime: A diary study on the unexplored costs of integrating the work and family domains

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A B S T R A C T

Facilitated by communication technology (i.e., smartphones), many employees adopt a work-family integration strategy to cope with work and home demands simultaneously. Taking boundary theory as a starting point, this quantitative diary study examines the potential impact of private smartphone use at work—i.e., boundary-crossing behavior—on employee well-being. We hypothesized that private smartphone use would be positively associated with the subjective experience of being interrupted, especially when smartphone use was appraised negatively (vs. positively). Additionally, we predicted that these interruptions by private smartphone use would be positively related to end-of-day exhaustion, and that this relationship would be stronger for employees who value work over family (high vs. low work centrality). The hypotheses were tested using a sample of 67 employees from various occupations who completed a short daily questionnaire for four successive workdays ($N = 237$ data points). The results of multilevel analyses generally supported the hypotheses. Theoretical and practical implications of our findings are discussed.

Mobile devices in general, and smartphones in particular, have become mainstream in our daily lives. These devices facilitate the use of social media, sending messages to family and friends, monitoring news feeds, playing online games, and watching videos on streaming services – anytime, anyplace. This behavior is not by definition limited to one's personal life, personal time, and perhaps even personal domain (i.e., at home). Mobile devices—like smartphones—have made it easier for employees to stay in touch with their family and friends and have facilitated handling personal issues at work (e.g., [Olson-Buchanan et al., 2016](#)). Additionally, [Rose \(2017\)](#) argues that digital technologies, like smartphones, are altering how we experience the world around us. In her study, she concluded that digital technologies are fragmenting our attention and involvements in different life domains. More broadly, it can be concluded that an inherent feature of the smartphone is that it divides our attention between being engaged in activities on the smartphone and conducting our primary (work) tasks.

[Vitik et al. \(2011\)](#) showed that employees dedicated approximately 2 h of a regular workday on personal Internet use like instant messaging, writing private e-mails and updating their social media profiles. [Holland and Bardoel \(2016\)](#) acknowledge that the consequences of this behavior for both the organization and the employee are still underexplored.

There are two main theoretical perspectives to private Internet use at work. From the cyberslacking/cyberloafing perspective (e.g., [Lavoie & Pychyl, 2001](#)), private Internet use at work is framed as undermining productivity and taking an advantage of working time and

organizational resources. Here, private Internet use during work time is often labeled as counterproductive work behavior and even as individual workplace deviance (e.g., [Lim & Chen, 2012](#)). Indeed, there are indications that personal media use at work may be counterproductive in terms of job performance (e.g., [Andreassen, et al., 2014](#); [Ayyagari et al., 2011](#); [Lim, 2002](#); [Weatherbee, 2010](#)).

The other perspective takes boundary theory as a starting point ([Ashforth et al., 2000](#); [Clark, 2000](#); [Nippert Eng, 1996](#)). Scholars in this research discipline argue that individuals may have different boundary management preferences ([Kossek & Lautsch, 2008](#); [Kreiner et al., 2009](#)). Employees who prefer integration of work and family domains accept role transitions and engage in cross-role behavior. In the case of integrating family and work domains, attending to private messages at work might be useful to simultaneously meet both family and work demands ([Derks et al., 2016](#)), which may result in a better work-home balance (e.g., [Olson-Buchanan et al., 2016](#)). As [Wajcman et al. \(2008\)](#) already showed in the pre-smartphone era, mobile phones are more extensively used to contact family and friends during worktime, than for work extension purposes during private time. Analyzing phone logs revealed that connecting with significant others is the predominant reason for using the phone during the day, even compared to work-related phone use. Building on this, they argue that the mobile phone offers new opportunities to maintain personal relationships and to create a sense of social presence, while being physically absent ([Wajcman et al., 2008](#)).

In the current study, we argue that private smartphone use at work is

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a work-family integration strategy with the aim of maintaining a healthy balance between family and work domains. By using the smartphone at work, individuals can fulfill private obligations and maintain social relationships with significant others. However, this work-family integration strategy also has a known downside, because it implies cross-role interruptions interfering with the work process that may come with costs in term of well-being. This may especially occur when disruptions are technology-mediated. Therefore, our central research question is how intrusive private smartphone use during the workday is and what the costs of this boundary crossing behavior are for employee well-being (i.e., daily exhaustion symptoms). As the intensity of private smartphone use and the experience of being interrupted by it is likely to vary from day to day, we conducted a daily diary study to capture within-person fluctuations in a methodologically sound way. Further, we want to remark that exhaustion originally refers to a long-term process, as it is one of the core dimensions of job burnout (Maslach & Leiter, 1997; Maslach, Schaufeli, & Leiter, 2001). In our diary study we operationalized it as exhaustion symptoms (see also Derks & Bakker, 2014) to capture more short-lived, daily feelings of exhaustion. To insure the readability, we'll refer to these daily exhaustion symptoms shortly as "exhaustion".

Our study aims to contribute to the literature in three different ways. First, we expand boundary theory, since there is ample research on work-related smartphone use during private time (e.g., Boswell & Olson-Buchanan, 2007; Perlow, 2012), but almost no research on private smartphone use during the workday (e.g., Dora et al., 2019). This is remarkable, since these behaviors are two sides of the same boundary management strategy aimed at the integration of work and life domains (Ashforth et al., 2000). Does boundary-crossing behavior during the workday have negative implications for employee well-being?

Second, although we focus solely on how private smartphone use might be perceived as interruptive during the workday—and ignore other potential interruptive activities—our study integrated the broader theoretical framework of interruptions (Jett and George, 2003) and boundary theory (e.g., Ashforth et al., 2000). We argue that private smartphone use in itself is not related to feelings of exhaustion. Indeed, there is even evidence on the recovery potential of private smartphone use as a micro break (e.g., Rieger et al., 2017). However, we contend that the feeling of being interrupted is the underlying mechanism explaining why private smartphone use will be related to exhaustion.

A third contribution of this study is that we examine whether work centrality (Paullay et al., 1994) affects the relationship between feeling interrupted by private smartphone use and exhaustion. We propose that for individuals who are strongly committed to their work and engaged in their tasks, feeling interrupted by private smartphone use is more strongly related to exhaustion than for individuals who are more family oriented. Further, in line with the work-family centrality concept, we

use the term "family" as an overarching concept to refer to the nonwork domain. In this study, we adopt a broad, inclusive, definition of the family concept implying that the family role entails more than just being a parent to your own children; it also entails being a sibling, grandparent, partner, or significant other. Fig. 1 represents the overarching model that guides the present study.

1. Theoretical background

1.1. Boundary management

Boundary theory states that the boundaries between the work and family domains can be impermeable and inflexible, leading to segmentation, or permeable and blurred, resulting in integration (Ashforth et al., 2000; Clark, 2000). When boundaries are more permeable, there are potentially more interruptions across domains, which then increase the likelihood that work-related issues will spill over to the private domain; and that private issues will spill over to the work domain. Boundary theory takes an individual perspective, since employees differ in how rigid and permeable they prefer their boundaries to be. Importantly, it proposes that how spill-over (e.g., cross-role interruptions) is experienced depends on the individual preference for segmentation or integration of work and family domains (Kossek & Lambert, 2005; Nippert Eng, 1996; Rothbard et al., 2005). This is particularly relevant nowadays, because the use of modern communication technologies makes the private domain easily accessible during working times and the work domain easily accessible during leisure time (Mathieu & Taylor, 2006; Peters et al., 2009).

In line with boundary theory (Ashforth et al., 2000; Clark, 2000; Nippert Eng, 1996), we propose that communication technologies (e.g., smartphones) have blurred the boundaries between work and personal life (Ramarajan & Reid, 2013; Reyt & Wiesenfeld, 2015). Boundary theory proposes that individuals differ in the extent to which they allow both domains (family and work) to be integrated based on their own preferences (Ashforth et al., 2000), but also dependent on the norms and expectations of their organization and colleagues (Derks et al., 2015). Since most employees are managing multiple roles simultaneously with different demands and expectations associated with each role, it is likely that occasionally they need to interrupt their work role to attend to their family role and vice versa (Kossek et al., 2012).

Context-incongruent smartphone use—in our case private smartphone use at work—can be considered boundary-crossing behavior, which will become more automatic and natural the more often it occurs. This implies that for those individuals who integrate their work and family domains, these cross-role interruptions will occur occasionally. Accordingly both work-related smartphone use during leisure time, and private smartphone use at work can be considered boundary-crossing

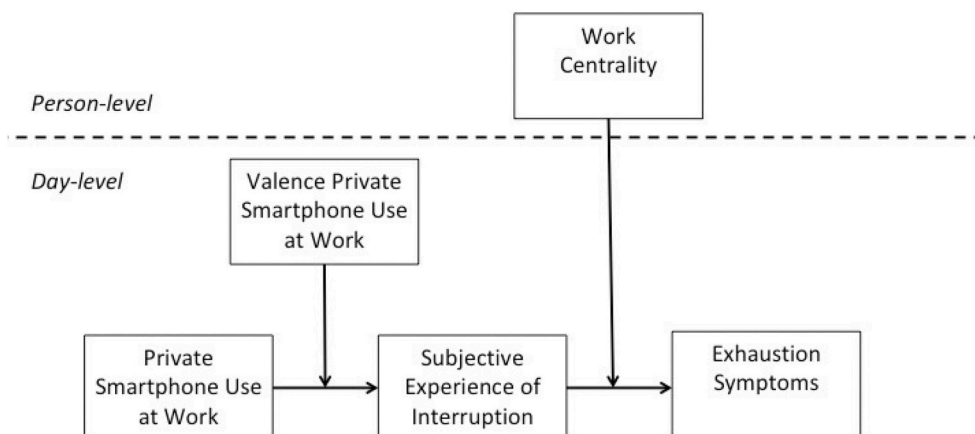


Fig. 1. Research model.

behavior. While e-mail, texting, surfing the Internet and social media platforms are integral tools for doing our jobs, they also provide easy access to family, friends, and other private matters at work (Colbert et al., 2016). This means that the same technology that makes employees available for work during non-work-hours, allows them to be available for family and friends during work time. Dora et al. (2019) showed that employees used their smartphone more often for private purposes during the workday than for work-related matters at home. These authors argue that because employees want to stay available for private matters at work, they compensate this behavior by also using it for work-related matters at home (though less often). It makes sense that the integration of work and family domains implies allowing boundary-crossing behavior in both directions; from work to family and from family to work. In the current study, we focus on private smartphone use at work representing boundary-crossing behavior where the personal roles may interfere with the work role.

1.2. Private smartphone use and interruptions

Besides the many positive things smartphone use can bring in terms of efficiency, more work-time control and increased autonomy over where to work (Demerouti et al., 2014); technology-mediated interruptions can be considered as a common case of collateral damage (Chen & Karahanna, 2014). Technology-mediated interruptions are “interruptions that occur via information communication technologies including both devices (e.g., smartphone, iPad) and applications (e.g., email and texting)” (Chen & Karahanna, 2014, p.18). Private smartphone use may entail monitoring behavior in terms of checking for new private messages, reading and answering e-mails, making private phone calls, surfing on the web, or using apps to track the news or for entertainment purposes. In line with the typology of Jett and George (2003), these kinds of technology-mediated interruptions can be classified as either intrusions or distractions. An intrusion is defined as “an unexpected encounter initiated by another person that interrupts the flow and continuity of an individual’s work and brings that work to a temporary halt” (p. 495). A distraction, on the other hand, is defined as “a psychological reaction triggered by external stimuli or secondary activities that interrupt focused concentration on a primary task” (Jett and George, 2003, p. 500). In line with Sonnentag et al. (2018), we focus on the subjective experience of being interrupted. However, whereas the latter authors only included e-mail and online messages, we take a broader perspective by also referring to a variety of mobile applications in our item—such as social media, news and/or playing online games—to provide a more realistic and inclusive view on private smartphone use during the workday (Chen & Karahanna, 2014). In line with this, Thulin et al. (2020) argue that social contacts mediated by communication on smartphones require individual co-attentiveness and co-presence, which may feel just as natural as face-to-face interactions. The smartphone is no longer a background activity during the workday, but instead becomes prevalent and potentially intrusive for the focal work activities.

Besides, we also ask participants how they appraise their private smartphone use during the day in terms of how positive or negative they experienced it. Although the concept of interruption has in itself a negative connotation and the disruption caused by an interruption is often seen in a negative light (Jett and George, 2003), this does not automatically imply that employees appraise their private smartphone use as negative. We argue that the valence of private smartphone use affects the subjective experience of being interrupted. Specifically, we assume that private smartphone use is more easily or more strongly interpreted as interruptive when using the smartphone is experienced as negative rather than positive.

Hypothesis 1. Daily private smartphone use during work is positively related to the experience of being interrupted (a), and this relationship is stronger when the valence of smartphone use is negative rather than

positive (b).

1.3. Interruptions and exhaustion

The current study focuses on cross-domain interruptions, namely in the direction from family to work. More specifically, we focus on private smartphone use at work. Building on the work of Ashforth et al. (2000), we propose that interruptions initiated in the other domain incur higher transition costs than interruptions initiated in the same domain. The reason for this is that the mental models and behaviors that are appropriate in one domain (e.g., work) often differ from those being appropriate in the other domain (e.g., home). For example, feelings of being in love may be strengthened by a smartphone-mediated conversation with one’s romantic partner, and these feelings may distract from work-related activities.

Interruptions are associated with cognitive costs (Eyrolle & Cellier, 2000) since they distract employees from the primary task (Gupta et al., 2013). Zijlstra et al. (1999) showed in an experimental study that participants appear to be able to cope with interruptions and are able to keep their performance up to a satisfactory level. However, this is associated with certain psychological costs, like an increase in effort expenditure and a decrease in well-being (Zijlstra et al., 1999).

Especially on days when employees experience private smartphone use as highly interruptive, they have to shift their attention from the primary task to private messages multiple times a day. Trying to bring your primary tasks to a satisfactory end and the mental demands of shifting your attention between task and interruption costs additional time and effort (Brixey et al., 2007). Frequent interruptions and the accompanied task switching require mental resources, which can be taxing. Accordingly, interruptions can be classified as stressors that foster strain (Baethge & Rigotti, 2013). In addition, the increased workload due to interruptions and an accumulating number of unfinished tasks reduces opportunities to recover during the day (Baethge & Rigotti, 2010) result in increased strain (Baethge et al., 2015) and emotional exhaustion (Wülser, 2006). Indeed, Sonnentag et al. (2018) showed that perceived interruptions increased negative states such as distress and irritation. Altogether, we hypothesize that private smartphone use at work is experienced as interruptive and this is, in turn, related to emotional exhaustion at the end of the workday.

Hypothesis 2. Daily private smartphone use is positively related to daily exhaustion via the subjective experience of being interrupted.

1.4. Work centrality as moderating variable

Individuals differ in how they manage the boundaries between their work and family domains (e.g., Kossek et al., 2012), but new technologies – including fast Internet and smartphones – have strongly facilitated the integration of work and family domains. Put differently, virtually all employees show boundary-crossing behavior by using the smartphone in the work context to deal with issues in private life. However, individuals do differ in how important work and non-work roles are for their identity and central values (Carr et al., 2008). Every person has a unique set of values (Carlson & Kacmar, 2000) that is stable over time and resistant to change (Rokeach, 1973). In our study, work centrality is defined as “the belief that individuals have regarding the degree of importance that work plays in their lives” (Paullay et al., 1994, p. 225). In other words, work centrality implies that identification with the work role is relatively stronger compared to identification with non-work roles, such as the family role (Carr et al., 2008). This also implies that individuals with high work centrality allocate more time and energy to work.

In support of this contention, Bagger et al. (2008) showed in an empirical study that family-work interference was more stressful for employees who had a low family identity salience (i.e., high work centrality). Additionally, for these employees, family-work interference was

associated with lower job satisfaction. In contrast, for employees high on family identity salience, job satisfaction was not affected by family-work interference. Shi et al. (2018) studied work centrality in the context of work-related ICT use during after-work hours. They showed that work-related ICT use in the evening was stronger related to focus on opportunities for employees who had a stronger work centrality. This provides a possible explanation why work-related ICT use has a more positive impact on some employees as compared to others.

Building on this initial empirical evidence, we propose that individuals who value work over family will react differently to interruptions caused by private smartphone use than individuals who value family over work. Since work centrality reflects a tendency to be fully engaged with the tasks at hand (Hirschfeld & Feild, 2000; Paullay et al., 1994), interruptions from the less valued domain (i.e., family/home) will have a stronger impact on exhaustion than it has for employees with a lower work centrality and, for example, a stronger family orientation.

Hypothesis 3. The subjective experience of being interrupted by private smartphone use is more strongly positively related to exhaustion for employees who have a high (vs. low) work centrality.

2. Method

2.1. Procedure and participants

Participants were approached using the researchers' social networks. We explained that the study was about their day-to-day behaviors and subjective experiences at work during one working week. Persons could participate in the study if they worked at least four days a week, and used a smartphone for both work-related and private purposes. When potential participants agreed to participate, they received an e-mail including informed consent, explaining the data collection process, and assuring confidentiality of the responses. All employees participated voluntarily and were free to decide whether to continue their participation during the research week. Both actions together resulted in a heterogeneous convenience sample of employees.

The data was collected through a tool for online questionnaires. The layout of the questionnaire was smartphone user friendly. Before starting the daily questionnaires, participants filled out a general online questionnaire including general background variables (demographics), the trait measurement (work centrality) that could be regarded stable over time, and a more extensive informed consent. We asked them to choose a "normal" workweek to participate in the diary part of the data collection. In the study week, they received an e-mail for four successive workdays within one working week. Since many employees in the Netherlands have a part-time day in the week and because in the data collection period there were weeks with single day holidays (e.g., Good Friday, Easter Monday, Ascension day), we chose for four workdays to give more participants the chance to participate. This e-mail was sent late in the afternoon on each study day (approximately 5pm), containing the link to the daily survey questionnaire. We instructed participants to fill out the survey at the end of their workday. Data from the online questionnaire tool show that there was considerable fluctuation in the exact time slots participants filled out the daily questionnaires, both between persons and within persons over the days.

Data collection took place in the Netherlands, using validated Dutch questionnaires. All measurements at the day-level were—when not available in state version—adjusted to daily measurement by including a reference to the current workday.

The study sample consisted of 67 employees, which resulted in 237–268 observations at the *within-person level*. Approximately 12% of all possible responses were missing. Since everyone participated two days or more, no cases were excluded from the data analyses. Participants were 51% ($n = 34$) male and 49% ($n = 33$) female. The mean age was 31.1 years ($SD = 12.38$). The sample was relatively highly educated;

among all participants 37% completed higher vocational training and an additional 42% held a university degree. Participants represented a diverse set of industries and held a broad variety of jobs. Specifically, the largest job categories comprised service jobs (26.9%), teaching, culture and science (14.9%), technical jobs (11.9%), and healthcare (10%).

2.2. General questionnaire (trait measures)

Work centrality was measured with the 5-item work-family centrality scale developed by Carr et al. (2008). Example items are: "The major satisfaction in my life comes from my work rather than my family," and "Overall, I consider work to be more central to my existence than family." All items were rated on a five-point Likert scale: 1 = totally disagree to 5 = totally agree. Cronbach's α of the scale was 0.71.

Demographics included in this general questionnaire were gender, age, educational level and job title.

2.3. Diary questionnaires (state measures)

Daily private smartphone use during work time was measured with the four-item smartphone-use scale developed by Derks and Bakker (2014). Besides a reference to time (today), we explicitly included a reference to private use in our measurement. Example items are: "Today, I felt obligated to answer private messages on my smartphone", and "Today, I was online available for private purposes (e.g., WhatsApp, social media, news, games). All items were rated on a five-point Likert scale ranging from: 1 = totally disagree to 5 = totally agree. As stated in the introduction, we purposely included a variety of applications in our items to provide a more realistic and inclusive view on private smartphone use (Chen & Karahanna, 2014). Cronbach's α of the scale varied across the research days, ranging from 0.60 to 0.72, with an average of 0.68 over all four research days.

Daily interruption by private smartphone use was measured with a self-constructed scale consisting of three items. In the introduction to the questions we emphasized that the questions related to participants' private smartphone use at work during the *current* workday. The items are: "Today, I was often distracted by private messages on my smartphone," "Today, my work was disturbed by my private smartphone use," and "Today my smartphone caused many interruptions at my work" (1 = totally disagree, 5 = totally agree). Cronbach's α of the scale ranged from 0.68 to 0.83, with an average of 0.91 over the four research days.

Valence of private smartphone use was measured with one item asking how positive or negative participants experienced their private smartphone use during the day. Answers were rated on a seven-point Likert scale ranging from 1 = very negative to 7 = very positive.

Daily exhaustion symptoms was measured using four items of the exhaustion dimension of the validated Dutch version of the Maslach Burnout Inventory (Schaufeli & Van Dierendonck, 2001) in the state version (see Derks & Bakker, 2014). Example questions are: "Today I felt mentally exhausted by my work," and "Today, I felt burned out from my work" (1 = completely disagree, 7 = completely agree). Cronbach's α ranged from 0.84 to 0.92, and the average alpha was .88.

Daily Workload was measured as a control variable because high workload is potentially related to our outcome variables and therefore may act as a confounding variable. It was measured with the three-item scale developed by Bakker et al. (2003). An example item is "Today, I had to work extra hard to finish things." (1 = never, 5 = very often). Cronbach's α ranged from 0.72 to 0.90, with an average of 0.83 over the days.

2.4. Strategy of analysis

Our research design entails repeated measurements on the day-level nested within individuals. This resulted in a two-level model with daily observations at the first-level ($N =$ between 237 and 268 study occasions) and the individual participants at the second level ($N = 67$

participants). To do justice to the interdependence of the observations within our data, we conducted multi-level analysis using MLwiN (Rashbash et al., 2000). The predictor variable at the individual level (work centrality) was centered to the *grand mean* and the predictor variables at the day-level (daily private smartphone use, valence of smartphone use, daily interruptions by private smartphone use and daily workload) were centered to the *person mean* (see for a more detailed discussion on the centering of variables regarding cross-level effects Aguinis et al., 2013). The interaction terms were calculated using the centered variables. As the control variable workload was a significant predictor of the outcome variable (exhaustion) and theoretically relevant (Jett and George, 2003; Sonnentag et al., 2010), it was included in further analyses.

3. Results

3.1. Descriptive statistics

Table 1 presents the means, standard deviations, and correlations among the demographic, control and study variables. For each day-level variable, intra-class correlations (ICC1) were calculated in order to examine the proportion of variance that is attributed to the two different levels of analysis. Results showed that 42.6% of the variance in private smartphone use at work, 79.5% of the variance in valence, 57.1% of the variance in the subjective experience of being interrupted by private smartphone use, 46.8% of the variance in workload, and 24.3% of the variance in exhaustion was attributable to within-person variations.

3.2. Hypotheses testing

Hypothesis 1a stated that daily private smartphone use at work is positively related to the subjective experience of being interrupted by your smartphone. Multi-level analysis showed indeed a positive relationship between private smartphone use and feelings of being interrupted ($\gamma = .82$, $SE = 0.09$, $t = 8.73$, $p < .001$). Furthermore, the predictor model showed a significant improvement in model fit over the null model ($\Delta-2x \log = 59.96$, $df = 1$, $p < .001$). Building on this in Hypothesis 1 b, we hypothesized that the positive relation between private smartphone use and interruption would be stronger when the private smartphone was being experienced as negative (vs. positive). To test this proposed moderation, we compared a predictor-only model containing private smartphone use and valence as predictors of experienced interruption by private smartphone use with an interaction model adding the interaction term between private smartphone use and valence. Table 2 shows the multilevel interaction effect of valence in the relationship between daily private smartphone use at work and feeling interrupted to be significant ($\gamma = -.22$, $SE = 0.11$, $t = 2.00$, $p < .05$). Furthermore, the interaction model showed a significant improvement in model fit over the predictor only model ($\Delta-2x \log = 4.12$, $df = 1$, $p < .05$).

Fig. 2 shows the interaction plot, indicating that private smartphone

Table 2

Multilevel Results of the Interaction of Daily private smartphone use and Valence on the subjective experience of feeling interrupted.

	Subjective experience of interruption			
	Predictor-only model		Interaction model	
	Estimate	SE	Estimate	SE
Intercept	2.04	0.08	2.04**	0.08
Private Smartphone use	0.83	0.09	0.81**	0.09
Valence	−0.07	0.04	−0.06	0.04
Private smartphone use x Valence			−0.22*	0.11
Variance level 2 (employee)	0.35 (56%)	0.09	0.35 (56%)	0.07
Variance level 1 (day)	0.28 (44%)	0.05	0.27 (44%)	0.03
−2 Log likelihood	481.768		477.65	

** $p < .001$, * $p < .05$. Data points = 237 of 268 cases in use (respondents $n = 67$, days $n = 4$).

use was even stronger related to the subjective experience of interruption when it was experienced as negative rather than positive. To examine the interaction pattern in more detail, we conducted simple slope tests using the online tool suggested by Preacher et al. (2006). When the valence of private smartphone use was appraised as negative, the relation between private smartphone use and feeling interrupted was

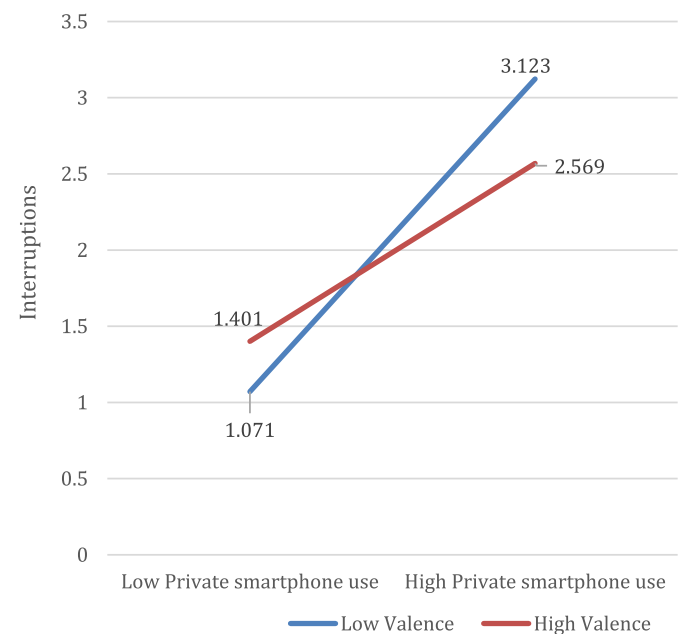


Fig. 2. Moderation effect of valence on the relationship between daily private smartphone use and feeling interrupted by private smartphone use.

Table 1

Means, standard deviations and correlations for all study variables.

	Mean	Std.	1.	2.	3.	4.	5.	6.	7.	8.
1. Gender (0 = male, 1 = female)	.51	.50		-.05	.05	.36**	.17	-.17	.79*	.21**
2. Age	31.1	12.38	-.05		.00	.00	-.00	.01	-.03*	-.22**
3. Workload (D)	3.57	.88	.02	.02		-.11*	-.10	.01	.11	-.05
4. Private smartphone use (D)	2.19	.66	.26**	.05	-.10		.38**	.10	.01	.22*
5. Interruption (D)	2.05	.86	.10	-.02	-.05	.59**		-.05	.17*	.04*
6. Valence smartphone (D)	5.18	1.13	-.08	-.08	-.01	-.20**	-.20**		.02	-.43**
7. Exhaustion (D)	3.08	1.43	.27**	-.21**	.23**	.19**	.22**	-.07	.09	.21
8. Work centrality	2.24	.53	.21**	-.22**	-.04	.17**	.03	-.21**		

** $p < .01$.

Note: $N = 67$ persons, and $N = 237$ – 268 occasions. Correlations below the diagonal are between daily variables are based on averaged scores across the four days that the study took place; correlations above the diagonal are the within-person correlations. (D) = daily measurement.

positive and significant ($\beta = 1.05$, $SE = 0.14$; $t = 7.64$, $p < .001$). When private smartphone use was appraised as positive rather than negative, the simple slope was also positive and significant ($\beta = 0.56$, $SE = 0.17$, $t = 3.31$, $p < .002$). However, as could be expected (since the interaction term was significant), the slopes were different from each other ($t = 2.05$, $p < .05$), providing full support for [Hypothesis 1](#).

Hypotheses 2 suggested that private smartphone use at work is indirectly related to daily exhaustion via the experience of being interrupted. To find out whether our results indeed supported a mediation model, we tested as [MacKinnon et al. \(2002\)](#) suggest, whether both the predictor-mediator and mediator-outcome paths were significant (see also [Kenny et al. 1998](#)). As reported above (H1), the direct relationship between private smartphone use (predictor) and feeling interrupted (mediator) is already established. Next, we tested whether interruptions by private smartphone use (mediator) and the outcome (daily exhaustion) were meaningfully related. Multilevel analysis including interruption as the main predictor and gender and workload as control variables, indicated a significant relationship with daily exhaustion ($\gamma = .23$, $SE = 0.08$, $t = 2.68$, $p < .01$). The predictor model showed a significant improvement in model fit over the control variables only model ($\Delta-2x \log = 7.08$, $df = 1$, $p < .01$). We used the calculation tool of [Preacher and Leonardelli \(2003\)](#) to test the significance of the proposed indirect effect, which supported the proposed mediated relation ($z = 2.74$, $SE = 0.07$, $p < .01$). In other words, private smartphone use related to feelings of being interrupted, which in turn was associated with higher exhaustion. [Hypothesis 2](#) is confirmed.

According to [Hypothesis 3](#), the relationship between feeling interrupted and exhaustion is moderated by work centrality in such a way that this relationship is stronger for employees high in work centrality. We compared the predictor-only model including age, gender, workload, work centrality and experienced interruption with the interaction model. The cross-level interaction effect of interruption by private smartphone use and work centrality on daily exhaustion was significant ($\gamma = .44$, $SE = 0.13$, $t = 3.34$, $p < .001$; see [Table 3](#)). The interaction model showed a significant improvement in model fit over the predictor-only model ($\Delta-2x \log = 10.75$, $df = 1$, $p < .001$).

[Fig. 3](#) shows the interaction plot, indicating that the relation between feeling interrupted by private smartphone use and exhaustion is stronger for employees who consider work more central to their lives than family. Again, to examine the interaction pattern in more detail, we conducted simple slope tests using the online tool suggested by [Preacher et al. \(2006\)](#). For employees high on work centrality, the tested relationship between feeling interrupted and exhaustion was positive and significant ($\beta = .47$, $SE = 0.11$; $t = 4.35$, $p < .001$). For employees low on work

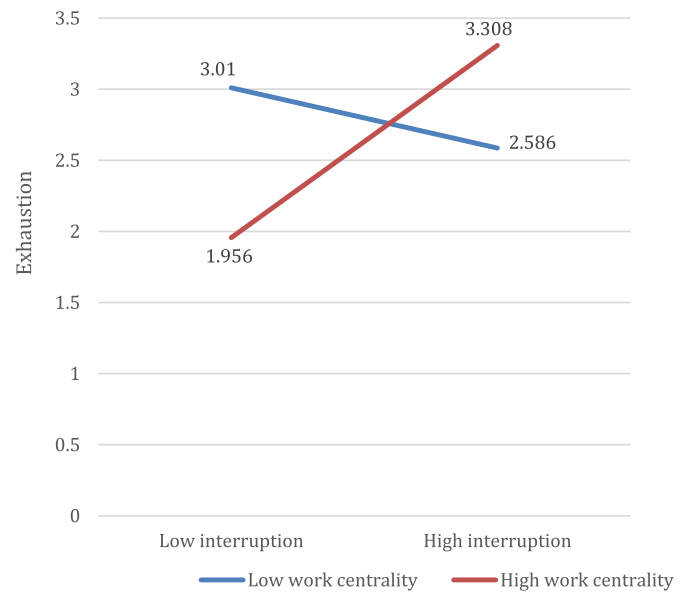


Fig. 3. Moderation effect of work centrality on the relationship between feeling interrupted by private smartphone use and daily exhaustion.

centrality, the simple slope was zero ($\beta = 0.00$, $SE = 0.11$, $t = 0.03$, *n.s.*), indicating that for these employees being interrupted by private smartphone use and exhaustion is not related. [Hypothesis 3](#) is supported. [Fig. 4](#) provides a comprehensive overview of the results.

4. Discussion

The use of smartphones spans the boundaries between the work and family domains, resulting in new opportunities and challenges for employers and employees ([Chesley et al., 2003](#)). Up until now, the consequences of work-related smartphone use in the home domain for work-family conflict ([Boswell & Olson-Buchanan, 2007](#); [Derks et al., 2015](#); [Schlachter et al., 2018](#)), recovery ([Derks & Bakker, 2014](#); [Van Laethem et al., 2018](#)), family role performance ([Derks et al., 2016](#)) and well-being (e.g., burnout symptoms; [Demerouti & Rispens, 2014](#); [Derks & Bakker, 2014](#)) are well understood. However, little is known about the consequences of nonwork-related smartphone use in the work domain. Therefore, the present study aimed to shed light on the other direction of boundary integration, namely private smartphone use at work.

The results of the present quantitative diary study convincingly showed that private smartphone use at work was associated with the subjective experience of being interrupted by it. This effect was stronger when private smartphone use at work was appraised as negative. Examples of negatively evaluated use of the smartphone during work time is when employees learn about a daily hassle in the family domain, reading disturbing news on the Internet, or receiving an unpleasant message in a WhatsApp group. These findings are in line with the work of [Chen and Karahanna \(2014\)](#) on technology-mediated interruptions. The latter study also showed negative side effects of nonwork-to-work technology-mediated interruptions, namely that it had a negative impact on work performance. Additionally, our work on private smartphone use as practice of family-work interference expands the classic work of [Jett and George \(2003\)](#), who made a typology of different types of interruptions, but did not take into account whether these interruptions originated from a context-congruent domain (i.e., work) or a context-incongruent domain (e.g., family, friends or leisure).

Furthermore, we predicted that private smartphone use at work is related to emotional exhaustion at the end of the workday via the subjective experience of being interrupted by it. Again, our results confirmed this hypothesis; on the days employees used their smartphone more intensively for private matters during the workday, they

Table 3
Multilevel results of the interaction of work centrality and feeling interrupted by private smartphone use. On daily exhaustion.

	Daily exhaustion			
	Predictor only model		Interaction model	
	Estimate	SE	Estimate	SE
Intercept	2.72**	0.21	2.72**	0.21
Age	−0.03*	0.01	−0.03*	0.01
Gender	0.78*	0.30	0.78*	0.30
Workload	0.13	0.09	0.12	0.09
Interruption	0.23*	0.08	0.23*	0.08
Work centrality	−0.08	0.29	−0.08	0.29
Work centrality x Interruption			0.44**	0.13
Variance level 2 (employee)	1.3 (73%)	0.25	1.31	0.25
Variance level 1 (day)	0.49 (27%)	0.05	0.46	0.05
−2 Log likelihood	657.43		646.681	

** $p < .001$, * $p < .01$. Data points = 237 of 268 cases in use (respondents $n = 67$, days $n = 4$).

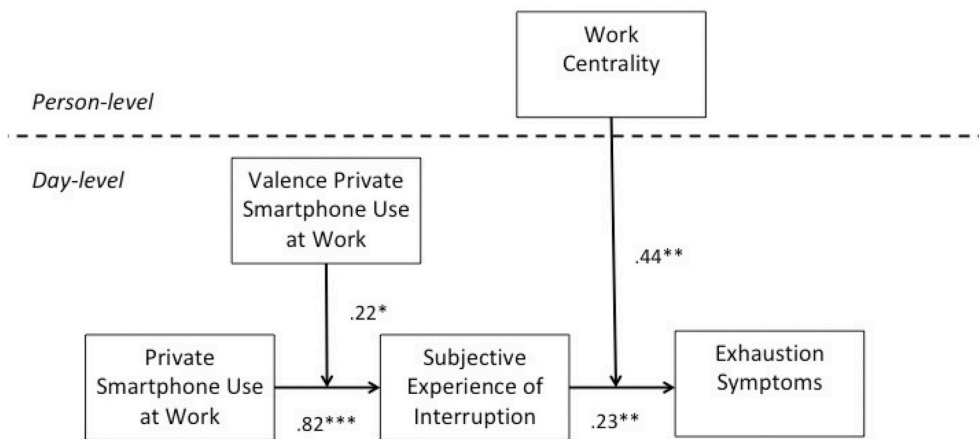


Fig. 4. Graphic representation of the results.

experienced more feelings of being interrupted, which, in turn, was related to increased emotional exhaustion. This means that we provide empirical evidence for the argument that interruptions can be seen as hindering demands or stressors that result in increased strain during the day (Baethge & Rigotti, 2013) refer to work tasks and conditions that require considerable effort (LePine et al., 2005), and that do not have growth potential. Research has shown that on the days employees are confronted with hindrance job demands, they experience reduced well-being (Breevaart & Bakker, 2018; Tadic et al., 2015).

Finally, we explored the moderating role of work centrality in the relationship between interruptions by private smartphone use and emotional exhaustion. We argued that boundary crossing behavior in the form of private smartphone use (family domain) during the working day (work domain) would be interruptive and might have higher costs in terms of exhaustion for those employees who value work over family. The results supported this hypothesis. This finding builds on the literature on work centrality (Paullay et al., 1994) showing that this kind of boundary crossing behavior is more detrimental to employees who identify strongly with work values. Whereas Shi et al. (2018) studied the role of work centrality on the impact of work-related smartphone use in the family domain, we examined the role of work centrality on the impact of private smartphone use in the work domain. Both studies together are complementary in unraveling the role of work centrality in combination with boundary-crossing behavior in both directions of spillover between work and family domains.

Where a stronger work centrality in the family domain was associated with beneficial impact of work-related ICT use at home (Shi et al., 2018); in the work domain, private ICT use was associated with interruptions and deteriorated well-being (current study). This makes sense, since being available for work by ICT in the family domain is less invasive for employees who identify stronger with the work domain—as compared to family—in the first place. In a similar vein, being available by ICT for family demands (less preferred domains) during the working day (preferred domain) is probably more disturbing for employees who identify more strongly with the work role. Of course we have to be careful in drawing conclusions, because these are just two first steps to explore the role of work centrality in combination with boundary-crossing behavior by means of new communication technology. Results of these studies have to be replicated and empirical evidence is still scarce.

Although our study focused on potential downsides of private smartphone use at work, we want to acknowledge that there is also empirical evidence on the bright side of private smartphone use at work. Fritz et al. (2011) argue that private smartphone activities (e.g., gaming, social media) may function as micro-breaks aimed at replenishing resources and increasing energy levels during the working day. Rieger et al. (2017) used an experimental approach to test whether

smartphones can indeed be used as a tool for mobile recovery. The results were mixed. On the one hand, smartphone users showed less relaxation than participants who did not use their smartphone during the waiting situation. On the other hand, smartphone users experienced a higher sense of control, compared to non-users (Rieger et al., 2017). Altogether, there are indications that private smartphone use at work, experienced as micro-break, has recovery potential, and may therefore not only have energetic costs.

Besides labeling private smartphone use at work as either positive or negative, we also have to take into account that this subjective experience may change over time. Dery et al. (2014) conducted a two-wave qualitative case study with a five-year time lag to investigate the user experience of the smartphone. The results indicated that at first, just after being introduced to the smartphone, employees struggled to disconnect and felt the pressure to monitor the constant flow of information. However, five years later, the same users found ways to cope with the opportunity to connect continuously; for example, by buying an additional device for private use only. In other words, over time, there seems to be a learning curve on how to profit from the benefits the smartphone brings without suffering from potential side effects (Dery et al., 2014).

4.1. Limitations

The present study has some limitations that should be acknowledged. At first glance, an experience sampling design would seem more suitable to answer our research questions than a daily diary design. However, we deliberately chose for a daily diary study design with measurements once a day—at the end of the workday—accepting the potential limitation of some retrospective bias. First, one interruption by private smartphone use on your workday might in itself not be exhausting. It takes some time to handle it, and then you move on to the original task at hand. However, when you have many interruptions on a single day, at a certain point it becomes problematic. Switching attention and energy between tasks and interruptions several times a day comes with cognitive costs, which can result in increased strain (Baethge et al., 2015). So, the cumulative effects of multiple interruptions in a limited time frame can be overtaxing mental systems. This implies that exhaustion builds up during the day and cannot be captured after one single interruption. Therefore, measuring at the end of the workday, taking into account all the interruptions of the day, is more representative for how it affects our main outcome variable, daily exhaustion. Second, as Dora et al. (2019) already acknowledged, private smartphone use at work is that ubiquitous, that filling out a questionnaire after every occasion is disruptive in itself or at least prolongs the interruption (Barta et al., 2012). Third, carrying out the assessment of private smartphone use during the workday by random alerts sent by the experience sampling tool may be

seen as intrusive since the reminder provided by the smartphone is in itself an interruption (Ohly et al., 2010).

Additionally, we have to note that all our daily variables were measured at the same moment in time, namely the end of their working day. In other words, the temporal order of the variables could not be established within our design, which has direct implications for the causality of our findings. For future studies, it is important to assess the variables at different points during the day in such a way that the predictor and outcome variables are temporally separated. In addition, we sent the links to the online questionnaires at 5 p.m. with the instruction to fill it out at the end of *their* workday. We did not differentiate between work locations (office, home or third location) or working times, we left this completely open. However, it is clear that employees worked not standard from nine to five. In future research it would be interesting to examine how different locations and worktimes affect employees' work-life integration strategies and what the role of the smartphone is in this process.

Another limitation is that we measured the valence of private smartphone use with one single item by evaluating how positive or negative they appraised it. The reason behind this is that we did not want to overtax participants with too many questions on a day. Furthermore, single item measurements are not uncommon in measuring positive constructs and have proven to be reliable and valid for happiness (Abdel-Khalek, 2006) and job satisfaction (Dolbier et al., 2005).

Finally, there are two characteristics of our sample that we want to reflect on. First, we used a convenience sampling technique to recruit participants. As Demerouti and Rispens (2014) showed, this may account for smaller effect sizes, implying that our results are rather conservative and might be an underestimation of the relations in the general population. Second, our sample consists of relatively young—approximately 31 years on average—participants. The measurement instrument of work centrality explicitly points at the family domain instead of a more general connotation like “nonwork” or “life” domain. Although we already explained in the introduction that the concept of family is much broader than just being a parent, it is still plausible that the results we found are an underestimation compared to the impact of the more general nonwork domain.

4.2. Future research

In the current study, we showed that boundary-crossing behavior (i. e., private smartphone use at work) as a result of the integration of work and family domains, is associated with certain unexplored costs. However, we did not include the motivation behind being available for private matters during work time. Inspired by the work of Delanoeije and Verbruggen (2019), it might be possible that this choice is not always that deliberate or volitional. Employees might experience pressures from both family and work domain to be available, which might serve as an additional stressor that could have influenced our results. Other motives to be engaged in private smartphone use during day could also be explored. For example, the smartphone use could be used as a tool for procrastination (Reinecke & Hofmann, 2016b; Vitak et al., 2011) or as a tool for workplace deviance (Lim & Chen, 2012), especially when work tasks are aversive, boring or too complex. Or, employees may suffer from fear of missing out specific to the context-incongruent domain (Reinecke et al., 2016a). Working parents for example, might wonder whether everything is okay with their children during the day. Others may want to make a phone call to coordinate a reconstruction activity in their house, or sending a text to a close friend who needs (emotional) support.

It would also be interesting for future research to include work-related smartphone use at home in the same study design. Previous research has suggested that employees may compensate for their private smartphone use at work by staying available for work in the evening (Dora et al., 2019), which is in turn would relate to decreased psychological detachment and increased exhaustion (Derks & Bakker, 2014).

As effort-recovery theory (Meijman & Mulder, 1998) states, employees who do not recover well during the evening, might start the next workday in a suboptimal state. When employees start the day with limited resources, because they are still tired, they have to invest additional effort to perform well. As we see in earlier work, dealing with interruptions is associated with cognitive costs (Eyrolle and Cellier, 2000; Zijlstra et al., 1999). This may imply that the resources necessary for dealing with interruptions at work are depleted faster during the day, resulting in feelings of exhaustion at the end of the workday.

4.3. Practical implications

Our results show that private smartphone use at work may have negative implications. Employees experience it as interruptive, which relates positively to exhaustion at the end of the workday. For employees who identify themselves strongly with work values—compared to family—the relation between feeling interrupted and exhaustion is stronger. These findings have implications for organizations and employees. Completely banning private smartphone use during the day might not be the ideal solution, since this will probably increase stress-levels of employees and may have detrimental consequences for their work-life balance. A possible strategy would be to induce interruption-free periods (longer, more frequent) on stressful days (Baethge et al., 2015). Since employees are most aware of their own stress-levels, this could be the result of a proactive boundary management strategy during the day. Another strategy is that parents negotiate who is the first contact when family members need their support. This can be differentiated on days of the week, or, dependent on the type of work they both have on specific days. Colbert et al. (2016) suggest that organizations can encourage mindful usage of technology for their employees in ways that promote time for focused thinking, opportunities for recovery, and effective collaboration. The awareness of how interruptive private smartphone use is during the workday and what potential consequences are in terms of exhaustion, might also be an eye-opener and a possibility to rethink one's own boundary management strategies and the daily enactment of this strategy.

4.4. Conclusion

Taken together, our study contributes to the research field of interruptions (Jett & George, 2003) and boundary theory (Ashforth et al., 2000) in showing the potential costs associated with boundary-crossing behavior in the form of private smartphone use during worktime. Our findings demonstrate that private smartphone use during worktime contributes to the subjective experience of feeling interrupted, even more when the private smartphone use is appraised as negative. Furthermore, we showed that on days that employees are more often interrupted by private smartphone use, they feel more exhausted at the end of the working day; in particular when work is very important to them. We provided consistent empirical evidence that there are downsides to private smartphone use at work in terms of employee well-being.

CRedit authorship contribution statement

Daantje Derks: Conceptualization, Methodology, Formal analysis, Writing - original draft, Writing - review & editing. **Arnold B. Bakker:** Writing - original draft, Writing - review & editing. **Marjan Gorgievski:** Writing - original draft, Writing - review & editing.

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