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RESEARCH ARTICLE

LIFE INTERRUPTED: THE EFFECTS OF TECHNOLOGY-MEDIATED WORK INTERRUPTIONS ON WORK AND NONWORK OUTCOMES[1]

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Work interruptions have made significant inroads into the knowledge workers' nonwork domain, in large part due to the ubiquitous nature of mobile devices that blur the work–nonwork boundaries by enabling work interruptions anywhere and at any time. We examine the effects of such technology-mediated work-related interruptions that occur during one's time off on both work and nonwork outcomes. Leveraging theoretical perspectives from interruption, work–life interface, and conservation of resources, we conceptualize both positive and negative effects of such interruptions on behavioral and psychological outcomes. We identify three mediating mechanisms via which these effects occur: interruption overload and psychological transition via which negative effects occur and task closure via which positive effects occur. Results reveal significant effects of interruptions on work and nonwork outcomes through the three mediating mechanisms. Although positive effects are observed, the total effects of work-related interruptions are detrimental across both work and nonwork outcomes, with the strongest negative effect on work exhaustion. The results suggest that after-hours work interruptions do not necessarily benefit work performance and come at the cost of work exhaustion. Analyses also reveal that the effects of interruptions are dependent on the technology via which these occur. While phone and messaging generate negative outcomes through interruption overload, e-mail leads to both positive and negative outcomes through task closure and psychological transition respectively. The study concludes with implications for research and practice on how to mitigate negative effects and enhance positive effects.

Keywords: Interruption, interruption overload, task closure, psychological transition, exhaustion, performance, work–life conflict, work–life enrichment, work–life interface

Introduction

Mobile communication technologies have contributed to a lifestyle based on interruptions (Hemp 2009). Although interruptions have been studied as a major productivity challenge faced by knowledge workers in the *workplace* (Perlow 1998), what has changed about *work* interruptions is the significant inroads that they have made into knowledge workers' *nonwork*[2] domain, in large part due to the ubiquitous nature of mobile devices that enable interruptions anywhere and at any

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The appendices for this paper are located in the "Online Supplements" section of the *MIS Quarterly*'s website (http://www.misq.org).

[2]We use *nonwork* as a broad-ranging term to capture people's life outside work (e.g., family life, personal life, and community involvement) and contrast it with their work domain. The term nonwork is equivalent to "life" from "work–life" (e.g., work–life conflict, work–life enrichment, and work–life boundary).

time (Chen and Karahanna 2014; Perlow 2012). Although most prior work focused on interruptions in the workplace and their effect on workplace task performance, the ubiquity of mobile technologies makes the transition between work and nonwork more frequent and on a moment-to-moment basis. Knowledge workers navigate their technologically suffused environment by constantly reprioritizing and responding to demands delivered via interruptions across various communication channels (Wajcman and Rose 2011), in order to meet both work and nonwork responsibilities during their time off. The increasingly permeable and flexible boundaries between work and nonwork suggest that after-hours work-related interruptions have ramifications beyond the work domain and impact one's nonwork domain as well (Kossek et al. 2011). Against this backdrop, our study focuses on work-related interruptions that occur in the nonwork domain through technology[3] and examines the effects of such cross-domain interruptions on work and nonwork outcomes.

The changing landscape of work–life interface due to technology-enabled connectivity is reflected in the various terms used in the literature to capture the ever-expanding presence of work in people's nonwork domain, ranging from telecommuting (e.g., Belanger et al. 2001; Gajendran and Harrison 2007) and telework (e.g., Golden et al. 2008) in early studies to mobile e-mail use (e.g., Mazmanian 2013; Mazmanian et al. 2013), electronic communications (e.g., Butts et al. 2015), and smartphone use (e.g., Derks et al. 2016; Ragsdale and Hoover 2016) in recent studies on after-hours connectivity. This also reveals a shift of scholarly attention from institutionalized work arrangements during working hours such as telecommuting to a more unpredictable, ephemeral, and episodic form of after-hours work engagement where knowledge workers experience a transitory form of work–life interaction, making frequent but (generally) momentary transitions between work and nonwork roles through technology-mediated work-related interruptions. Although many of these technology-mediated interruptions are minuscule and take just minutes, the sheer number of such interruptions may turn them into a costly challenge. Moreover, due to the oftentimes unplanned nature of these interruptions coupled with their prevalence, reprioritizing demands and reallocating resources between work and nonwork on the fly represent a constant need (Wajcman and Rose 2011). We aim to understand this increasingly prevalent form of work–life interaction.

There is a consensus in prior research on the impact of after-hours work-related technology use on the work–life interface constructs (e.g., work–life conflict) and work-related consequences (e.g., job satisfaction, turnover intentions), but our understanding of its nonwork-related consequences and of performance effects is rather limited. Moreover, negative consequences have received more scholarly attention than positive consequences (e.g., bringing to closure pestering work demands by leveraging slack resources in the nonwork domain to bring peace of mind). Most studies have focused on one or the other without juxtaposing both *positive and negative* effects on *work and nonwork* domains to provide a more holistic view of the relative magnitudes of such effects and of the net impact of after-hours work-related technology use. In addition, there is little explication of the mediating mechanisms via which these effects on outcomes manifest. Two studies (Butts et al. 2015; Derks et al. 2014) represent emerging efforts in explaining how the effects of after-hours work-related technology use develop, but each focus on a single mediating mechanism and a single outcome. Finally, extant studies have not compared the effects of interruptions delivered by different technologies (e.g., e-mail, phone) to assess technology-dependence of positive and negative outcomes. To address the gaps in the literature, we view after-hours work-related technology use as a form of interruption of nonwork activities by work, and we (1) juxtapose the effects of such interruptions on *both* work and nonwork outcomes; (2) posit *both* positive and negative effects; (3) identify three mediating mechanisms via which these effects occur; (4) compare the *mediated* and net *total effects* of interruptions on outcomes; and (5) examine effects cumulatively across technologies and individually by technology. From a practical perspective, the question we aim to address is whether these interruptions, which have been shown to have negative effects on work–life interface, have benefits as well—at least on work outcomes. Further, by opening up the black box to include mediating mechanisms that juxtapose when and how interruptions can be harmful and beneficial we can devise interventions (e.g., technology features) that can forestall negative effects and leverage positive effects.

Related Literature

After-Hours Work-Related Use of Technology

A number of studies have focused on the consequences of *work-related* technology use occurring in the nonwork domain (see Appendix A).[4] Work–life interface outcomes

[3]For brevity, we refer to work-related interruptions that occur in the nonwork domain through technology as after-hours work-related interruptions or just work-related interruptions, unless we specifically indicate otherwise.

[4]Our literature review on after-hours work-related technology use identified 28 studies (Appendix A). Twenty-three studies include work-related technology use outside work, whereas the other five examine other constructs such as addiction to mobile e-mail (Turel et al. 2008, 2011), organizational encouragement for dual use of mobile IT (Köffer et al. 2014), technology overload (Harris et al. 2015), and workplace telepressure (Barber and Santuzzi 2015). Nine out of the 23 studies do not differentiate between

represent the most researched consequences of after-hours work-related technology use and include work–life conflict (e.g., Boswell and Olson-Buchanan 2007; Butts et al. 2015; Derks et al. 2016; Chen and Karahanna 2011; Fenner and Renn 2010; Ferguson et al. 2016; Freitas et al. 2015; Ragsdale and Hoover 2016), psychological detachment (Derks et al. 2014), and blurring of work–life boundaries (Mazmanian 2013; Mazmanian et al. 2013). Work-related outcomes are examined in seven studies and include job burnout (e.g., Ferguson et al. 2016), work exhaustion (e.g., Derks et al. 2014; Ragsdale and Hoover 2016), organizational commitment (e.g., Ferguson et al. 2016), turnover intentions (e.g., Ferguson et al. 2016), work autonomy and work communication norms (Mazmanian et al. 2013), work engagement (Ragsdale and Hoover 2016), and work satisfaction (e.g., Diaz et al. 2012). None of the studies has examined work-performance outcomes, which is the outcome commonly examined in interruption studies. Nonwork-related outcomes, solely captured by nonwork performance, are examined in only three studies (Chen and Karahanna 2011; Derks et al. 2016; Freitas et al. 2015). While after-hours work-related technology use can lead to important consequences in both the work and nonwork domains, none of the studies reviewed has juxtaposed both work-related and nonwork-related effects in the same model to empirically assess the overall impact. It is also noteworthy that while all studies acknowledge negative consequences, only two report positive effects in terms of reduced work–life conflict and enhanced nonwork performance (Derks et al. 2016) and increased work satisfaction (Diaz et al. 2012). Only Diaz et al. (2012) includes both positive and negative (increased work–life conflict) effects in the same model to understand their relative magnitudes.

Moreover, there is limited understanding of the mechanisms via which after-hours work-related technology use leads to outcomes with only two studies[5] identifying mediating mechanisms. Specifically, Butts et al. (2015) identify anger as a mechanism between electronic communications during nonwork time and work–life conflict, and Derks et al. (2014) report psychological detachment as a mechanism between after-hours work-related smartphone use and work exhaustion. Although both studies have enhanced our understanding of how after-hours work-related technology use impacts outcomes, they solely focus on mechanisms leading to *negative work* consequences, each examining a single outcome (i.e., work–life conflict and work exhaustion, respectively), without differentiating the effects by technology. In fact, most of the studies reviewed examine the effects of after-hours work-related technology use cumulatively across technologies with the exception of two qualitative studies on mobile e-mail use (Mazmanian 2013; Mazmanian et al. 2013).

Hence, our review suggests that (1) nonwork outcomes of after-hours work-related technology use have received limited attention relative to work–life interface and work-related outcomes; (2) prior research is skewed toward negative outcomes, leaving positive outcomes underexplored; (3) how after-hours work-related technology use leads to positive and negative, work and nonwork outcomes is not yet well understood; and (4) separate effects via specific technology are less explored than the cumulative effects across technologies. We aim to address these gaps.

Technology-Mediated Interruptions

We draw upon the interruption literature to understand the episodic and oftentimes unpredictable nature of after-hours work-related technology use. An interruption refers to an occurrence that impedes or delays the recipient by breaking the continuity of an ongoing activity (Jett and George 2003). It is a discrete occurrence, with a finite duration and clear starting and ending points. The focus of our study, an *after-hours work-related technology-mediated interruption*, is a work-related occurrence via technology that impedes or delays an individual by breaking the continuity of an ongoing task in the nonwork domain (that is not necessarily technology-based).

Interruptions have been studied as a productivity challenge in the *workplace* (Perlow 1998). These interruptions dampen knowledge workers' ability to think profoundly for any length of time (Ophir et al. 2009) and their ability to engage in anything that requires sustained attention (McFarlane and Latorella 2002); negatively affect decision-making performance (Gupta et al. 2013; Speier et al. 2003) and appraisal of workload (Kirmeyer 1988); and have been associated with stress (Galluch et al. 2015) and process losses (Cameron and Webster 2013). It takes individuals an average of 8 uninterrupted minutes to get into productive thinking and a creative state (Fried 2005), but, once they are interrupted, it costs them

work-related and nonwork-related (e.g., gaming, social media use, etc.) use and examine the work and nonwork impact of *overall* (work-related and nonwork-related) technology use outside work. The other 14 studies, which are relevant to our study, have a defined focus on work-related use. Given our focus on the consequences and mediating mechanisms of after-hours work-related interruptions, our discussion draws upon the 12 studies in this set that focus on downstream consequences (2 of the 14 studies focus solely on antecedents (Richardson and Benbunan-Fich 2011; Tennakoon et al. 2013)).

[5]We identified four studies that examine the mediating effect of *work–life conflict* on the relationship of work-related technology use to nonwork performance (Chen and Karahanna 2011; Derks et al. 2016; Freitas et al. 2015) and turnover intentions (Ferguson et al. 2016). Given our focus on the mediating mechanisms through which work-related technology use influences outcomes, rather than the interrelationship between outcomes, we excluded these.

about 25 minutes to return to the interrupted task (Mark et al. 2005). Although work interruptions have made significant inroads into knowledge workers' *nonwork* domain, little scholarly attention in the interruption literature has been devoted to work-related interruptions outside work. Such interruptions cross the temporal and geographical boundaries between work and nonwork domains, and thus generate consequences beyond work.

We examine the effects of work-related interruptions at the *aggregate* level, both across interruptions and across technologies. First, although interruptions have been studied as a *task-level* phenomenon (with a focus on the effect on task performance), examining their effects on work and nonwork outcomes (i.e., at the domain level rather than the task level) requires that we focus on the *cumulative* effects of interruptions. A single work-related interruption, when assessed in isolation, may not demonstrate a salient impact on a work or nonwork domain. However, although the amount of resources demanded by *each* interruption may be negligible, collectively such interruptions can consume significant amounts of resources that would otherwise be devoted to nonwork activities. This collective effect may have a salient impact on outcomes that would be missed if we focus at the task level or on the effect of a single interruption. Second, work-related interruptions may occur through a wide variety of devices (e.g., tablet) and applications (e.g., e-mail). To assess the cumulative effects of interruptions, it is therefore important to capture work-related interruptions that occur via *multiple* applications and across devices.

Work–Life Interface

Given our focus on interruptions that cross the work–life boundary, our theorizing also draws upon the work–life interface literature, which acknowledges both positive and negative work–life interactions and is relevant given the potential positive and negative effects of after-hours work-related interruptions. Negative effects are captured by work–life conflict, which acknowledges opposing demands from one's work and nonwork domains such that meeting demands in one domain makes it difficult to meet demands in the other (Greenhaus and Beutell 1985). Positive effects are captured by work–life enrichment, which acknowledges that experiences in one domain can improve the quality of engagement in the other (Greenhaus and Powell 2006).

Mobile technologies have made the boundary between work and nonwork increasingly flexible and permeable, enabling people to cross work–nonwork boundaries when necessary and dynamically allocate resources to tasks across the two domains. This gives rise to work flexibility, defined as one's ability to influence "when, where, and for how long one engages in work-related tasks" (Hill et al. 2008, p. 152). Although work–life interface research has reported a variety of organizational practices designed to provide flexibility for when knowledge workers engage in work-related tasks (e.g., flextime) and where they do so (e.g., flexplace), these practices represent institutionalized forms of flexibility that result from deliberate design efforts of organizations and have well-defined and preplanned transitions between work and nonwork. Mobile technologies enable flexibility in when and where work is conducted beyond such formal arrangements in that they enable *moment-to-moment* transitions between work and nonwork. As a result, knowledge workers are often caught in an ongoing process of juggling work and nonwork demands and making micro-role, on-the-fly transitions between the two domains. This enables knowledge workers to dynamically and more optimally allocate their resources globally rather than being confined within the geographical and temporal boundaries of a certain domain. These moment-to-moment transitions between work and nonwork roles and their implications are not yet well explored and work–life interaction scholars call for research to understand the impact of technology on the blurring of work–nonwork boundaries (Kossek et al. 2011).

Conservation of Resources Theory

The conservation of resources (COR) theory (Hobfoll 1989) postulates that individuals strive to conserve and acquire valued resources, which include time, energies (e.g., physical, mental, and psychological energies), conditions (e.g., marriage, organizational tenure), objects, and personal characteristics (e.g., self-esteem) (Grandey and Cropanzano 1999), with time and energies being especially relevant to our examination of the effects of work-related interruptions. According to the *resource conservation* tenet of COR, negative outcomes such as psychological and behavioral strains arise from actual or anticipated resource loss (e.g., when resource demands exceed an individual's capacity). The *resource acquisition* tenet of COR suggests that people invest personal resources in order to gain new resources, and that positive outcomes result when they have enough resources to invest in a way that fits their preferences.

We leverage COR to understand the resource dynamics induced by work-related interruptions to explain how such interruptions influence work–life conflict and enrichment. Although the work–life interface perspective identifies various ways in which work–life interaction may produce positive or negative outcomes due to the shift of resources across domains, the COR theory explicitly recognizes the critical role of resource dynamics. From the COR perspective, work–life conflict and enrichment are essentially the outcomes of individuals' resource allocation. After-hours

work-related interruptions entail shifting resources across the work–life boundary to meet work demands, and excessively doing so may eventually deplete people's *resource reserves* (defined as the resources needed by individuals to adequately engage in the nonwork domain). As such, given its emphasis on the role of resources in generating and preventing strain outcomes, particularly for discretionary behaviors, COR provides a useful lens to examine the dynamics of resource allocation during after-hours interruptions and understand their impact.

Research Model

To explain the negative and positive effects of work-related interruptions on work and nonwork outcomes, we identify three mediating mechanisms—interruption overload, psychological transition, and task closure—that capture the dynamics of resource losses and gains (Figure 1). We will elaborate on these in the following section. While interruption overload and psychological transition capture negative effects, task closure captures positive effects.

Negative Effects

Work-related interruptions pose a threat to people's resources of time and energy and, often, to personal relationships in that devoting resources to interruptions leaves one with fewer resources to address nonwork obligations, making this a zero-sum game. The invasive effects of technology on people's nonwork domain have intensified this by expanding situations where individuals have less time and energy to spend with family but instead devote these resources to addressing work demands, a concept called *techno-invasion* (Tarafdar et al. 2007). To conceptualize the negative effects of interruptions, we draw upon (1) work–life conflict, which represents the simultaneous occurrence of opposing demands from work and nonwork such that meeting work demands makes it difficult to meet nonwork demands (Greenhaus and Beutell 1985), and (2) COR's resource conservation tenet that suggests that anticipated and actual loss of resources can give rise to psychological and behavioral strains (Grandey and Cropanzano 1999).

The literature identifies three major forms of work–life conflict relevant to our study: time-based, strain-based, and psychological conflict (Greenhaus 1988). Time-based conflict occurs when devoting time to work consumes time needed to fulfill nonwork responsibilities (Greenhaus and Beutell 1985). Strain-based conflict occurs when work-produced strain (e.g., fatigue, tension) makes it difficult to meet nonwork demands (Greenhaus and Beutell 1985) by decreasing one's mental and physical resources (Edwards and Rothbard 2000). Both time-based and strain-based conflicts are centered on the transfer of valued resources from nonwork to work and how this hampers psychological and behavioral outcomes, motivating conceptualization of negative effects of interruptions through *interruption overload*. Psychological conflict is concerned with individuals' psychological preoccupation with work while they are physically in the nonwork domain, motivating conceptualization of negative effects through *psychological transition*.

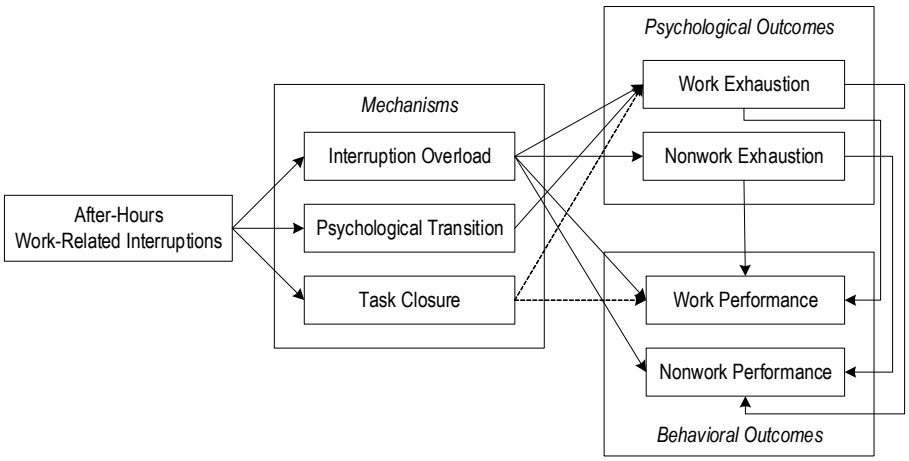
Negative Effects Through Interruption Overload

According to COR theory, psychological and behavioral strains arise when demands are appraised as taxing or exceeding one's available resources (Halbesleben and Bowler 2007; Halbesleben and Wheeler 2015). Although work-related interruptions represent a form of resource drain where time and energy consumed by the interruptions reduce the amount available for engagement in nonwork (Edwards and Rothbard 2000), we suggest that such shift of time and energy to work becomes consequential, giving rise to time-based and strain-based conflict *only* when it starts eroding one's resource reserve and thus impairs one's capacity to meet nonwork demands. Thus, we define *interruption overload* as the state in which individuals have more work-related interruptions than they can adequately handle in the nonwork domain.[6] We discuss the resulting negative psychological and behavioral consequences of interruption overload next.

Psychological Outcomes: *Work exhaustion*, defined as the depletion of emotional and mental energy by work demands (Moore 2000), is a widely studied psychological outcome in the work–life interface literature (e.g., Leiter and Maslach 1988) and relevant to the current study where interruptions place additional work demands on knowledge workers during nonwork hours. Work exhaustion results in individuals experiencing fatigue, irritability, wearing out, frustration, and being used up (Maslach and Jackson 1981) as well as a general loss of concern, interest, spirit, and trust (Maslach 1982).

Work-related demands through interruptions creep into people's nonwork domain, sometimes even causing activities (e.g., seeing a movie) to be rescheduled or canceled. This is exacerbated by heightened work expectations for around-the-clock responsiveness resulting from increased connectivity

[6]This is based on the definition of information overload, which refers to the state in which an individual is no longer able to process or utilize all communication inputs, experiencing breakdown (Rogers and Agarwala-Rogers 1975).



For paths between mediators and dependent variables, adverse effects are represented by solid lines and beneficial effects by dotted lines.

Figure 1. Research Model

(Mazmanian et al. 2013). After a point, demands from an excessive number of work-related interruptions exceed one's slack resources available to accommodate them, resulting in time-based and strain-based conflicts. As a result, individuals feel stressed, irritable, tense, fatigued from work, and exhausted. Empirical evidence corroborates this: frequency of IM interruptions has been linked to perceptions of increased workload (Gupta et al 2013) which, in turn, has been associated with work exhaustion (Moore 2000).

H1: *The positive relationship between extent of after-hours work-related interruptions and work exhaustion will be mediated by interruption overload.*

We define *nonwork exhaustion* as the depletion of one's emotional and mental energy by *nonwork* demands. When people are *overloaded* with work-related interruptions, work demands have exhausted their slack resources and start tapping into resources necessary to meet nonwork demands. The volume of nonwork demands, which used to be manageable, may become overwhelming when individuals no longer have adequate time and energy to attend to them. As such, they will experience time-based and strain-based conflicts and feel irritable, tense, stressed, and fatigued when they try to satisfy the nonwork demands with a shortage of time and energy.

H2: *The positive relationship between extent of after-hours work-related interruptions and nonwork exhaustion will be mediated by interruption overload.*

Behavioral Outcomes: Task performance has been the focal outcome in interruption studies and there is abundant evidence that interruptions impair productivity, increasing errors and execution time of the primary task (e.g., Speier et al. 2003). Performance at the domain level is an accumulation of performance across tasks. A few task-level incidents of errors or increase in execution time may not result in noticeable performance loss at the aggregate level. However, these become salient when accumulating beyond a tolerable range or occurring too frequently. As such, we examine the collective impact of interruptions on work and nonwork performance.

Through work-related interruptions, knowledge workers essentially supplement their time at work by taking work home, which can lead to deleterious consequences in their nonwork domain (e.g., Ayyagari et al. 2011). Work-related interruptions may affect *nonwork performance* (defined as the fulfillment of the general demands and responsibilities associated with one's nonwork domain, such as family, leisure, community (Frone et al. 1997)) when they collectively exhaust individuals' slack resources and leave them with inadequate time and energy to fulfill their nonwork responsibilities in a timely and satisfactory manner. This is corroborated by empirical evidence of the negative effects of work-related interruptions on nonwork performance both in the United States and in Brazil (Chen and Karahanna 2014; Freitas et al. 2015).

H3: *The negative relationship between extent of after-hours work-related interruptions and nonwork performance will be mediated by interruption overload.*

Work performance refers to the fulfillment of the general demands and responsibilities associated with one's work (Frone et al. 1997). The constant connectivity to work, along with a growing expectation for around-the-clock responsiveness and work commitment, has extended work beyond the workplace (Mazmanian et al. 2013). Although one would expect this to result in work performance gains, we suggest that when overloaded with work-related interruptions, individuals may not have sufficient resources to address the buildup of work demands and, therefore, may fail to respond in a timely manner or even miss some truly important ones.

H4: *The negative relationship between extent of after-hours work-related interruptions and work performance will be mediated by interruption overload.*

Negative Effects Through Psychological Transition

Psychological transition refers to the psychological movement between work and nonwork, including disengagement from one domain and engagement in another (Ashforth et al. 2000). Although a physical transition from nonwork to work is no longer necessary due to mobile technologies, addressing after-hours work-related interruptions requires psychological transitions that allow individuals to activate appropriate work-related mental models and behaviors. These psychological transitions may result in psychological conflict, that is, psychological preoccupation with work while within the nonwork domain (Carlson and Frone 2003; Greenhaus 1988). The asynchronous nature of many communication technologies further facilitates psychological transitions from nonwork to work. For example, e-mail enables one to rehearse a message before sending or reinterpret a message after the communication is over, making it challenging to keep these work-related thoughts well contained within the duration of the interruption.

The resources consumed during psychological transitions may not add up to a significant amount, but such transitions generate a feeling that one's leisure time is fragmented and invaded, which is a significant source of strain (Ragu-Nathan et al. 2008). Through psychological transitions, ruminative thoughts about work can give rise to elevated levels of psychological fatigue and make individuals unable to unwind from work during nonwork hours, which is linked to impaired well-being and recovery experiences (Sonnentag and Fritz 2007). Further, psychologically disconnecting from work after hours reduces work exhaustion by enabling individuals to take a temporary break from work demands (Sonnentag et al. 2010). As such, as work-related interruptions increase, we expect them to generate work exhaustion by nurturing preoccupation with work and depriving individuals of real time off.

H5: *The positive relationship between extent of after-hours work-related interruptions and work exhaustion will be mediated by psychological transition.*

We do not hypothesize mediated effects of psychological transition on nonwork exhaustion, work performance, or nonwork performance. First, nonwork exhaustion is defined as depletion of an individual's emotional and mental resources by *nonwork* demands and, therefore, not directly influenced by a work stressor. Second, unlike interruption overload, the mediating mechanism of psychological transition does not connote tapping into critical reserves (i.e., exceeding available slack resources), which would influence work and nonwork performance. Rather, psychological transition captures the fragmentation of one's mental space by work rumination (i.e., work exhaustion). Such an *internal* element of work–life interference may or may not exhaust one's slack resources and thus does not necessarily manifest in *outward* behavioral interference such as performance (Carlson and Frone 2003).

Positive Effects

Positive Effects Through Task Closure

We draw upon work–life enrichment and COR's resource acquisition tenet to conceptualize the positive effects of work-related interruptions. What people derive from their participation in one domain, such as skills, income, social capital, and flexibility, may facilitate their participation in the other domain (Carlson et al. 2006). Among these, work flexibility (Hill et al. 2008) is particularly relevant to our study since mobile technologies enable temporal and geographical flexibility. Such flexibility enables knowledge workers to reprioritize work and nonwork demands during the fleeting moments of work-related interruptions and use their time and energy more effectively, making these resources available to work-related tasks at times of most benefit. Positive outcomes result when people have the resources necessary to effectively handle work and nonwork demands, when they are able to allocate resources in a way that fits their preferences, and when they feel satisfied with the way they invest their resources (Grawitch et al. 2010). Work-related interruptions present an opportunity for people to allocate resources globally in a way that enhances their chances for resource gains and fits their preferences.

Therefore, addressing work-related interruptions may reflect individuals' deliberate resource investment strategies to acquire resources by achieving work goals or responding to work stressors. As such, we posit that work-related interruptions may be beneficial when they enable individuals to mobilize and use slack resources in their nonwork domain to address those work-related demands that truly deserve preferential treatment. Given that such flexibility can also be misused or abused when people make poor prioritization decisions, we propose task closure as the mediating mechanism via which positive effects can result from one's careful evaluation and mindful choice of which interruptions to accommodate. *Task closure* refers to the extent to which after-hours work-related interruptions allow one to bring to completion unfinished work-related communications or tasks. It captures individuals' selective boundary-crossing behaviors when they choose to accommodate certain work-related interruptions.

Psychological Outcomes: After-hours preoccupation with work may arise from tasks that are left unfinished when individuals physically exit the work domain. A number of studies attest to the spillover between work and nonwork (Ashforth et al. 2000; Edwards and Rothbard 2000; Rothbard 2001). Emotions and behaviors in one domain can carry over to the other, so suspended or unfinished work tasks may linger as people transition from work to nonwork, calling for closure. These lingering thoughts may give rise to elevated levels of work exhaustion as they make people unable to disengage from work. In fact, lack of closure is associated with psychological interference (Rennecker and Godwin 2005) and anxiety (Colbert et al. 2006; Freeman et al. 2006). Work-related interruptions can mitigate the anxiety, frustration, and preoccupation that result from individuals' unresolved concerns with work to the extent to which they allow individuals to bring to closure their lingering work-related tasks and thoughts, and free up their mental and emotional resources, allowing them to disengage from work. Therefore, we expect work-related interruptions to mitigate work exhaustion by enabling task closure.

> **H6**: *The negative relationship between extent of after-hours work-related interruptions and work exhaustion will be mediated by task closure.*

Behavioral Outcomes: Work-related interruptions enable individuals to continue with and further bring to completion unfinished work-related tasks after hours rather than waiting until they physically return to work. As a result, people can shorten the turnaround time in accomplishing these tasks. This can happen even during short in-between times in a fashion called *time slicing*, which refers to people using very small portions of time to be productive (Govindaraju and Sward 2005). For example, people can reply to a client's inquiry while waiting to be seated at a restaurant. Hence, we expect work-related interruptions to enhance work performance by enabling individuals to leverage the slack resources in their nonwork domain and bring unfinished work-related tasks to closure.

> **H7**: *The positive relationship between extent of after-hours work-related interruptions and work performance will be mediated by task closure.*

We do not hypothesize mediating effects of task closure on nonwork exhaustion or nonwork performance. Nonwork exhaustion is the depletion of one's emotional and mental energy by nonwork demands and, therefore, not directly affected by task closure that involves work demands. Although task closure may benefit the performance of a specific nonwork task by reducing one's preoccupation with work, thus enabling one to fully engage in the nonwork task, we do not expect such effect to manifest at the *domain* level unless the preoccupation accumulated across interruptions has tapped into one's resource reserves, which we capture via information overload.

Control Variables

We included four control variables in the study. First, *polychronic orientation*, defined as the extent to which one prefers to be engaged in two or more tasks simultaneously (Bluedorn et al. 1999), controls for individual differences in dealing with concurrent tasks (i.e., interruption and the primary task) and has been shown to affect individuals' performance and resource allocation during concurrent tasks (Bluedorn et al. 1999; Cameron and Webster 2013). Second, prior research has identified several demographic variables influencing work–life interaction. *Gender* is a commonly included demographic variable, given that prior studies report gender differences in the spillover effects between work and nonwork (e.g., Rothbard 2001) and on the likelihood that one places importance on nonwork roles (Cinamon and Rich 2002). Moreover, *presence of children* has been found to influence one's satisfaction with work–life balance (e.g., Valcour 2007). We also include *age* as a control variable given that age has been found to affect work exhaustion in previous IS studies (Moore 2000). We use fashion consciousness as a theoretically unrelated ideal marker variable to assess common method variance.

Moreover, given the relationship between exhaustion and performance found in prior studies (e.g., Cropanzano et al. 2003) and the spillover effects between work and nonwork outcomes (e.g., Rothbard 2001), we include relationships between our dependent variables. Work and nonwork exhaustions imply fatigue, irritability, and a loss of interest (Maslach and Jackson 1981), all of which interfere with effective functioning in one's work and nonwork domains (i.e., work and nonwork performance). In fact, prior studies have shown that work exhaustion is related to behavioral strain such as withdrawal from people and poor relations with spouse and children (Maslach and Jackson 1981). Moreover, the work and nonwork outcomes in our model can also spill over to the outcomes in the other domain. For example, bringing to closure a pestering work-related task can reduce knowledge workers' work exhaustion, which, in turn, enhances their capability to focus on nonwork responsibilities.

Methodology

Our study employed a two-stage methodology. We first interviewed 16 knowledge workers (total of 20 hours) on technology-mediated interruptions that they experienced in their work and nonwork domains. The interviews yielded qualitative data that informed our conceptualization of outcomes and mediators and scale development. We then conducted a field study using surveys to collect data. We first conducted a pilot study of employees at a Fortune 1000 technology firm to refine and validate our scales (see Appendix B). For the main study, we used a market research firm, eSearch, to survey knowledge workers who use mobile devices. The survey was sent to a random sample of eSearch panel members who were at least 18 years old, worked as knowledge workers full-time in the United States, and had a minimum annual income of $30,000. A total of 354 individuals accessed our survey with valid responses from 237, of which 29 responded after receiving a reminder. Table 1 provides the demographic information for our respondents.

Results of unpaired t-tests suggested no significant differences on the constructs of the study and on demographics between individuals who responded before and after the reminder, alleviating to some extent concerns about nonresponse bias (Armstrong and Overton 1977).

Measures

To measure extent of work-related interruptions, we drew upon existing measures of technology use to develop scales that capture both the frequency and duration of interruptions. We capture these for interruptions that (1) were initiated by others as well as those initiated by the focal individual; and (2) occurred through a range of technologies (i.e., phone, e-mail, and messaging). We chose these three communication technologies based on their prominent role in professional and personal communications as confirmed by our interviewees and our literature review of after-hours work-related technology use.

We operationalize work and nonwork performances in terms of communication responsiveness and responsibility fulfillment. We adapted Moore's (2000) work exhaustion scale to measure work exhaustion and nonwork exhaustion and Roberts and O'Reilly's (1974) information overload scale to measure interruption overload. We developed new scales to operationalize psychological transition and task closure based on the construct definitions and refined them through three rounds of item sorting and a pilot study.[7] We assessed fashion consciousness with two items from the Generalized Overall Fashion Consciousness scale (Gould and Stern 1989). Appendix C shows the scales we used. Responses were captured on seven-point Likert scales.

Data Analysis

We analyzed the data using covariance-based structural equation modeling in Mplus (Muthén and Muthén 2007). Because of missing data for our control variables of age and gender, our effective sample size is 183.[8]

The model fit statistics for our measurement model (confirmatory factor analysis) (see Table 2) are all within the recommended ranges (Kline 2005) indicating that our scales have acceptable psychometric properties. In addition, all of our scales demonstrated (1) high internal consistency reliability, with composite reliability coefficients ranging from 0.79 to 0.95, and above the recommended 0.7 guideline (Fornell and Larcker 1981), (2) good discriminant validity in that the square root of the average variance extracted (AVE) for each construct is larger than the inter-construct correlations, and (3) good convergent validity in that all indicators have good loadings on their substantive latent factors and the AVE for all constructs exceeds 0.5 (see Appendix D).

[7]Details of our scale development and item sorting rounds can be obtained from the first author.

[8]As a robustness check, we also performed the analysis with (1) the full sample (without age and gender as controls) and (2) the 183 respondents but without age and gender as controls. In both cases, the pattern of significant results remained the same as those we present, suggesting that the results of our analysis using the 183 respondents are representative of the entire sample.

Table 1. Sample Demographics

Demographic Variables	Distribution
Age*	Mean = 45.2, Standard deviation = 9.8 ; Missing: 22%
Education*	High school: 3%; Some college: 19%; Vocational technical graduate: 2%; College graduate: 24%; Some graduate school: 6%; Postgraduate degree: 24%; Missing: 22%
Gender*	Male: 39%; Female: 39%; Missing: 22%
Children under 18	0: 54%; 1: 19%; 2: 21%; 3: 5%; 4 and above: 1%
Relationship	Single: 25%; Spouse/Significant other: 75%
Device provided/subsidized by employer	Yes: 35%; No: 65%
Industry*	Agriculture/Forestry/Fishing: 2%; Construction: 4%; Manufacturing: 14%; Transportation/Communications/Utilities: 9%; Wholesale Trade: 2%; Retail Trade: 5%; Finance/Insurance/Real Estate: 10%; Services: 38%; Public Administration: 11%; Missing: 4%
Occupation*	Exec. Mgmt: 2%; Finance/Acct.: 8%; Human Resources: 1%; IT/MIS: 12%; Operations: 8%; Manufacturing: 5%; Health Services: 4%; Shipping/Receiving: 1%; Administration: 8%; Sales/Marketing/PR: 3%; Research: 5%; Missing: 43%

*Data for these variables were provided by eSearch. Missing data reflect individuals who did not provide us with their eSearch ID and, thus, eSearch was unable to provide us with their demographic data.

Table 2. Model Fit Statistics

	Measurement Model (n = 183)	Measurement Model with Common Method Factor (n = 183)	Structural Model (n = 183)
CFI	0.945	0.962	0.931
Chi-square/df	1.623 (599.015/369)	1.459 (496.175/340)	1.625 (752.407/463)
RMSEA (90% Confidence Interval)	0.058 (90% C.I.: 0.050 – 0.067)	0.050 (90% C.I.: 0.040 – 0.059)	0.058 (90% C.I.: 0.051 – 0.066)
SRMR	0.057	0.043	0.085

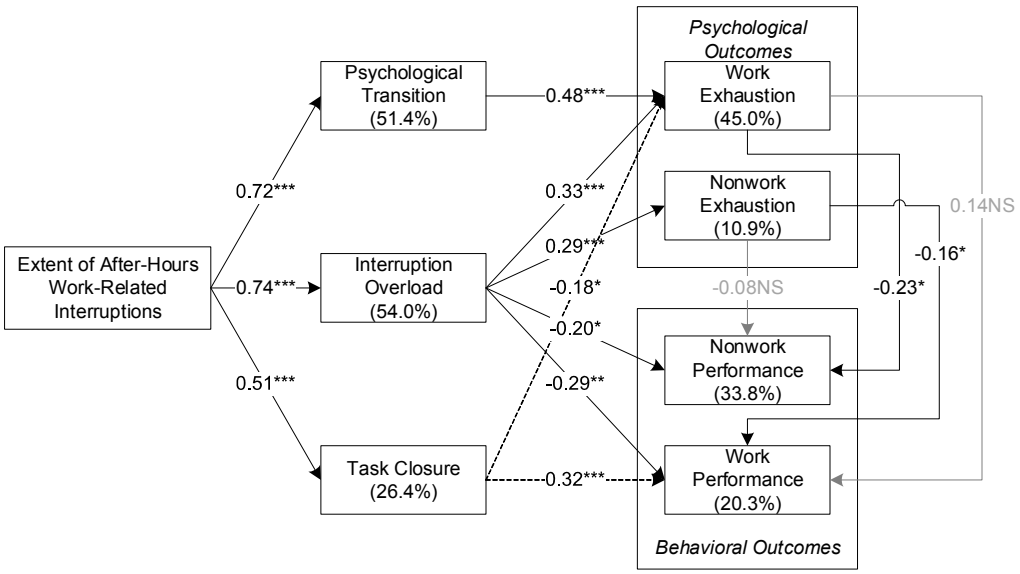
Common Method Variance

We assessed common method variance (CMV) in three ways. First, we included a latent common method factor in the CFA (Podsakoff et al. 2003) and compared the fit indices with our original CFA to assess the presence of common method bias (Table 2). The difference in CFI is 0.017, which is lower than the suggested 0.05 threshold (Little 1997) and the difference in chi-square is nonsignificant. Second, we included a common method factor in our structural model to account for the effect of CMV on the structural paths. Comparison of results across the models with and without the method factor indicates that the pattern of significant and nonsignificant effects remains the same. Finally, we used the CFA marker technique (Williams et al. 2010) to detect CMV by comparing the change in fit between a model in which the marker construct-substantive item loadings are constrained to be equal and one in which they are constrained to zero (i.e., our baseline model). The chi-square difference test was nonsignificant (chi-square difference = 0.087; 1 df), indicating that CMV is not a major concern. Collectively, these results suggest that CMV does not pose a serious threat to the study validity.

Results

The results of our structural model test (Figure 2) support the hypothesized relationships. The fit indices (Table 2) suggest that the structural model demonstrates acceptable fit with the data.

Our hypotheses posited that the effects of interruptions are mediated by interruption overload, psychological transition, and task closure. To test our mediation hypotheses, we use the Sobel test (Baron and Kenny 1986; Sobel 1982) (see Appendix E for details). Specifically, results of the Sobel tests



Nonsignificant effects are represented by grayed-out lines; for paths between mediators and dependent variables, adverse effects are represented by solid lines and beneficial effects by dotted lines.

Control Variables	Work Performance	Nonwork Performance	Work Exhaustion	Nonwork Exhaustion
Polychronicity orientation	0.07NS	0.38***	-0.20**	-0.06NS
Age	0.28***	0.12NS	-0.9NS	-0.004NS
Gender (0 = male, 1 = female)	0.08NS	-0.04NS	0.13*	0.12NS
Number of children under 18	0.09NS	0.20**	-0.08NS	0.13NS

***p < 0.001 **p < 0.01 *p < 0.05 NS - nonsignificant

Figure 2. Structural Model with Results

support the proposed mediating effects of interruption overload between work-related interruptions and (1) work exhaustion (H1) ($t = 3.99$, $p < 0.001$); (2) nonwork exhaustion (H2) ($t = 3.56$, $p < 0.001$); (3) nonwork performance (H3) ($t = -2.21$, $p < 0.05$); and (4) work performance (H4) ($t = -2.79$, $p < 0.01$). The Sobel tests also support the proposed mediating effect of psychological transition between work-related interruptions and work exhaustion (H5) ($t = 5.36$, $p < 0.001$) and the proposed mediating effects of task closure between work-related interruptions and (1) work exhaustion (H6) ($t = -2.32$, $p < 0.05$); and (2) work performance (H7) ($t = 3.74$, $p < 0.001$). Thus, we find support for all our hypotheses.

We also tested the proposed full mediation model (Figure 2) against a competing model of both direct and mediated effects (i.e., a partially mediated model). The direct effects of interruptions on outcome variables are not statistically significant. A chi-square difference test for these nested models is also nonsignificant (chi-square difference = 5.35; 4 df). As such, the proposed full-mediation model, the more parsimonious of the two, presents the better fit for the data.

Given that we posited both positive and negative effects via our mediators, we also calculated the total effects of interruptions on the four outcome variables (Table 3) to assess net effects. We elaborate on these results in our discussion section.

Post Hoc Analysis: Technology-Specific Effects

Given that we also captured the frequency and duration of interruptions via phone (mean = 3.24, SD = 1.73), e-mail (mean = 3.72, SD = 1.83), and messaging (mean = 2.35, SD = 1.53) we conducted a *post hoc* analysis to explore whether and how interruptions via these technologies have differential effects on outcomes. We also tested a partially mediated model for each medium but none of the direct effects was significant. Results of this analysis (Appendix F) show that the interruption effects via phone, e-mail, and messaging are mediated by different mechanisms.

Table 3. Total Effects and Mediated Effects

		Work Exhaustion	Nonwork Exhaustion	Work Performance	Nonwork Performance
Extent of Interruptions (overall)	**Total Effects**	**0.49**	**0.21**	**-0.08**	**-0.26**
	Through Interruption Overload	0.24	0.21	-0.24	-0.20
	Through Psychological Transition	0.34			-0.08
	Through Task Closure	*-0.09*		*0.16*	*0.02*

Adverse effects shown in regular font, beneficial effects in italics, total effects in bold.

Table 4. Summary of Hypothesis Testing Results

Hypothesized Effects	Overall	Phone	E-mail	Messaging
H1: Extent of interruptions → Interruption overload → Work exhaustion	Supported	Supported	No	Supported
H2: Extent of interruptions → Interruption overload → Nonwork exhaustion	Supported	Supported	No	Supported
H3: Extent of interruptions → Interruption overload → Nonwork performance	Supported	Supported	No	No
H4: Extent of interruptions → Interruption overload → Work performance	Supported	Supported	No	Supported
H5: Extent of interruptions → Psychological transition → Work exhaustion	Supported	No	Supported	No
H6: Extent of interruptions → Task closure → Work exhaustion	Supported	No	Supported	No
H7: Extent of interruptions → Task closure → Work performance	Supported	No	Supported	No

Our results (Table 4) show that *interruption overload* is the only mechanism that significantly mediates the effects of phone and messaging interruptions on work exhaustion (phone: $t = 3.17$, $p < 0.01$; messaging: $t = 2.46$, $p < 0.05$), nonwork exhaustion (phone: $t = 3.01$, $p < 0.01$; messaging: $t = 2.39$, $p < 0.01$), and work performance (phone: $t = -2.50$, $p < 0.05$; messaging: $t = -2.11$, $p < 0.05$). However, whereas interruption overload mediates the effect of phone interruptions on nonwork performance ($t = -2.01$, $p < 0.05$), it has a nonsignificant mediating effect for messaging interruptions ($t = -1.79$, $p = 0.07$). In contrast, the effects of e-mail interruptions are mediated by *psychological transition* and *task closure*. Psychological transition significantly mediates the effect of e-mail interruptions on work exhaustion ($t = 2.86$, $p < 0.01$) and task closure significantly mediates the effects of e-mail interruptions on work exhaustion ($t = -1.98$, $p < 0.05$) and work performance ($t = 2.75$, $p < 0.01$).

Table 5 presents the total effects of the three technologies. Phone interruptions have the most negative total effects while messaging interruptions have almost neutral (slightly adverse) total effects. E-mail interruptions have a positive total effect on work performance, no total effect on nonwork exhaustion, and almost neutral (slightly adverse) total effect on work exhaustion and nonwork performance.

Discussion

The objective of the study is to understand the effects of after-hours work-related interruptions on work and nonwork. We focus on the cumulative (rather than task-level) effects of such interruptions, acknowledge both their positive and negative consequences, and identify three mediating mechanisms via which these interruptions positively and negatively influence work and nonwork outcomes. Finally, we examine whether these effects vary by the communication medium via which an interruption occurs.

Consequences of Work-Related Interruptions

Our results suggest that the blurring of work–life boundaries due to ubiquitous technologies is consequential not only to work outcomes but also to nonwork outcomes. First, Table 3

Table 5. Total Effects by Technology

		Work Exhaustion	Nonwork Exhaustion	Work Performance	Nonwork Performance
Phone Interruption	**Total Effects**	**0.27**	**0.13**	**-0.13**	**-0.12**
	Through Interruption Overload	0.15	0.13	-0.13	-0.12
	Through Psychological Transition	0.11			
	Through Task Closure				
E-mail Interruption	**Total Effects**	**0.09**	**0.00**	**0.12**	**-0.02**
	Through Interruption Overload				
	Through Psychological Transition	0.16			-0.03
	Through Task Closure	*-0.07*		*0.12*	*0.02*
Messaging Interruption	**Total Effects**	**0.08**	**0.07**	**-0.07**	**-0.07**
	Through Interruption Overload	0.08	0.07	-0.07	-0.07
	Through Psychological Transition				
	Through Task Closure				

Adverse effects shown in regular font, beneficial effects in italics, total effects in bold.

shows that the total effects of work-related interruptions on work and nonwork outcomes are detrimental across the board, increasing work and nonwork exhaustion, impeding nonwork performance, and, to a lesser extent, impeding work performance. Whereas the effect sizes of work-related interruptions on nonwork exhaustion and nonwork performance are moderate (0.21 and -0.26 respectively), interruptions have a small total effect on work performance (-0.08) and a large total effect on work exhaustion (0.49). The relatively sizable total effect on work exhaustion suggests that a foremost influence of these interruptions is the psychological outcome of making us feel drained of emotional and mental energy due to work demands and become unable to psychologically disconnect from work via what some researchers and the popular press call "electronic leashes." The effect sizes also suggest that there is a net cost of these interruptions on the nonwork domain both in terms of feeling mentally exhausted from nonwork demands that now must be met with fewer resources and in terms of hampered ability to meet one's nonwork responsibilities. The total effect of interruptions on work outcomes is mixed. There is a very small negative (almost neutral) effect on work performance but a large negative effect on work exhaustion. In other words, our results suggest that interruptions do not necessarily benefit work performance and come at the cost of feeling exhausted from work.

Second, although work-related interruptions have negative total effects, a closer look at the mediated effects reveals that the effects mediated by interruption overload and psychological transition and those mediated by task closure affect work and nonwork in opposite directions. However, the positive effects through task closure fall short of reverting the negative effects through interruption overload and psychological transition. The only exception is the total effect on work performance where the positive and negative effects are approximately equal. This suggests that not all interruptions are counterproductive. Harnessing the positive effects of interruptions may require that individuals be more discriminating in which work-related interruptions they address in their nonwork domain.

Mediating Mechanisms

One important contribution of our study is the identification of three mediating mechanisms—interruption overload, psychological transition, and task closure—that explain the positive and negative effects of interruptions. Effects mediated by *interruption overload* are of similar magnitude across all four outcomes, suggesting that interruptions will lead to both psychological and behavioral strains when they exhaust individuals' slack resources and tap into their resource reserves. Furthermore, the magnitude of such negative effects does not materially differ across work and nonwork. That is, work-related interruptions adversely influence both work and nonwork when they bring demands into individuals' nonwork domain beyond what they can juggle.

While interruption overload has the broadest impact among the three mechanisms examined in this study, *psychological transition* is hypothesized to only mediate the effect of work-related interruptions on work exhaustion.[9] Given that work

[9]We tested the mediating role of psychological transition on all four outcome variables by adding direct paths between them, but only the effect on work exhaustion is statistically significant.

exhaustion significantly affects nonwork performance as a form of spillover between work and nonwork, the mediated effect of work-related interruptions on work exhaustion further extends to nonwork performance. This latter effect is much weaker, suggesting that effects mediated by psychological transition manifest mainly at the psychological rather than the behavioral level.

Finally, *task closure,* which has positive effects, makes the total effects of interruptions on work performance neutral and mitigates some of the negative effects on the other two outcomes. Moreover, it is noteworthy that the total effect of interruptions mediated by task closure is strongest on work performance and weakest on nonwork performance.

Technology-Specific Effects

The differential effects of interruptions via phone, e-mail, and messaging suggest that the communication medium via which an interruption occurs does make a difference. We suggest that such differential effects can be explained by three different capabilities afforded by the communication technologies: immediacy of feedback, reprocessability, and rehearsability. We suggest that immediacy of feedback influences the process through interruption overload, while reprocessability and rehearsability influence the process via psychological transition and task closure.

Immediacy of feedback delineates the temporal elements of information transmission via a medium, which concerns the interpersonal exchange *among* individuals (Dennis et al. 2008). It influences the amount of *control* an individual has over the timing of information transmission, which is typically negotiated between communicators rather than being entirely within the discretion of either side. Technologies with low immediacy of feedback allow the flexibility of delaying responses without disrupting interaction. As a result, such interruptions allow individuals to delay responses to an opportune time without giving offense. For example, the asynchronous nature of e-mail makes it less intrusive than phone (synchronous) and messaging (near-synchronous). E-mail users can usually tolerate long gaps of silence and e-mail processing is a solitary activity where people do not have to negotiate with their communicators on matters such as when to check e-mails and how much time to spend on writing e-mails. With greater latitude to *control when* and *how* to deal with e-mail interruptions, people may choose a time when they have available slack resources to deal with e-mail interruptions. Such temporal distancing enables individuals to manage their moment-to-moment availability (Mazmanian et al. 2013). Therefore, e-mail interruptions are less likely to affect performance and exhaustion through interruption overload, although individuals in our sample experienced e-mail interruptions to a greater extent than phone and messaging interruptions.

On the other hand, work-related interruptions via technologies high in immediacy of feedback may induce interruption overload. Phone and messaging have high synchronicity. Individuals on one side of a phone or messaging conversation do not have sole control over the duration, timing (when the conversation is initiated), or intensity of the conversation. For example, given the immediacy and social presence features of messaging as a collaborative tool, messaging interruptions typically require immediate attention and preempt individuals from the primary task (Gupta et al. 2013), which may not be a problem until one's slack resources are exhausted. Interruptions via phone and messaging are more likely to be oblivious to individuals' processing capacity at the moment of their occurrence and therefore adversely affect exhaustion and performance when they start tapping at resource reserves (i.e., interruption overload). As such, *we expect immediacy of feedback to influence interruption overload, such that interruptions by technologies high in immediacy of feedback are more likely to lead to those hypothesized effects that are mediated via interruption overload*.

Rehearsability and *reprocessability* represent technology capabilities that facilitate information processing, which concerns the composition and interpretation of information by each individual separately. As such, control over this process is largely under the discretion of the focal individual. Rehearsability refers to the extent to which a medium allows users to revise a message before sending; reprocessability refers to the extent to which a medium allows users to reconsider a message either within the context of the communication or after the communication has ended (Dennis et al. 2008).

Technologies high in rehearsability or reprocessability can give rise to overly frequent or unnecessarily prolonged engagement in message processing (Dennis et al. 2008). Highly rehearsable technologies allow individuals to take more time to compose, deliberate, or edit a message, while highly reprocessable technologies allow individuals to reexamine or reinterpret a message multiple times after it has been received (Dennis et al. 2008). The prolonged and repeated encoding (i.e., drafting and editing) or decoding (i.e., reading and interpreting) of a work-related message requires individuals to *psychologically transition* into their work-related roles longer or more frequently, increasing preoccupation with work. Thus, through interruptions via highly rehearsable or reprocessable technologies such as e-mail, work can linger in a person's mind for a prolonged time or more frequently, which nurtures rumination. As such, *we expect rehearsability and reprocessability to influence psychological transition, such that interruptions by tech-*

nologies high in rehearsability or reprocessability are more likely associated with those hypothesized effects that are mediated via psychological transition.

Although e-mail and messaging are both ranked high on rehearsability and reprocessability (Maruping and Agarwal 2004), our results suggest that preoccupation is salient only in the case of *e-mail* interruptions (as reflected by the significant mediating effect of psychological transition). Unlike e-mail, which is typically considered formal workplace communication and is often used for transmission of complex or large volumes of information, messaging is used predominantly for informal communications, especially a quick and brief exchange with one's communicator. Furthermore, messaging is near synchronous and encourages almost instantaneous response, thus reducing the duration of preoccupation. This may suggest some interaction effects between immediacy of feedback and rehearsability/reprocessability with respect to their effects on psychological transition. Phone communications are low on both rehearsability and reprocessability. Although preoccupation with a phone conversation may linger past its conclusion, one cannot edit or re-listen to a phone conversation, thus limiting the number of psychological transitions to just the two that occurred when people crossed the work–life boundaries (i.e., when they started and ended the phone call). This would explain why the effects of phone interruptions are not significantly mediated by psychological transition.

A communication medium high in rehearsability and reprocessability, such as e-mail, can also facilitate task closure. High reprocessability enables asynchronous communications by documenting a message for the intended recipient to review at a later time when it is more opportune. This represents an important factor that people consider in their choice of communication technologies in order to discharge their responsibility to communicate (Straub and Karahanna 1998). Technologies high in rehearsability allow individuals to interweave encoding of a message with a primary task, as and when they have time, facilitating their efforts in bringing a communication task to closure. Instead of pressuring individuals to mentally compose a perfect version of what they intend to convey, interruptions via highly rehearsable technologies (e.g., e-mail) enable them to take smaller steps toward completing the message by making use of the amount of slack resources available at the moment when they are attending to the primary task. People can create a draft version of the intended communication at different points in time and later review the content before sending it to bring to closure unfinished tasks.

We have abstracted three technology capabilities that provide insights into the technology-specific effects we observed. Our explanations provide a first step toward theorizing technology-specific effects of interruptions. Future research can test our explanations of these technology capabilities, identify additional capabilities, and test their effects on work–life outcomes.

Implications and Conclusion

Limitations

Before discussing the implications of the study we must acknowledge its limitations. This is a cross-sectional study and, therefore, we can only test associations. Thus, our causal explanations are based on our theorizing. Our sample consists of knowledge workers in the United States. This was a deliberate choice in order to eliminate confounding effects of culture. To the extent to which boundary permeability and flexibility and how individuals handle interruptions are culturally dependent, results may not generalize to other cultures (e.g., to feminine cultures (Hofstede 1980) which place a premium on work–life balance). Given that effects may differ in such cultures, cross-cultural studies would be helpful to understand cultural influences on the nature and effects of after-hours work-related interruptions. The use of self-report data to assess work and nonwork performances is another limitation. Although we adapted the performance scales that are widely used in the work–life literature, due to social desirability, it is possible that respondents may have over-reported their assessment of their work and nonwork performances.

Our study used a sample of knowledge workers randomly selected from a panel that met certain criteria in terms of employment, age, and income. We also have information on respondents' age, gender, education, industry, and occupation for the majority of our sample, and information on number of children, relationship status, and whether the device was provided by their employer for all respondents. While we cannot assess nonresponse bias and selection bias (whether the panel from which the sample was drawn is representative of all knowledge workers in the United States), we believe that the demographic information we have, coupled with the criteria used to select the panel, gives a reasonable (though incomplete) picture of who our respondents are. Most previous studies on interruptions have used samples from a particular occupation or profession such as police radio dispatcher (Kirmeyer 1988) and product development teams (Addas and Pinsonneault 2015) or college students (Galluch et al. 2015; Gupta et al. 2013; Speier et al. 2003). Despite the merits of leveraging a cross-industry and cross-organization sample of respondents in our study, future studies should systematically assess generalizability of our results across knowledge workers and within specific organizations and examine how organizational norms may affect the relationships in our model.

Contributions to Research and Future Research

We make several contributions to the research on after-hours work-related technology use in general and on interruptions in particular. First, our study juxtaposes both positive and negative effects of work-related interruptions on both work and nonwork outcomes. Despite the predominantly negative outcomes associated with after-hours work-related technology use, the negative connotation of interruptions, and the negative effects observed in this study, such cross-domain technology use may also yield desirable outcomes such as alleviated exhaustion and performance gains. Identification of such opposing effects articulates the contradictory and complex entailments that knowledge workers face as they integrate mobile technologies into everyday life. As shown by our *post hoc* analysis, the same technology (i.e., e-mail) can empower knowledge workers to dynamically allocate their resources across work and nonwork, but at the same time make it increasingly difficult to psychologically disconnect from work. The dynamics of how the mediated effects lead to total effects also shed light on how such paradoxical effects unfold. Moreover, by juxtaposing both work and nonwork effects of work-related interruptions, we add to the limited understanding of nonwork-related outcomes in the literature. Including both positive and negative effects of interruptions on both work and nonwork outcomes offers a more holistic view, enabling a comparison of effects based on valence (i.e., positive and negative) and scope (i.e., work and nonwork).

Second, we also contribute to the limited understanding of the mechanisms via which the positive and negative effects on work and nonwork outcomes develop. Our identification of the three mediators is not meant to be exhaustive of all mechanisms of how such interruptions affect knowledge workers' everyday practices. Future research can identify additional mediating mechanisms and examine additional psychological and behavioral outcomes other than the ones posited in the current study.

Third, we investigate work-related interruptions that occur via a portfolio of three technologies and examine both the cumulative effects of interruptions through these technologies collectively as well as the distinctive effects of each technology separately. Our *post hoc* analysis reveals differential effects of work-related interruptions that occur via each of these technologies. In addition to the theoretical implications around the three technology capabilities that we have already discussed, the fact that cumulative effects differ from those of each individual technology highlights the importance of including a portfolio of technologies in studies of after-hours work-related technology use to accurately estimate the effects of such use on outcomes.

Furthermore, we also contribute to the literature on interruptions. By focusing on one type of *cross-domain interruption* (i.e., work-related interruptions that occur in one's nonwork domain), this study extends the interruption literature beyond a single domain (primarily the workplace) and beyond the task level, which has been the norm. Assessing the aggregate impact of these interruptions allows us to shed light on the gains and losses *collectively* caused by the interruptions in our work and nonwork domains, which may not be salient when each interruption is examined in isolation. This study can be complemented by future studies that investigate the other type of cross-domain interruption (i.e., nonwork interruptions that occur at work) and its effects. Mobile communication technologies enable nonwork interruptions to make inroads into the work domain as much as they allow work to invade the nonwork territory. Given that work-related and nonwork-related interruptions differ by nature and that work and nonwork domains have asymmetrically permeable boundaries, we expect nonwork-related interruptions to have different consequences in work and nonwork domains and different mediating mechanisms from those identified for work-related cross-domain interruptions in this study.

Given the growing prominence of cross-domain interruptions enabled by mobile communication technologies, future research is needed to understand how knowledge workers can manage interruptions. Cross-domain interruptions are an unavoidable outcome of today's mobile technologies. Therefore, how to manage them represents a major challenge faced by knowledge workers. Interruption management mechanisms can be based on technologies, social norms, and self-discipline and each of these may be differentially efficacious in mitigating negative effects of interruptions (Chen 2011). Future research on this topic would be beneficial.

Finally, we also contribute to the work–life interface and COR literatures by examining cross-domain interruptions via communication technologies as a *transitory* form of work–life interaction that extends beyond the traditional focus on technology-mediated institutionalized practices (e.g., telecommuting) that are common in this literature. Technology-mediated interruptions render work–life interactions more frequent and on the fly during seemingly effortless transitions between the two domains and thus will be more likely to generate different outcomes than other forms of role transition examined in this literature. Given the relative lack of scholarly attention to the matter, researchers call for better understanding of how rapid technological advances affect the work–life interface (Kossek et al. 2011) and identification of new linking mechanisms that account for work–life interaction (Edwards and Rothbard 2000). Our research is a step in this direction.

Additionally, our investigation of work-related interruptions sheds light on individuals' resource allocation decisions made on a *moment-to-moment* basis and *across domains*, which have not been well explored in the COR literature. From the COR perspective, resource allocation, motivated by individuals' need to conserve and acquire resources, is typically studied as a mindful decision with behavioral manifestations at the workplace such as interpersonal citizenship behavior (Halbesleben and Wheeler 2015), employee voice behavior (Ng and Feldman 2012), counterproductive work behavior (Penney et al. 2011), and organizational commitment (Lapointe et al. 2011). Applying the COR perspective to our study on work-related interruptions, we demonstrate the relevance of the COR theory as a lens to understand resource dynamics that repeatedly take place across work–life boundaries in a transitory manner.

Implications for Practice

Our study has important implications for practice. First, understanding how work-related interruptions affect their work and nonwork domains enables knowledge workers to make informed decisions regarding whether and how to deal with interruptions. Given that work-related interruptions have both negative and positive effects, it is important that individuals and organizations are aware of ways to enhance positive and mitigate negative effects. There is a fine line between effectively leveraging interruptions and overusing them, depleting resource reserves. In a world of constant connectivity, it is crucial that knowledge workers know how to sift through the many work demands that creep into their nonwork domain via technologies and identify the interruptions that truly deserve their physical and mental resources.

Second, organizational norms about after-hours technology use should be consciously developed, given the negative effects of work-related interruptions on both work and nonwork domains. Research on geographically dispersed teams has recognized the importance of group operating norms and "contracts" in facilitating technology-mediated communications and collaborations (Cramton 2001). Shared understandings about what behaviors are and are not appropriate also play an important role in shaping people's expectations and behaviors in the context of work–life interaction. The growing prevalence of mobile technologies has given rise to new organizational norms with low tolerance of communication delays even during time off. As such, knowledge workers tend to give preferential treatment to work-related interruptions, and expect the same from their colleagues. Therefore, organizations need to examine their current norms with respect to dealing with work-related interruptions during nonwork hours and develop norms that promote a healthy work–life interface.

Third, developers should make technology a more powerful tool in interruption management. For example, while iPhone users can block all incoming communications with the "Do Not Disturb" feature, they can differentiate more important communications (e.g., emergencies and those from specific groups in one's contacts) from the rest with the "Repeated Calls" and "Allow Calls From" settings. Moreover, after declining an incoming call, users can reply with a pre-set text message (e.g., "I will call you later") or set up a reminder to call back. An emerging direction in human–computer interaction is to develop an interruption management system that can decide on behalf of the mobile users how to handle an incoming call based on contextual factors such as schedule, time of the day, location, relationship with the caller, and whether the user is driving (Vilwock et al. 2013). Thus technological solutions hold great potential in interruption management to enable individuals both to better manage how and when they are interrupted and to make better use of their limited cognitive and attentional resources.

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MIS Quarterly

RESEARCH ARTICLE

LIFE INTERRUPTED: THE EFFECTS OF TECHNOLOGY-MEDIATED WORK INTERRUPTIONS ON WORK AND NONWORK OUTCOMES

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Appendix A

Review of Studies on the Effects of Work-Related Technology Use Outside the Work Domain

The literature review targeted articles published between 1995 and 2016 in the following journals: *MIS Quarterly, Information Systems Research, Journal of Management Information Systems, Journal of the Association for Information Systems, Journal of Strategic Information Systems, European Journal of Information Systems, Information Systems Journal, Information & Management, Information & Organization, Information Technology & People, Computers in Human Behavior, Academy of Management Journal, Academy of Management Review, Journal of Applied Psychology, Journal of Management, Management Science, Organization Science, Personnel Psychology, Human Resource Management Journal, Human Resource Management Review, Journal of Human Resource, Journal of Vocational Behavior,* and *Human Relations*; and in the proceedings of the following conferences: *International Conference on Information Systems and Americas Conference on Information Systems.*

We excluded studies on telecommuting and telework from our review because they represent institutionalized work arrangements and are different from the focus of our study.

Table A1. Review of Studies on the Effects of Work-Related Technology Use Outside the Work Domain

Study	Theories	Methodology	Independent Variable	Dependent Variable	Moderating Variable	Mediating Variable	Control Variable
Studies on Work-Related Technology Use in the Nonwork Domain (targeted at solely cross-domain technology use)							
Boswell and Olson-Buchanan (2007)	Boundary theory	Survey	Affective commitment, job involvement, ambition	Work-to-life conflict (reported by employee and significant other respectively)	N/A	*Frequency of communication technology use after hours*	Marital status, parental status, position, hours spent working during nonwork time in a typical week
Fenner and Renn (2010)	Technology acceptance model	Survey	Perceived usefulness, psychological climate	Work-family conflict	Setting goals/ priorities, mechanics of time management, preference for organization	*Frequency of technology-assisted supplemental work*	Age, gender, education, household income, presence of children at home, conscientiousness, portability of work, reduction of interruptions, ability to work at one's own pace, telecommunications links with office
Chen and Karahanna (2011)	Work–life conflict, interruption	Survey	Frequency of nonwork-to-work other-initiated interruptions, frequency of work-to-nonwork self-initiated interruptions	Nonwork performance	N/A	Work–life conflict	Age, gender, device provided by employer, work load, nonwork load
Richardson and Benbunan-Fich (2011)	Human agency theory	Survey	Organizational distribution, subjective norm, polychronicity, role integration preference, personal innovativeness with IT	*Work connectivity behavior after-hours*	N/A	N/A	Age, gender, marital status, job level
Diaz, Chiaburu, Zimmerman, and Boswell (2012)	Theory of planned behavior	Survey	Communication technology flexibility	Work satisfaction	N/A	*Communication technology use to perform job during nonwork hours, work-to-life conflict*	N/A
Mazmanian (2013)	Frames of reference, cognitive frames	Interview, grounded theory	Use of mobile e-mail devices to work anywhere/ anytime (focus of the qualitative study)	Expanded accessibility, erosion of personal time	Frame (in)congruency	Communication norms, work identity, material aspects of the technological artifact, vulnerability to social pressures, visibility of communication practices	N/A
Mazmanian, Orlikowski, and Yates (2013)	Autonomy	Interview, grounded theory	Use of mobile e-mail devices to work anywhere/anytime (focus of the qualitative study)	Work norms, flexibility, personal autonomy, peace of mind, control over interaction, ability to disconnect from work	N/A	Collective expectations of availability, work engagement	N/A

Study	Theories	Methodology	Independent Variable	Dependent Variable	Moderating Variable	Mediating Variable	Control Variable
Tennakoon, da Silveira, and Taras (2013)	Boundary theory, border theory, human agency	Survey	ICT perception, segmentation, work flexibility, work demands, nonwork demands	Work-related ICT use on work days, *work-related ICT use on nonwork days*, nonwork-related ICT use on work days, nonwork-related ICT use on nonwork days	N/A	N/A	Age, gender, education, income
Derks et al. (2014)	Psychological detachment	Survey (diary)	Work-related smartphone use after working hours	Work-related exhaustion	Perceived segmentation norm	Psychological detachment	Age, gender, workload
Butts, Becker, and Boswell (2015)	Affective events theory	Survey	Affective tone and time required of work-related electronic communication received during nonwork time	Work-to-nonwork conflict	Social context factors (abusive supervision, communication sender), receiver factors (segmentation preference)	Emotional responses (anger, happiness)	Age, gender, marital status, parental status, work hours, and workplace segmentation
Freitas, Maçada, and Brinkhues (2015)	Work–life conflict	Survey	Frequency of work-to-nonwork interruptions, frequency of nonwork-to-work interruptions	Work performance, nonwork performance	N/A	Work-to-nonwork conflict, nonwork-to-work conflict	N/A
Derks et al. (2016)	Boundary theory, work-family conflict	Diary study with surveys	Work-related smartphone use in evenings	Family role performance	Segmentation preference	Work-family conflict	Age, gender, educational level, marital status, number of children living at home, workload
Ferguson et al. (2016)	Family systems theory, conservation of resources theory	Survey	Frequency of mWork (i.e., using a smartphone or tablet with Internet access to engage in work tasks during family time)	Turnover intention	N/A	Time-based work-family conflict, strain-based work-family conflict, behavior-based work-family conflict, burnout, spousal resentment towards job incumbent's organization, organizational commitment, spousal commitment to job incumbent's organization	Age, gender, number of children, organizational tenure, hours worked per week, frequency of using a smartphone or tablet with Internet access to engage in work tasks during family time by spouse
Ragsdale and Hoover (2016)	Job demands-resources model	Survey	Work-related cell phone use during nonwork time	Emotional exhaustion, work engagement, work-family conflict	Cell phone attachment	N/A	N/A

Study	Theories	Methodology	Independent Variable	Dependent Variable	Moderating Variable	Mediating Variable	Control Variable
Studies on Work-Related Technology Use in the Nonwork Domain (technology use that includes both work- and nonwork-related uses)							
Cousins and Robey (2005)	Theory of human agency	Case study	Technology use by nomadic computing users (focus of the qualitative study)	Blurred boundary between work and personal life	Individual differences (from human agency perspective), boundary management	N/A	N/A
Middleton and Cukier (2006)	"Dark side" of mobility	Interview	Mobile e-mail usage (focus of the qualitative study)	Danger, anti-social behavior, distraction, infringement on work–life boundaries	Organizational culture	N/A	N/A
Prasopoulou, Pouloudi, and Panteli (2006)	Socio-temporal order	Interview, log	Use of mobile phones (focus of the qualitative study)	Vulnerability to organizational claims and any-time availability, temporal bound-aries that people enact in order to balance work and non-work demands	N/A	N/A	N/A
Golden and Geisler (2007)	Boundary theory	Interview	Intentions and goals for use	Satisfaction with PDA, perceived impact of PDA on work and life		Use of personal digital assistant (PDA)	Background, work and home situations, leisure activities
Abril and Romero (2010)	Masculinity	Interview	ICT use (focus of the qualitative study)	Management of time dedicated to work and personal life, extension of work day, nego-tiation between work, family, and personal domains, gender roles	N/A	N/A	N/A
Dery, Kolb, and MacCormick (2014)	Duality, requisite connectivity	Case study	Smartphone use (focus of the qualitative study)	Smartphone's representation of work and freedom from work, sense of disconnectivity from work	N/A	N/A	N/A
Carvalho, Francisco, and Relvas (2015)	Review	Conceptual	Attitudes toward information commu-nication tech-nologies (ICTs), types of ICTs	Family func-tioning: family cohesion, family roles, rules and intergenera-tional conflicts, family bound-aries, inter-actional scen-arios, family relational patterns	N/A	Use of ICTs in everyday family life (focus of the review)	N/A

Study	Theories	Methodology	Independent Variable	Dependent Variable	Moderating Variable	Mediating Variable	Control Variable
Cousins and Robey (2015)	Affordances	Interview	Use of mobile technologies by mobile workers	Affordances for managing work–life boundaries: mobility, connectedness, interoperability, identifiability, personalization	N/A	N/A	N/A
Fujimoto et al. (2016)	Positive psychology of optimal human functioning	Interview, survey	Mobile technology usage	Work engagement, emotional exhaustion	N/A	Job autonomy	Age, gender, occupation type, job tenure, extraversion
Other Studies Related to Work-Related Technology Use in the Nonwork Domain							
Turel, Serenko, and Bontis (2008)	Work–life interface, technology acceptance model, technology addiction	Survey	Addiction to mobile e-mail	Perceived usefulness, work-family conflict, organizational commitment	N/A	Technology-family conflict, work overload	Age, gender (removed after first stage of analysis)
Turel, Serenko, and Bontis (2011)	Social cognitive theory, technology addiction	Survey	Addiction to mobile e-mail	Work-family conflict, organizational commitment	N/A	Technology-family conflict, work overload	Age, gender
Köffer et al. (2014)	Work–life conflict	Survey	Organizational encouragement for dual use of mobile IT (i.e., for both private and work activities), work–life segmentation culture	Work-to-life conflict	Work–life segmentation preference	Work overload	N/A
Harris et al. (2015)	Conservation of resources theory, leader-member exchange	Survey	Information overload, communication overload, system feature overload	Work-family conflict	Leader-member exchange quality	N/A	Age, gender, marital status, spouses who worked in paid work activities, organizational tenure, computer hours worked per week
Weinert, Laumer, Maier, and Weitzel (2016)	Role conflict theory	Survey	IT-based work-home conflict	Work exhaustion	N/A	Time-based work-home conflict, strain-based work-home conflict, behavior-based work-home conflict, IT-based exhaustion	Age, gender

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Appendix B

Pilot Study

The pilot study was conducted at a Fortune 1000 technology company, which is headquartered in the Midwest, had a revenue of approximately $1.76 billion, and employed a total of 6,600 employees at the time of data collection. We sent the questionnaire to 300 knowledge workers in the company and received 119 valid responses back, yielding a response rate of 39.7%. The main purpose of the pilot study was to refine and validate our measures.

The pilot study makes two major contributions to the main study. First, it helped us refine the operationalization of our constructs, especially items measuring interruptions and performance. In particular, we realized that duration represents an important aspect of interruption and subsequently included it in our main study. Moreover, our pilot study used very broad measures of performance from the Organizational Behavior literature that were not sufficiently granular for our context. As a result, we developed new measures of performance for the main study.

Second, the pilot study motivated us to theorize the mediating mechanisms to account for the positive and negative effects of interruptions. Data analysis in our pilot study provided preliminary evidence of the existence of positive and negative effects of interruptions. This motivated us to identify mediating mechanisms to explain the observed effects, which we do in the current study.

Appendix C

Constructs and Scales

Table C1. Constructs and Measures

Construct	Definition	Source	Measure*
Extent of work-related cross-domain interruptions	Technology-mediated work-related cross-domain interruption refers to a technology-based occurrence that originates from the work domain but takes place in the personal life domain, impeding or delaying an individual by breaking the continuity of an ongoing task (e.g., receiving a work-related phone call while having dinner at home).	Items based on an exploratory study (n = 16) and refined through a pilot survey (n = 119)	Frequency 1: During my time off, I frequently get interrupted about work related matters through technology (phone call, e-mail, and messaging). Frequency2: I frequently stop what I am doing during my time off to initiate work related activities through technologies (phone call, e-mail, and messaging).
			Duration 1: During my time off, dealing with work-related interruptions initiated by others (via phone call, e-mail, and messaging) is time-consuming. Duration 2: Dealing with work interruptions I initiate during my time off (via phone call, e-mail, and messaging) is time-consuming.

Construct	Definition	Source	Measure*
Work Performance	Work performance refers to the fulfilment of the general demands and responsibilities associated with work.	Items based on work performance scale (Kossek et al. 2001; Williams and Anderson 1991) and refined through an exploratory study (n = 16), a pilot survey (n = 119), and card sorts (n = 10)	Work Perf.1: I am viewed as very responsive in dealing with work-related matters.
			Work Perf.2: I am viewed as very responsive in my work-related communications.
			Work Perf.3: Overall, I am very effective in getting my work done.
			Work Perf. 4: I provide help and support to my colleagues, clients, and other work contacts in a very timely manner.
			Work Perf.5: I solve work-related problems in a very timely manner.
Nonwork Performance	Nonwork performance refers to the fulfilment of the general demands and responsibilities associated with nonwork.	Items adapted from work performance scale (Kossek et al. 2001; Williams and Anderson 1991) and refined through an exploratory study (n = 16), a pilot survey (n = 119), and card sorts (n = 10)	Nonwork Perf 1: I am viewed as very responsive to attending to my personal life responsibilities.
			Nonwork Perf.2: I am viewed as very responsive in my personal communications.
			Nonwork Perf.3: I provide help and support to my family and friends in a timely manner.
			Nonwork Perf.4: I deal with personal life demands in a very timely manner.
			Nonwork Perf.5: Overall, I am effective in fulfilling my personal life demands.
Work emotional exhaustion	Work emotional exhaustion refers to the depletion of one's mental resources due to one's work.	Items based on work exhaustion subscale of the General Burnout Questionnaire (Schaufeli et al. 1995) and card sorts (n = 10)	Work Exhaustion 1: I feel emotionally drained from my work.
			Work Exhaustion 2: I feel emotionally fatigued because of the demands of my job.
			Work Exhaustion 3: I feel burned out from my work.
Nonwork emotional exhaustion	Nonwork emotional exhaustion refers to the depletion of one's mental resources due to one's personal life.	Items based on work exhaustion subscale of the General Burnout Questionnaire (Schaufeli et al. 1995) and card sorts (n = 10)	Nonwork Exhaustion 1: I feel emotionally drained from my personal life.
			Nonwork Exhaustion 2: I feel emotionally fatigued from the demands of my personal life.
			Nonwork Exhaustion 3: I feel burned out from my personal life.
Interruption overload	Interruption overload occurs when an individual has more work-related interruptions during his/her time off than one can adequately handle.	Items based on information overload scale (Roberts and O'Reilly 1974) and card sorts (n = 10)	Interruption Overload 1: During my time off, I have more work-related interruptions than I have energy to deal with.
			Interruption Overload 2: During my time off, I have more work-related interruptions than I can handle.
			Interruption Overload 3: During my time off, I have more work-related interruptions than I have time to deal with.
			Interruption Overload 4: During my time off, work-related interruptions take up more energy than I have.
			Interruption Overload 5: During my time off, the number of work-related interruptions I receive exceeds my ability to handle them.
			Interruption Overload 6: During my time off, I don't have enough time to deal with all the work-related interruptions that I receive.

Construct	Definition	Source	Measure*
Task closure	Task closure refers to the extent to which work-related interruptions during one's time off allow one to bring to completion unfinished work-related communi-cations or tasks.	Items based on literature (Straub and Karahanna 1998) and card sorts (n = 10)	Task Closure 1: Work-related interruptions during my time off allow me to bring closure to unfinished work-related tasks.
			Task Closure 2: Work-related interruptions during my time off allow me to bring unfinished work-related communications to closure.
Psychological transition	Psychological transition refers to the mental movement between the domains of work and personal life, including mental disengagement from one domain (exit) and engagement in another (entry).	Items based on literature (Ashforth et al. 2000) and card sorts (n = 10)	Psychological Transition 1: After a work-related interruption during my time off, it typically takes me some time to stop thinking about work.
			Psychological Transition 2: After a work-related interruption during my time off, it typically takes me some time to mentally disengage from work.
Polychronicity orientation	Polychronic orientation refers to the extent to which one prefers to be engaged in two or more tasks or events simultaneously.	Items based on the polychronic orientation scale (Bluedorn et al. 1999; Turner and Reinsch 2004) and card sorts (n = 10)	Polychronicity 1: I like to juggle several activities at the same time.
			Polychronicity 2: I like to multi-task.
Fashion conscious-ness	Fashion consciousness refers to an individual's involvement with fashionability (marker variable).	Items based on the generalized overall fashion consciousness scale (Gould and Stern 1989)	Fashion 1: I'm very alert to changes in fashion.
			Fashion 2: I would say I'm very fashion conscious.

All constructs were measured on a 7-point Likert scale (strongly disagree – strongly agree).

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Appendix D

Descriptives, Correlations, and Measurement Model Statistics

Table D1. Descriptives, Correlations, and Measurement Model Statistics

	Reliability	Mean (SD)	CFA Item Loadings^	1	2	3	4	5	6	7	8	9	10
1. Extent of interruptions	0.93	3.49 (1.86)	0.89-0.97	0.93									
2. Work performance	0.85	5.87 (0.91)	0.61-0.84	0.02	0.74								
3. Nonwork performance	0.87	5.40 (1.08)	0.68-0.88	-0.10	0.34	0.77							
4. Work exhaustion	0.93	4.17 (1.84)	0.88-0.93	0.32	-0.10	-0.42	0.90						
5. Nonwork exhaustion	0.91	3.39 (1.65)	0.84-0.93	0.16	-0.18	-0.21	0.31	0.88					
6. Interruption overload	0.95	2.67 (1.61)	0.80-0.93	0.69	-0.23	-0.28	0.49	0.29	0.87				
7. Psychological transition	0.89	4.25 (1.91)	0.88-0.91	0.63	0.02	-0.23	0.51	0.10	0.57	0.89			
8. Task closure	0.91	4.35 (1.66)	0.91-0.93	0.50	0.18	-0.02	0.05	0.09	0.24	0.39	0.92		
9. Polychronicity	0.79	5.00 (1.40)	0.75-0.87	0.20	0.15	0.42	-0.18	-0.03	0.00	0.01	0.23	0.81	
10. Fashion consciousness	0.87	3.81 (1.50)	0.70-0.94	-0.11	0.10	0.01	-0.09	-0.15	-0.10	0.04	-0.01	-0.05	0.83

The shaded leading diagonal elements represent the square root of average variance extracted (AVE).
^The CFA loadings reflect the range of loadings (lowest loading-highest loading) that the items of each scale have on their latent construct.

Appendix E

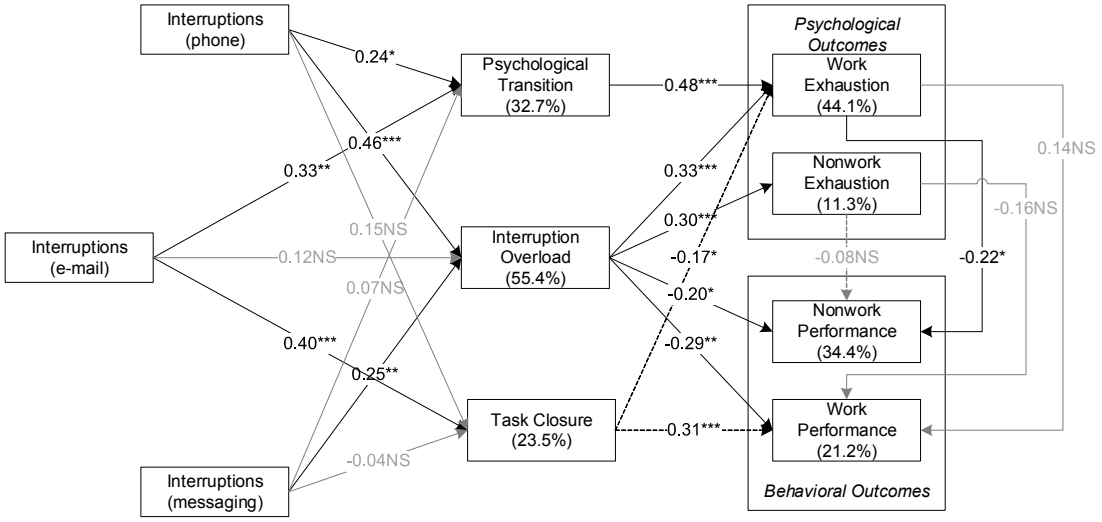
Sobel Mediation Test Results

Table E1. Sobel Mediation Test Results

Test	Path	Beta	S.E.	*t*-value	*p*-value
H1: Extent of interruptions → Interruption overload → Work exhaustion	Extent of interruptions → Interruption overload	0.74	0.04	3.99	0.00
	Interruption overload → Work exhaustion	0.33	0.08		
H2: Extent of interruptions → Interruption overload → Nonwork exhaustion	Extent of interruptions → Interruption overload	0.74	0.04	3.56	0.00
	Interruption overload → Nonwork exhaustion	0.29	0.08		
H3: Extent of interruptions → Interruption overload → Nonwork performance	Extent of interruptions → Interruption overload	0.74	0.04	-2.21	0.03
	Interruption overload → Nonwork performance	-0.20	0.09		
H4: Extent of interruptions → Interruption overload → Work performance	Extent of interruptions → Interruption overload	0.74	0.04	-2.79	0.01
	Interruption overload → Work performance	-0.29	0.10		
H5: Extent of interruptions → Psychological transition → Work exhaustion	Extent of interruptions → Psychological transition	0.72	0.04	5.36	0.00
	Psychological transition → Work exhaustion	0.48	0.08		
H6: Extent of interruptions → Task closure → Work exhaustion	Extent of interruptions → Task closure	0.51	0.06	-2.32	0.02
	Task closure → Work exhaustion	-0.18	0.07		
H7: Extent of interruptions → Task closure → Work performance	Extent of interruptions → Task closure	0.51	0.06	3.74	0.00
	Task closure → Work performance	0.27	0.09		

Appendix F

Post Hoc Analysis by Technology Type



Nonsignificant effects are represented by grayed-out lines; for paths between mediators and dependent variables, adverse effects are represented by solid lines and beneficial effects by dotted lines.

Control Variables	Work Performance	Nonwork Performance	Work Exhaustion	Nonwork Exhaustion
Polychronicity orientation	0.09NS	0.40***	-0.20**	-0.06NS
Age	0.28***	0.12NS	-0.09NS	-0.002NS
Gender (0 = male, 1 = female)	0.07NS	-0.04NS	0.13*	0.13NS
Number of children under 18	0.09NS	0.20**	-0.08NS	0.13NS

Figure F1. Model Results by Technology

Table F1. Sobel Tests of Mediation for Interruptions Via Phone

Test	Path	Beta	S.E.	*t*-value	*p*-value
H1: Extent of interruptions → Interruption overload → Work exhaustion	Extent of interruptions → Interruption overload	0.46	0.09	3.17	0.00
	Interruption overload → Work exhaustion	0.33	0.08		
H2: Extent of interruptions → Interruption overload → Nonwork exhaustion	Extent of interruptions → Interruption overload	0.46	0.09	3.01	0.00
	Interruption overload → Nonwork exhaustion	0.30	0.08		
H3: Extent of interruptions → Interruption overload → Nonwork performance	Extent of interruptions → Interruption overload	0.46	0.09	-2.01	0.04
	Interruption overload → Nonwork performance	-0.20	0.09		
H4: Extent of interruptions → Interruption overload → Work performance	Extent of interruptions → Interruption overload	0.46	0.09	-2.50	0.01
	Interruption overload → Work performance	-0.29	0.10		
H5: Extent of interruptions → Psychological transition → Work exhaustion	Extent of interruptions → Psychological transition	0.24	0.12	1.92	0.06
	Psychological transition → Work exhaustion	0.48	0.08		
H6: Extent of interruptions → Task closure → Work exhaustion	Extent of interruptions → Task closure †				
	Task closure → Work exhaustion				
H7: Extent of interruptions → Task closure → Work performance	Extent of interruptions → Task closure†				
	Task closure → Work performance				

†Given the nonsignificant effect of extent of *phone* interruptions on task closure, task closure does not significantly mediate the effects of extent of *phone* interruptions on work exhaustion (H6) or work performance (H7).

Table F2. Sobel Tests of Mediation for Interruptions Via E-mail

Test	Path	Beta	S.E.	*t*-value	*p*-value
H1: Extent of interruptions → Interruption overload → Work exhaustion	Extent of interruptions → Interruption overload ††				
	Interruption overload → Work exhaustion				
H2: Extent of interruptions → Interruption overload → Nonwork exhaustion	Extent of interruptions → Interruption overload ††				
	Interruption overload → Nonwork exhaustion				
H3: Extent of interruptions → Interruption overload → Nonwork performance	Extent of interruptions → Interruption overload ††				
	Interruption overload → Nonwork performance				
H4: Extent of interruptions → Interruption overload → Work performance	Extent of interruptions → Interruption overload ††				
	Interruption overload → Work performance				
H5: Extent of interruptions → Psychological transition → Work exhaustion	Extent of interruptions → Psychological transition	0.33	0.1	2.86	0.00
	Psychological transition → Work exhaustion	0.48	0.08		
H6: Extent of interruptions → Task closure → Work exhaustion	Extent of interruptions → Task closure	0.40	0.11	-1.98	0.05
	Task closure → Work exhaustion	-0.17	0.07		
H7: Extent of interruptions → Task closure → Work performance	Extent of interruptions → Task closure	0.40	0.11	2.75	0.00
	Task closure → Work performance	0.31	0.08		

††Given the nonsignificant effect of extent of *e-mail* interruptions on interruption overload, interruption overload does not significantly mediate the effects of extent of *e-mail* interruptions on work exhaustion (H1), nonwork exhaustion (H2), nonwork performance (H3), or work performance (H4).

Table F3. Sobel Tests of Mediation for Interruptions via Messaging

Test	Path	Beta	S.E.	*t*-value	*p*-value
H1: Extent of interruptions → Interruption overload → Work exhaustion	Extent of interruptions → Interruption overload	0.25	0.08	2.46	0.01
	Interruption overload → Work exhaustion	0.33	0.08		
H2: Extent of interruptions → Interruption overload → Nonwork exhaustion	Extent of interruptions → Interruption overload	0.25	0.08	2.39	0.02
	Interruption overload → Nonwork exhaustion	0.30	0.08		
H3: Extent of interruptions → Interruption overload → Nonwork performance	Extent of interruptions → Interruption overload	0.25	0.08	-1.79	0.07
	Interruption overload → Nonwork performance	-0.20	0.09		
H4: Extent of interruptions → Interruption overload → Work performance	Extent of interruptions → Interruption overload	0.25	0.08	-2.11	0.04
	Interruption overload → Work performance	-0.29	0.10		
H5: Extent of interruptions → Psychological transition → Work exhaustion	Extent of interruptions → Psychological transition †††				
	Psychological transition → Work exhaustion				
H6: Extent of interruptions → Task closure → Work exhaustion	Extent of interruptions → Task closure †††				
	Task closure → Work exhaustion				
H7: Extent of interruptions → Task closure → Work performance	Extent of interruptions → Task closure †††				
	Task closure → Work performance				

†††Given the nonsignificant effects of extent of *messaging* interruptions on psychological transition and task closure, psychological transition does not significantly mediate the effect of extent of *messaging* interruptions on work exhaustion (H5), and task closure does not significantly mediate the effects of extent of *messaging* interruptions on work exhaustion (H6) or work performance (H7).