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REVIEW ARTICLE

Time to Disentangle the Information and Communication Technology (ICT) Constructs: Developing a Taxonomy around ICT Use for Occupational Health Research

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Abstract

The use of information and communication technology (ICT) in the workplace has gained considerable research attention in the occupational health field due to its effects on employee stress and well-being. Consequently, new ICT-related constructs have proliferated in occupational health research, resulting in a need to take stock of both potential redundancies and deficiencies in the current measures. This paper disentangles ICT-related constructs, developing a taxonomy of ICT-related constructs in terms of ICT demands, resources, motivation, use, and strains. We then integrate this taxonomy with stress and motivation theories to identify three key implications for ICT and workplace health research and practices in terms of providing suggestions on understudied areas for building better theories, highlighting important psychometric issues for building better constructs and measures, and offering recommendations for building better interventions. This review aims to serve as a guide for researchers to move forward with the current state of research and provide recommendations for organizations in terms of both potential repercussions and best practices for ICT use in the workplace.

Keywords Information and communication technology · Employee well-being · Occupational stress · Work recovery · Construct proliferation · Technology use

Introduction

Information and communication technologies (ICT) have driven substantial changes in the nature and process of work (Cascio and Montealegre 2016). Smartphones and other

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mobile devices are increasingly being used to keep both work and personal information at one's fingertips (Anderson 2015). These devices have changed how we conduct work and the interplay between work and nonwork (Cascio and Montealegre 2016). Teleworking that relies heavily on electronic communications is becoming the "new normal"— especially during the COVID-19 pandemic crisis— as many employers have been taking actions to transition employees from working face-to-face to working remotely (Society of Human Resource Management 2020). Consequently, research on how ICT affects behavioral, social, and psychological aspects of occupational health is continuing to grow in popularity in occupational health psychology (OHP) journals.

Researchers have made strides in adapting and building occupational health theories around technological implications for worker well-being (e.g., Day et al. 2010; O'Driscoll et al. 2010; Tarafdar et al. 2017). A variety of terms are currently used to describe technological experiences that affect worker well-being, such as technostress (Ragu-Nathan et al. 2008), ICT demands (Day et al. 2012), and workplace telepressure (Barber and Santuzzi 2015). However, we need more empirical work to develop systematic approaches to address the proliferation of technology-related constructs and theoretical developments, which helps build testable models that comprehensively capture emerging ICT constructs. Despite widespread interest in the popular media around workplace ICT use, the literature lacks sufficient consensus on how to conceptualize and measure ICT constructs; construct proliferation potentially is common due to the interdisciplinary nature of ICT research. Therefore, this paper makes important contributions to ICT research in providing a coherent and theory-driven classification of existing ICT-related constructs from multiple disciplines (e.g., OHP, information systems), Such a classification can increase the accessibility and utility of ICT research for practitioners. In doing so, based on the existing occupational health literature on ICT use and associated terms, we: (1) created a taxonomy of these ICT-use terms; and (2) developed key implications for research and practice that provide suggestions on understudied areas for building better theories, highlight important psychometric issues for building better constructs and measures, and offer recommendations for building better interventions.

Conceptual Ambiguity of ICT Constructs and Measures

As interest in the impact of ICT in the workplace continues to grow, so does the need to conduct more research on the implications for worker well-being. Yet there has not been a comprehensive treatment of ICT constructs and measures in occupational stress theoretical frameworks that provide the empirical foundation for such research.

To date, reviews on ICT use have tended to focus on theory development on specific areas of ICT research (i.e., demanding and resourceful aspects of ICT use, Day et al. 2010; positive and negative outcomes of technostress, Tarafdar et al. 2017) and practical implications of ICT use in specific settings such as human resource management and career development (Atanasoff and Venable 2017; Cascio and Montealegre 2016; Gardner et al. 2003). Reviews that have explicitly addressed technology-related constructs and measures have focused either on narrowly defined behavioral measures referring to work-related technology use outside of work hours (i.e., technology-assisted supplemental work; Ďuranová and Ohly 2016; Schlachter et al. 2018), nonwork-related technology use during work hours (Ivarsson and Larsson 2011), or

measurement gaps in existing theoretical frameworks (Tarafdar et al. 2017). Thus, systematic exploration into ICT use and associated constructs and their measurement is an important step to understand the conceptual clarity among demands/resources, motivational factors, and technology-related behavioral and strain outcomes.

Moreover, because of the challenges in conceptualizing and measuring ICT constructs, media outlets may reference ICT-related terms from youth and social media research that have not been studied or validated in the organizational context (e.g., nomophobia, fear of being offline; Lieberman 2016; Rosen and Samuel 2015). Although sampling across contexts and disciplines can create solid, broad-based constructs, using these terms in the context of work and the workplace is troubling given the lack of empirical work linking these terms to existing workplace constructs and validating them in a work context.

Therefore, we chose key theoretical approaches of occupational health and stress that have laid the foundation of the past ICT research to develop our taxonomy of technological constructs emerging from existing literature in OHP as well as other interdisciplinary areas (e.g., information systems). We provide an exhaustive review of ICT-related constructs in the OHP literature. Through critical assessment and (re)conceptualization of constructs, we integrate constructs whose measures have evidence of validity and focus on reducing the empirical overlap among constructs (i.e., demands and resources, motivational factors, and outcomes). We also discuss the implications of disentangling ICT-use terms for both researchers and practitioners, where we offer recommendations for theory testing and measurement development, and suggestions for technological interventions. We aim to advance the occupational health research in several ways. First, this paper serves as a key resource for researchers who are interested in conducting ICT-use research by providing a theory-driven classification of existing ICT-related constructs based on our comprehensive review. Second, we also review the constructs' measures and identify limitations of the measurements for future psychometric development of both existing and new constructs. Last, we offer important future directions for this classification based on existing theoretical perspectives and empirical findings in ICT-use research.

Moving toward a Holistic Taxonomy of ICT-Related Terms

Currently, there are different foci of ICT research, including the impact of both behavioral indicators and psychological aspects of ICT use. Much of the literature has begun with a *behavioral approach*, in that research focuses on measuring technology-use behaviors, such as smartphone use and work-home boundary crossing and creation, to answer research questions around the role of ICT use in influencing well-being at work and home (e.g., Boswell and Olson-Buchanan 2007; Ohly and Latour 2014; Olson-Buchanan and Boswell 2006). The behavioral measurement approach to investigating positive and negative outcomes of ICT use is mostly based on frequency measures of work-related technology use. For example, Ďuranová and Ohly (2016) reviewed both antecedents and consequences of work-related technology use during after-work hours. The use of technology at home for work-related purposes tends to be related to poor physical and psychological recovery, as indicated by a lack of sleep (e.g., Barber and Jenkins 2014; Lanaj et al. 2014), low psychological detachment from work (e.g., Derks et al. 2014; Van Laethem et al. 2018), and both directly

(e.g., Killion et al. 2014) and indirectly related to high exhaustion via psychological detachment (Derks et al. 2014). One of the most commonly studied outcomes of using technological devices for work is work-family interface constructs: When individuals perceive less control over their work, they tend to experience more domain-crossing behaviors (i.e., meeting work role demands while at home) and work-family conflict (e.g., Fenner and Renn 2010; Schieman and Young 2013).

However, the behavioral approach does not provide much information about *why* technology-use behaviors arise and *when* they influence worker well-being. Research examining ICT usage often overlooks important social and psychological processes that can provide nuance for understanding the impact of technology on workplace interactions and outcomes. In addition, the rapid development and adoption of new technologies is a challenge, as behavioral measures referencing specific media can become outdated quickly (e.g., references to pagers seem obsolete). Research on the psychological experiences of ICT use is accumulating (e.g., Matusik and Mickel 2011; Ohly and Latour 2014), which has helped us to understand individual perceptions, and even motivations, behind ICT use. Therefore, as research continues to expand beyond the focus simply on usage or behaviors, we introduce a guiding holistic taxonomy for classifying and integrating ICT constructs in a meaningful way to move the literature forward.

A Taxonomy of ICT-Use Terms

Brief Theoretical Overview

By outlining a holistic taxonomy for understanding ICT constructs and measurement strategies driven by key occupational stress and motivation theories, we both integrate and supplement the aforementioned approaches to studying ICT in the workplace. Given that many existing ICT constructs in occupational health research were developed based on existing key job stress theories and models, our paper is guided primarily by the Job Demands and Resources Model (JD-R; Bakker and Demerouti 2007, 2017) and the Self-Determination Theory (Ryan and Deci 2000), as well as the existing work on ICT.

The JD-R model explains how job and work environmental demands (i.e., physical, psychological, social, and organizational aspects of the job that require to expend psychological and physical effort) and resources (i.e., work factors that can facilitate individuals' goal achievement and promote positive outcomes, as well as reduce ill-being) may affect employee motivation and strain, and then organizational outcomes (Bakker and Demerouti 2007, 2017; Schaufeli and Taris 2014). The continuous effort expenditure on demanding job tasks (including ICT-related factors) results in strain reactions like fatigue, such that individuals need to recover from job-related stressors and restore energy or psychological resources (Meijman and Mulder 1998). Resources can come from one's job (e.g., autonomy of work schedule), the organization (e.g., technology support team in a company), and the individual (e.g., technological skills or knowledge; Lee et al. 2020). Individuals are motivated to obtain—and avoid losing—resources because addressing demands can deplete resources, thereby resulting in negative outcomes unless resources are replenished (Halbesleben et al. 2014; Hobfoll

1989). In this framework, ICT-related psychological and technical factors could be perceived as being either demanding or supporting. For example, organizations that make work more accessible via ICT devices may increase the availability and response expectations, which can exhaust employees' physical and psychological energy. Conversely, having control over how one uses technology may be a key resource to protect individuals from experiencing strain outcomes (cf. Piszczek 2017).

Self-Determination Theory (SDT; Ryan and Deci 2000) also distinguishes between autonomous (i.e., having a sense of volition) and controlled motivation (i.e., having a sense of pressure) that directs one's work-related behaviors differently (including ICT use). SDT also posits that satisfaction of three fundamental psychological needs (autonomy, competence, and relatedness) is central for enhancing psychological well-being. The need of autonomy represents one's need to perceive the volition in freely choosing what to do. The need of competence represents one's need to feel accomplished in engaging challenging tasks or obtaining new skills. The need of relatedness represents one's need to feel connected and related to others (Ryan and Deci 2000). Therefore, SDT can help to address the psychological processes of how technological demands and resources may facilitate or thwart individuals' need satisfaction, and subsequently influencing their strain and well-being outcomes.

Guided by these major theoretical frameworks, we organize the key ICT constructs into five categories as they relate to worker well-being and health. Based on the JD-R Model, constructs can be classified as (1) ICT Demands or (2) ICT Resources, and based on SDT, ICT can be framed in terms of (3) ICT Motivational Factors. Because the actual behavioral components are still important to consider, we also include (4) ICT Use as a separate category. Finally, it is important to understand constructs surrounding (5) ICT Strain Outcomes (see Table 1).

ICT Demands

With the increased use of technology in the workplace, ICT demands were termed to describe any (situational) technology-related factors or processes from the work environment that workers may perceive as stressful and that require physical and psychological effort (Day et al. 2010). Because employees can be reached by ICTs for work anywhere and anytime; workers may experience extended exposure to work- and technology-related factors that exploit their energy, even outside of work hours. Day et al. (2012) introduced, developed, and validated an ICT demands framework capturing a wide range of negative technology-related aspects. Other studies also have developed constructs that can be considered as types of ICT demands, or created similar items and subdimensions with different wordings and terms (e.g., Ragu-Nathan et al. 2008; Stadin et al. 2016). Integrating these studies examining the role of ICT demands, we specifically include ICT hassles, information overload, availability expectations, and interpersonal stressors. *ICT hassles* are demanding situations with using technologies where technical problems arise in ICT use (e.g., file losses, internet connections), which may interfere with getting work done (Day et al. 2012). *Information overload* describes the demanding experiences of dealing with increased amount of information getting processed due to the high accessibility to, and fast delivery of, information via technology (Day et al. 2010). *Availability expectations* refer to the extent to which an employee is expected to be available and respond to work-related

Table 1 Taxonomy of ICT-related Construct with General Construct Definitions and Sample Items

Overarching Categories	Subcategory	Example Measures/Measurements and Sample Items
ICT DEMANDS	ICT hassles	• *ICT hassles*: "My computer freezes." (Day et al. 2012)
	Information overload	• *Email overload*: "I have trouble finding information in my email." (Dabbish and Kraut 2006) • *Information overload*: "I find that I am overwhelmed by the amount of information I have to process on a daily basis." (Karr-Wisniewski and Lu 2010) • *Workplace/electronic interruptions*: "incoming e-mails and other online messageskept me from doing my job." (ten Brummelhuis et al. 2012; Sonnentag et al. 2018)
	Availability expectation	• *Availability expectation*: "I'm expected to check e-mail and/or voicemail when I'm out of the office." (Day et al. 2012) • *Organizational expectations for email monitoring*: "People who influence my behavior at work think that I should monitor electronic communications away from work." (Becker et al. 2019) • *Extended availability requirement*: "My supervisors expect me to be available for work outside regular working hours." (Dettmers et al. 2016a) • *The after-hours electronic communications expectations*: "My organization expects me to respond to after-hours electronic work communications immediately." (Piszczek 2017) • *Supervisor expectations*: "My supervisor expects me to respond to work-related messages during my free time after work." (Derks et al. 2015)
	Interpersonal stressors	• *Cyber incivility*: "Someone at work said something hurtful to me through e-mail." (Lim and Teo 2009) • *Workplace cyberbullying*: "Been sent conflicting information." (Farley et al. 2016) • *Cyberbullying act at work*: "Rumors or gossips are being spread about you by means of ICTs." (Atanasoff and Venable 2017) • *Cyberaggression*: "Email described as hostile towards you." (Weatherbee 2007) • *Poor communication*: "I have misinterpreted the tone of my incoming e-mail messages." (Day et al. 2012)
ICT RESOURCES	Organizational-supplied resources	• *Resources/upgrades*: "My organization implements appropriate software as it becomes available." (Day et al. 2012) • *Personal assistance*: "Our information technology support staff are helpful." (Day et al. 2012) • *Technical support provision*: "Our end-user help desk is easily accessible." (Ragu-Nathan et al. 2008) • *Involvement facilitation*: "Our end users are rewarded for using new technologies." (Ragu-Nathan et al. 2008) • *Literacy facilitation*: "Our organization provides end-user training before the introduction of new technology." (Ragu-Nathan et al. 2008)

Table 1 (continued)

Overarching Categories	Subcategory	Example Measures/Measurements and Sample Items
	ICT-supplied resources	• *Control over ICT use*: "I have control over how I use technology at work." (Day et al. 2012) • *ICT flexibility*: "Communication technologies (e.g., e-mail, cellular phone devices) allow me to have more flexibility in when and where I work." (Diaz et al. 2012) • *Control of job contact:* "I can influence whether I am contacted outside regular working hours for work-related matters." (Dettmers et al. 2016b)
	Individual-supplied resources	• *Computer self-efficacy*: "I feel very competent using computer aided technology." (Salanova et al. 2000) • *Computer user self-efficacy*: "Most difficulties I encounter when using computers, I can usually deal with." (Cassidy and Eachus 2002)
ICT	MOTIVATIONAL FACTORS • *Controlled motivation for smartphone use*: "I use the smartphone because someone else wants me to, or demands to do so. I would not use it if I did not get a form of reward or recognition for doing so." (Ohly and Latour 2014) • *Workplace telepressure*: "I have an overwhelming feeling to respond right at that moment when I receive a request from someone." (Barber and Santuzzi 2015) • *Workplace FoMO*: "I worry that I might miss important work-related updates." (Budnick et al. 2020) • *Fear of missing out*: "If I would use my smartphone less for work-related (private) matters while at home (work), I would fear missing out on important things." (Dora et al. 2019)	Controlled motivation
Autonomous motivation	• *Autonomous motivation for smartphone use*: "I	

Table 1 (continued)

Overarching Categories	Subcategory	Example Measures/Measurements and Sample Items
	use the smartphone because I believe it is important. I see the utility of it and do so voluntarily." (Ohly and Latour 2014)	
ICT USE	Work-related ICT use during nonwork time	• *Frequency measures*: "How frequently do you use a mobile device to perform your job during family time?" (Ferguson et al. 2016) • *Frequency measures*: "How often do you check your smartphone at home on an average working day?" (Dora et al. 2019) • *Likert-type scales*: "I used my smartphone intensively." (Derks and Bakker 2014) • *Dichotomous measure - boundary management*: "I limit the amount of time or when I use communication technologies for work purposes during nonwork hours." (Olson-Buchanan and Boswell 2006)
	Nonwork-related ICT use during work time	• *Frequency measures:* "How often do you use your smartphone for private matters at work on an average working day?" (Dora et al. 2019) • *Frequency measures - cyberloafing*: "How often do you check nonwork-related emails during work hours?" (Lim 2002) • *Frequency measures with computation – workplace internet leisure browsing:* "Reading/Writing newsgroup/discussion forum messages." (Coker 2013) • *Likert-type scales - cyberslacking*: "When I'm working remotely, I get distracted more with nonwork related internet activities than I do when I'm at the office." (O'Neill et al. 2014)
	Work-related ICT use during work time	• *Likert-type scales - responsiveness*: "I responded immediately to online messages, even when I was busy with other things." (Sonnentag et al. 2018) • *Likert-type scales - electronic multitasking*: "During meetings, I use communication technology devices." (Stephens and Davis 2009)
ICT STRAIN OUTCOMES		• *ICT stress:* ""I feel stressed out by technology in my workplace." (Day et al. 2012) • *Emotional reaction*: "I find dealing the amount of emails I receive stressful." (Brown et al. 2014) • *E-anxiety*: "Please indicate the extent to which you felt the following today when you think about work-related electronic communication outside of work: tense." (Becker et al. 2019) • *Work-to-life conflict due to office-home smartphone use*: "The work use of smartphones produces strain that makes it difficult to fulfill home/personal duties (Yun et al. 2012) • *Technology-family conflict*: "The use of mobile email takes up time that I feel I should spend with my family and friends." (Turel et al. 2011)

electronic messages (Day et al. 2010; Piszczek 2017). *Interpersonal stressors of ICT use* are the technology-mediated stressors involving poor interpersonal interactions or mistreatment (e.g., cyber incivility, cyberaggression; Weatherbee 2010) or information misinterpretation.

Similar to other workplace demands, these ICT-related factors or situations can be considered as causes of, or threats of resource loss, resulting in strain experiences (cf., conservation of resource theory; Halbesleben et al. 2014; Hobfoll 1989), or load reactions such as fatigue caused by extended exposure to increased level of cognitive processing demands to meet work requirements and expectations (cf., effort-recovery model; Meijman and Mulder 1998). Extended work times (e.g., at home, in the evenings and on weekends) that are made possible by ICT could result in lack of recovery, which ultimately leads to negative well-being outcomes. When workers encounter ICT hassles, attentional and energy resources are directed from work-related tasks to resolving the technical issues, which may cause strain and exhaustion (Day et al. 2012), and productivity loss (O'Driscoll et al. 2010). With the rapid development and implementation of new technological devices and software, ICT hassles have the potential to affect workers daily (especially during a critical pandemic time when employees must work remotely, and organizations may not have had time to test ICT platforms). In addition, receiving large amount of information in a limited amount of time could cause interference with one's primary tasks and unnecessary attention shifts, thus increasing exposure to demands. Often, information is received unexpectedly via asynchronous forms of interactions (e.g., email): This constant reception of new messages may interrupt one's workflow, creating workplace interruptions (Jett and George 2003; Pachler et al. 2018; Sonnentag et al. 2018). Workers also experience information overload by accessing other work-related tasks via ICT during meetings (Stephens and Davis 2009).

With the convenience afforded by ICT, when workers feel that they are expected to monitor their electronic devices for work communications outside of typical work hours, they may have to spend additional resources after work, which can be associated with lack of proper recovery and poor well-being (Becker et al. 2019; Dettmers et al. 2016a; Piszczek 2017). This expectation may be formed through perceptions of workplace norms around ICT use in work teams or the entire organization (either explicit or implicit norms; Becker et al. 2019). In communicating with others, problematic ICT-mediated mistreatment, such as cyber incivility (i.e., a perception of low intensity, disrespectful behaviors through ICT, including rude or inconsiderate messages online), may create stress and even interrupt one's work productivity (Park et al. 2018; Stich et al. 2015).

Measures of ICT Demands Previous research has developed measures that tap into these key ICT demands. For ICT hassles, Day et al.'s (2012) validated ICT demands scale included five items covering several common and major technology-related hassles at work. Relatedly, Karr-Wisniewski and Lu (2010) identified system feature overload, which measures the demanding situations when technological features were too complex and cause difficulties in performing work tasks.

Information overload can be measured in several ways: (1) the extent to which workers perceive that there is more information to process than one's available capacity (Karr-Wisniewski and Lu 2010); (2) the "volume" of information in a specific

technological communication medium (e.g., email quantity; Barber and Jenkins 2014; Dabbish and Kraut 2006); (3) lack of time due to workplace interruptions, which can be measured in a variety of ways (e.g., Garrett and Danziger 2008; Karr-Wisniewski and Lu 2010; Pachler et al. 2018; Sonnentag et al. 2018; ten Brummelhuis and Bakker 2012; Wilkes et al. 2018). Work interruption scales that have the connotation of external stimuli and effort consumption (e.g., intrusion, interruption, and discrepancy detections; Wilkes et al. 2018) may address the construct the best. For example, one measure taps specifically into interruptions via electronic messages and emails (Sonnentag et al. 2018; ten Brummelhuis et al. 2012).

Several measures tap into availability expectation (during nonwork time). Day et al. (2012) included availability expectation and response expectation as two separate subdimensions, whereas Becker et al.'s (2019) measure for organizational expectations for email monitoring included the items for expectations regarding both availability and responding messages. Other researchers have created or modified measures to capture the perception of being available via ICT outside of regular work hours, including supervisor expectations (Derks et al. 2015), extended availability requirement (Dettmers et al. 2016b), after-hours electronic communications expectations (Piszczek 2017), and climate for technology-assisted supplement work capturing guidance and support of staying connected off-work (Fenner and Renn 2010). These measures have implicitly (Day et al. 2012) or explicitly stated that the expectations come from their organizations or supervisors (e.g., "My organization expects me to respond to after-hours electronic work communications immediately"; Piszczek 2017).

Measures assessing interpersonal stressors of ICT use include those related to poor communication (e.g., Day et al. 2012), as well as technology-mediated interpersonal mistreatments, such as cyber incivility, cyberbullying, and cyberaggression (see Weatherbee 2010, for a review). Cyber incivility is usually measured with a scale developed by Lim and Teo (2009) that consists of 14 incivility incidences made through work-related ICT. There are several validated measures of cyberbullying that capture the repetitive and enduring nature of perceived negative acts through ICT (Farley et al. 2016; Hong et al. 2014; Vranjes et al. 2018). Cyberaggression can be measured with a validated scale from Weatherbee (2007), which captures more serious, harmful acts via ICT communications from a specific source (i.e., supervisor, co-workers, subordinates, or customers).

ICT Resources

ICT resources refer to any technology-related factors from the work environment that may be perceived as supporting work goal achievement, alleviating negative impacts of job and ICT demands, and facilitating personal growth (Day et al. 2010). The definition of ICT resources is consistent with the theoretical models pertaining to general job resources, such that the resources help to achieve goals (as specified in COR theory; Halbesleben et al. 2014) and have motivational potential (as specified in JD-R model; Bakker and Demerouti 2007). Following the categories of resources in previous research (Lee et al. 2020; ten Brummelhuis and Bakker 2012), we identified three types of ICT

resources, in terms of organization-supplied, ICT-supplied, and individual-supplied resources.

Organization-supplied resources include technical support for ICT use (e.g., personal assistance and technological upgrades; Day et al. 2012) to facilitate work progress by ensuring efficient solutions for technological issues and regular system upgrades. As suggested by the matching hypothesis and the JD-R model, if the type of resources corresponds to the type of demands, then the available resource will have the optimal buffering effect to reduce adverse impacts of the demand on well-being outcomes (de Jonge and Dormann 2006). Likewise, resources (support) specific to ICT are expected to potentially attenuate the effects of ICT demands on well-being outcomes. In fact, ICT technical support (e.g., providing personal assistance, technical resources outside of work hours) has been shown to reduce the negative relationship between ICT hassles and availability expectation on indicators of burnout (Day et al. 2012; Dettmers et al. 2016b).

Not only can organizations provide ICT resources, but technologies themselves can be considered as resources. Technologies provide the means to access work-related information and tasks remotely, which can lead to increased productivity (O'Driscoll et al. 2010) and work flexibility (Hill et al. 2008). Employees could experience an increased sense of control over deciding how to use ICT to get their work done (Day et al. 2012). Unlike organization-supplied technical ICT support, these ICT-supplied resources are similar to psychological job resources (e.g., job autonomy; Lee et al. 2020), which could reduce strain outcomes due to experiences of job demands. For instance, findings from Diaz et al. (2012) suggest that flexibility (facilitated by ICT) in managing one's work was associated with decreased work-life conflict and increased job satisfaction. Additionally, ICT could be used as a way to stay socially connected with coworkers (e.g., via social media), which in turn, may increase job satisfaction (Robertson and Kee 2017).

Although organization- and ICT-supplied resources as contextual resources are distal from oneself (ten Brummelhuis and Bakker 2012), individual-supplied resources are considered more proximal to oneself. That is, personal resources are individual characteristics involving ICT use that can contribute to completing work goals. Examples include technological skills and knowledge, and computer or ICT self-efficacy (i.e., beliefs to be able to master technology-related tasks; Salanova et al. 2000). Proficiency in technology use and adaptability to technological changes are essential for today's workers to succeed in work environments where technology-mediated communications occur frequently (e.g., virtual teams; Kirkman et al. 2002).

Measures of ICT Resources The validated scales of both Day et al.'s (2012) ICT support and Ragu-Nathan et al.'s (2008) technostress inhibitors (including literacy facilitation, technical support provision, and involvement facilitation subscales) can be considered as organization-supplied resources and are similar in terms of capturing the extent to which an organization and its information technology support team provide sufficient technical resources. For example, items measuring technical support provision are similar (e.g., "our end-user help desk is responsive to end-user requests"; Ragu-Nathan et al. 2008) to those of personal assistance in the ICT support scale (e.g., "my organization's technical support people respond promptly to any of my problems"; Day et al. 2012). Dettmers et al. (2016a) measured equipment adequacy with three

items reflecting whether an individual has an adequate access to, and technical equipment for, work-related information outside of regular work hours and worksites.

For ICT-supplied resources, Diaz et al. (2012) used a measure ICT flexibility to capture employees' perception of whether ICT allows for flexibility in managing work. The subscale of lack of control over ICT use (Day et al. 2012) includes three positively worded items that essentially assess the extent to which workers feel that they have control over using and choosing ICT for work purposes. Similarly, Dettmers et al. (2016b) used three items to capture one's control over how they could be contacted outside regular work hours. Fenner and Renn (2010) studied perceived usefulness of technology, which captures employees' beliefs that technologies are very useful and aid in completion of work and productivity.

The computer self-efficacy scale (Cassidy and Eachus 2002; Salanova et al. 2000) is a form of individual-supplied resource. It assesses self-perception that one is capable of mastering computer-related skills and knowledge, and it has been used with other forms of ICT (e.g., information technology self-efficacy; Staples et al. 1999). Previous research has also captured self-efficacy in virtual work context. For instance, remote work self-efficacy measures one's self-efficacy of managing work tasks remotely (Staples et al. 1999). Knowledge and skills related to ICT use could be captured by similar items used to evaluate knowledge, skills, ability, and other characteristics needed for performing virtual teamwork (Krumm et al. 2016). Previous experiences with ICT use and remote work and training are important factors that can boost self-efficacy in ICT use and remote work (Cassidy and Eachus 2002).

ICT Motivational Factors

Motivational factors may further explain the way in which ICT demands and resources affect employee well-being. Based on the SDT, staying connected via ICT could be driven by controlled motivation or by autonomous motivation. Examples of controlled motivation include feeling guilty for not using ICT (i.e., introjected motivation) or because someone wants them to (i.e., external motivation). Alternatively, examples of autonomous motivation are being interested in connecting with others (i.e., intrinsic motivation) or feeling like staying connected is useful and important for one's personal goals (i.e., identified motivation; Ohly and Latour 2014; Ryan and Deci 2000). Controlled motivation for smartphone use was associated with decreased positive affect and increased negative affect, whereas autonomous motivation for smartphone use was associated with well-being, in terms of increased positive affect and recovery, and decreased negative affect (Ohly and Latour 2014).

Related to controlled motivation, two constructs have been proposed to capture ICT-specific motivation for connectivity: workplace telepressure (Barber and Santuzzi 2015) and fear of missing out (FoMO; Budnick et al. 2020). Workplace telepressure represents the psychological experiences of feeling the preoccupation with and urge to respond to electronic messages as quickly as possible, regardless if it is driven by external work factors such as organizational expectations to be available, or internal individual factors such as conscientiousness (Barber and Santuzzi 2015). Workplace telepressure can disrupt recovery experiences and result in physical exhaustion and sleep problems; however, it also tends to be positively associated with work

engagement (Santuzzi and Barber 2018). Workplace FoMO refers to apprehension related to missing valuable work information and being excluded from social activities (Budnick et al. 2020). It has been shown to be associated with increased burnout, but not related to work engagement (Budnick et al. 2020). There is scant research on autonomous motivation of ICT use. Because the experience of being connected to work is not limited to one type of motivation, research is needed to explore more autonomous reasons for staying connected with ICT. For instance, individuals who are passionate about one's work and have strong work identity may be more likely to be self-motivated to engage in work tasks that may involve ICT use (Perrewé et al. 2014).

Researchers have recently highlighted how individuals' needs for autonomy, social connectivity (relatedness), and productivity (competence) can either foster or hinder worker motivation and well-being in the context of ICT use (Day et al. 2019). The autonomy paradox illustrates how well-being may be positively influenced by having internal and external control of ICT use, whereas a perceived lack of control over excessively intrusive features of ICT may reduce well-being (Day et al. 2019). The social connectivity paradox depicts how ICT use creates alternative channels to fulfill the need for belonging, but it may also cause social problems due to the ease of interacting one another. The productivity paradox refers to how ICT may facilitate work progress due to the efficiency and technological advancements, which could fulfill one's competence need, but ICT also may delay work completion due to interruptions and glitches in ICT. On the positive side, ICT devices can give employees the flexibility to engage in job crafting behaviors, which can facilitate need satisfaction, ultimately increasing well-being due to increased person-environment fit (Tims et al. 2012). On the negative side, ICT devices may increase perceptions of external control—driven by reasons misaligned with one's values—which may thwart need satisfaction, thus impairing well-being (e.g., Ragsdale and Hoover 2016).

Measures of ICT Motivational Factors Motivational components are also incorporated in some measures of ICT-related constructs. For controlled motivation, Ohly and Latour (2014) assessed controlled motivation to use smartphone for work purposes in the evening by adapting previous introjected and external motivation scales. In addition to this scale, new measures for workplace telepressure (Barber and Santuzzi 2015) and workplace FoMO (Budnick et al. 2020) have been validated and used in the literature. FoMO experiences could be also captured with specificity of the context and the purpose of ICT use. Dora et al.'s (2019) measure taps into FoMO when using ICT with context-incongruent purposes (i.e., work [nonwork] use during nonwork [work] time). In addition, a measure of email stress (i.e., perceived pressure to monitor and respond to emails) contains similar items measuring workplace telepressure (e.g., "I feel pressure to deal with my email"; Hair et al. 2007).

Measures capturing autonomous motivation are still scarce in the literature, besides an adapted scale used in Ohly and Latour (2014), which asked participants to indicate their levels of intrinsic and identified motivation to use smartphone for work purposes in the evenings. Job connectedness, defined as the extent to which individuals voluntarily or involuntarily remain connected to job-related tasks via ICT outside of work, conceptually taps into motivational experiences in ICT use, despite the lack of specificity of autonomous (voluntary) versus controlled (involuntary) motivation (Rajah and Lim 2015). However, the actual items of the job connectedness scale (e.g., "I check

work-emails regularly when I am away from the office.") are more aligned with measuring ICT use (e.g., Derks and Bakker 2014).

ICT Use

ICT use has been conceptualized as the extent to which one uses technologies for either work or nonwork purposes. Multiple terms and phrases for ICT use exist in the literature, such as work contact (Schieman and Young 2013), mWork (as a short form of mobile work; Ferguson et al. 2016), technology-assisted supplemental work (Fenner and Renn 2010), and new ways of working (ten Brummelhuis et al. 2012). Although they have different constructs names, they all describe employee behaviors of using ICT devices or media. When looking at ICT use in OHP, in addition to constructs around extended use, we can view ICT behaviors in terms of the misalignment of the ICT use purposes and contexts (i.e., either engaging in work-related ICT use during nonwork time and/or engaging in nonwork-related use during work time).

ICT makes it easier to blur boundaries between work and nonwork domains by allowing one to access work easily any time (Olson-Buchanan and Boswell 2006). Engaging in *work-related ICT use during nonwork time* can have negative consequences in terms of poor recovery (e.g., Derks et al. 2014; Ohly and Latour 2014), impaired well-being (e.g., Derks and Bakker 2014; Ohly and Latour 2014), and increased work-life conflicts, as reported by both the employee and their significant other (e.g., Boswell and Olson-Buchanan 2007; Carlson et al. 2018; Ferguson et al. 2016). The increased work-related ICT use during nonwork time may be explained by ICT demands (e.g., organizational expectation, Becker et al. 2019; Fenner and Renn 2010), motivational factors (e.g., workplace telepressure; Barber and Santuzzi 2015), and individual differences (e.g., ambition; Boswell and Olson-Buchanan 2007).

Nonwork-related ICT use during work time may involve shopping for personal goods online, calling family members during work, and sending nonwork-related emails. Depending on the characteristics of the nonwork-related activities that one is engaging in via ICT (and motivation for doing so), the behavior could have a negative connotation of work deviance (e.g., cyberloafing; Lim 2002) or a positive connotation of recovery (Ivarsson and Larsson 2011). Engaging in cyberloafing would be associated with ill-being because of time loss for work or backlog of work, whereas engaging in fun activities for recovery would be associated with well-being (Reinecke and Hofmann 2016).

Other constructs in the literature capture work-related ICT behaviors in the work domain. For instance, electronic multitasking refers to when employees use multiple ICT devices during work meetings, which can be largely influenced by organizational behavioral norms (Stephens and Davis 2009). Relatedly, work involving more meetings augments work-related ICT (e.g., email communications regarding meeting schedules and information sharing; Dabbish and Kraut 2006). Smartphone use during work may provide convenience to quickly answer requests or receive updates. However, intensive work-related smartphone use during work hours has been associated with lower work engagement for those who reported higher levels of workplace telepressure (Van Laethem et al. 2018).

Measurement of ICT Use Researchers have developed various measures to assess ICT behavior. Instead of listing existing measures (see Ďuranová and Ohly 2016, for an

overview), we briefly review different measurement techniques. One commonly used technique is capturing the frequency of using electronic communication devices, which has been used for both work-use during nonwork time (e.g., Diaz et al. 2012; Ferguson et al. 2016) and nonwork-use during work time (Lim 2002; Vitak et al. 2011). An example item is "How frequently do you use a mobile device to perform your job during family time?" (Ferguson et al. 2016). Typically, the items are written in a similar way, except that they have slightly different references of ICT functions or devices (e.g., mobile device, emails/text messages, phone calls), times (e.g., family time, outside of regular work hours, nonwork hours), and locations or contexts (e.g., at work, in meetings). Most are measured as a frequency of specific or general ICT behaviors (e.g., engaging in leisurely internet browsing activities during work hours from a given list). In looking at nonwork ICT use at work, Coker (2013) further converted the reported frequency to percentage of leisure browsing out of total work time.

Additionally, other researchers use Likert-type scales with descriptive items of ICT behaviors. Examples include the technology-assisted supplemental work scale (Fenner and Renn 2010), a measure on smartphone use after work assess work-ICT use during nonwork time (Derks and Bakker 2014). It is important to note that the latter contains items that may appear to assess psychological experiences similar to telepressure (e.g., "When my smartphone blinks to indicate new messages, I cannot resist checking them;" Derks and Bakker 2014), despite being labeled as a behavioral "use" measure conceptually. The same measure has been adapted to the work context to assess work-related smartphone use during work hours (Van Laethem et al. 2018). Other researchers created a scale capturing electronic multitasking behavior during meetings (Stephens and Davis 2009). A scale of responsiveness captured the behavior of reacting quickly to work-related online messages (e.g., "I responded immediately to online messages, even when I was busy with other things"; Sonnentag et al. 2018), which in part reflects the behavioral manifestation of the psychological pressure to respond (i.e., telepressure). For nonwork-use during work time, O'Neill et al. (2014) developed a scale on cyberslacking via Internet misuse while working remotely. The content of these descriptive items is similar to the direct frequency measures of ICT behaviors and such measures provide a snapshot of behaviors associated with electronic communications and notifications.

Other measurement techniques include quantifying time consumption on ICT use and dichotomizing behavioral occurrences of ICT use. For instance, a measure of 'new ways of working' asked participants to report the hours of using remote access, working at home, emailing, and phone calling (ten Brummelhuis et al. 2012). Olson-Buchanan and Boswell (2006) used dichotomous items (yes/no) to determine whether individuals set boundaries for using ICT to perform work tasks during nonwork time. In addition, many measures related to boundary management have included items capturing the role of ICT use. For example, a common measure of work-nonwork border permeability or boundary strength contains ICT behavioral items: "I frequently receive work-related correspondence at home (e.g., email, faxes, phone calls)" and "I receive work-related calls while I am at home" (Clark 2002; Hecht and Allen 2009).

ICT Strain Outcomes

With the prevalence of ICT use, the associated outcomes have begun to receive attention. In occupational stress models, strains are physical, behavioral, or psychological reactions to demands in the work environment (Sonnentag and Frese 2013). As illustrated by our earlier theoretical overview, employee strain occurs when investing effort into meeting demands and/or lacking sufficient resources (Bakker and Demerouti 2007). Although we present this framework linearly, it is worth noting that employee experiences of strain can also result in a problematic feedback loop, where strains can lead to job demands (Meier and Spector 2013; Tang 2014).

Research on ICT demands, resources, motivation and use has examined associated strain reactions typically in the form of negative affect, exhaustion, and physical health complaints. To uncover the differential relationships between experiences with ICT use and strain outcomes, researchers have developed terms referring to ICT-specific strain outcomes. Admittedly, terms in this category may, in part, be developed by simply relabeling an existing term or measure to reference technology-related settings. For example, 'new' concepts/terms are measured using an existing emotional reactions scale that normally references "work" in general but adjusting the wording to ask about "technological aspects of work." Nevertheless, we review this existing literature to get a complete picture on research in this area and how to advance ICT-use research.

Measures of ICT Strain Outcomes There are only a limited number of measures for ICT-specific strain outcomes in the literature.[1] Many are used by adapting an existing measure of affective strain with a stem phrase referencing technology behaviors. Unfortunately, given that many researchers outside of OHP may be unfamiliar with the precise stress process terminology to distinguish strains from stressors, as well as specify the type of strain experienced (Sonnentag and Frese 2013), several terms referring to affective outcomes of ICT use may be inaccurate. As one of the earliest conceptual examples, the term "technostress" was used to describe strain experienced from ICT use (Ragu-Nathan et al. 2008), which suggests "technostrain" should be a better term based on the conceptual definition.[2] Interestingly, Ragu-Nathan et al. (2008) did not actually measure the concept of "technostress." Other researchers later suggested that technostress can be measured with two dimensions: technoaddiction and technostrain, in which the latter includes anxiety and fatigue from using technology (Salanova et al. 2013). Based on OHP frameworks, technoaddiction would also be classified as a motivational orientation given that it is defined as an uncontrollable need to use ICT for work-related purposes excessively and compulsively (see Ng et al. 2007 and Van den Broeck et al. 2011, for work-related addiction).

Other measures also have included a mix of affective strain reactions with other outcomes. Yun et al. (2012) studied affective reactions to smartphone use at work with

[1] Moreover, some Information System research looked at attitudes toward ICT when technologies were seen as a new addition to the workplace. These studies focused on affective experiences towards facing a computer or computer-based tasks at work (see Beaudry and Pinsonneault 2010; Venkatesh, 2000).

[2] Instead they use the word "technostress creators and technostress inhibitors" to describe ICT-related demands and resources and link them with work attitudes like job satisfaction and organizational commitment. In the occupational stress literature, the appropriate terminology for those concepts would be technostressors versus technoresources.

a measure that was labeled broadly as "job stress." Some items alluded to burnout (emotionally exhausted, burned out) while others referenced tension (nervous and stressed). Additional items referenced physical health complaints (minor health problems) and difficulties with coping. Similarly, Hair et al. (2007) mixed affective reactions with motivational experiences. They conceptualized "email-related stress" as an affective reaction to email usage; however, the actual items did not follow traditional strain reaction measurement practices. Only one item appeared to assess affective reactions ("email is source of stress for me"), whereas other items focused on motivational experiences ("I feel pressure to deal with my email"), expectation demands from others ("People expect a reply to emails within a few days") and even demand expectations *they* exert onto *others* ("I expect a reply to emails within days").

Another email-specific measure of strain has been labeled as "email overload appraisal" (Brown et al. 2014). This measure evaluated individuals' emotional reactions towards dealing with emails by asking whether they find managing their emails to be "stressful." Note that researchers recommend against using the less precise word "stress" or "stressful" in measures, as most people interpret "stressful" in this wording context to equate with emotional reactions like frustration and anxiety (Jex et al. 1992). An example of a measure taking this approach is a measure of e-anxiety (Becker et al. 2019). These researchers adapted an existing anxiety measure (Spielberger State-Trait Anxiety Inventory; Marteau and Bekker 1992) to ask how often an employee felt tense or anxious due to work-related communications outside of work (including, but not limited to, email).

Due to the ease of crossing life domains using ICT devices, work-nonwork interface has also been studied as a common outcome of intensive technological use (e.g., Derks and Bakker 2014; Derks et al. 2015; Diaz et al. 2012). One measure directly captured work-life conflict from office-home smartphone use (Yun et al. 2012). Another (Turel et al. 2011) focused their measure on time-based rather than strain-based conflict. In this measure, questions were related to how email on their mobile device took time away from friends and family.

Implications for Research and Practice

The goals of this paper were to 'tidy up' our understanding of ICT terminologies and measures scattered across the literature, creating a coherent and theory-driven classification of ICT-related constructs, and to integrate the research on ICT and employee health and well-being into this classification to facilitate future research. The current state of the literature makes it difficult to identify appropriate terms and measures to test conceptual models that provide strong contributions to the OHP literature. Therefore, we outlined a holistic taxonomy of ICT-related terms to classify various constructs in five key areas of ICT demands, resources, motivational factors, use, and strain outcomes. Our taxonomy of ICT-related concepts offers researchers and practitioners who are interested in ICT research a guide for potential research gaps and measurement options in terms of building better theory, measurement, and interventions on ICT use and worker well-being.

Building Better Theory

If researchers are to continue making strides in understanding the impact of work-related ICT use on employee health (both during and after work hours), further theory development and testing around ICT-related concepts is important. Although we did not directly address the inter-relationships among the categories of ICT concepts, our review of the taxonomy identified areas of research that are underdeveloped and may warrant additional attention. Below, we offer a few suggestions for future ICT research to move forward for theory testing and further development.

Following the theoretical application of the JD-R model to ICT use (Bakker and Demerouti 2017; Day et al. 2010), empirical evidence demonstrates that ICT demands, predominantly availability expectations, and cyber incivility (a key component of poor communications), correlate with negative strain outcomes, such as exhaustion, negative affect, and sleep problems, as well as work-family conflict issues. These effects are also contingent on boundary conditions of personal (e.g., self-regulation) or job resources (e.g., job control; Dettmers et al. 2016a; Kao et al. 2020; Park et al. 2018; Park et al. 2020). However, research on the resources side has not yet been studied extensively – and those few studies focus mostly on organizational-supplied resources – rather than on individual-supplied resources. For example, several studies found direct effects of organization-supplied resources (equipment adequacy, technical support) on strain and exhaustion, but also suggest that type of resources has a moderating effect on the ICT demands-strain outcomes relationships (Day et al. 2012; Dettmers et al. 2016a). Because the taxonomy in this paper identified three forms of resources, more research is needed to develop and improve relevant measures capturing ICT- and individual-supplied resources. We also need more research that examines the dual-processes propositions from JD-R model in the ICT-use context. Perhaps workers who constantly use various kinds of ICT for work may develop strong skills for using and trouble-shooting ICT devices, thereby perceiving fewer technical problems. Other resources may protect individuals from experiencing strain and job dissatisfaction by allowing more latitude in making decisions around ICT use, such as the control over when and where to use work emails (see Day et al. 2010).

In addition, research addressing the underlying psychological (motivational) processes explaining the demands/resources-outcome relationships is beginning to emerge, but currently only in a piecemeal way across a few studies. Drawing from both SDT and the "i-Paradox" framework, autonomous reasons for ICT use can manifest in multiple ways that show alignment between an individual's work goals and their personal values. Examples include having control over how and when to use ICT, experiencing enhanced work productivity due to ICT use, and fulfilling needs of social connection; however, undermining any of these three psychological mechanisms may induce controlled motivation for ICT use. As reflected in the taxonomy, existing research on ICT motivational factors often focuses on controlled motivation, driven by the experienced encroachment on autonomy and connectivity (Mazmanian et al. 2013) or lack the specificity in types of motivation. This limitation presents an opportunity to understand psychological experiences of need fulfillment and frustration in ICT use. Constructs representing these experiences can provide insight into the motivational potential of ICT demands and resources, and their indirect effects on health and well-being outcomes, which then guide ICT design and management practices conducive to supporting employee needs. For example, engagement with "challenging" ICT

demands (e.g., increased information overload associated with time pressure; cf. Sonnentag et al. 2018) may be less detrimental to employee well-being than "hindrance" demands (e.g., hassles), due to autonomous versus controlled motivational differences in ICT use (Vujčić et al. 2017).

Finally, the taxonomy includes constructs conceptualized at the individual-level. However, technological changes and associated experiences may be influenced by teams (meso-level) and organizations (macro-level). For example, motivation to use specific technological platforms or change working arrangements may stem from more macro contextual factors, such as organizations' adoption of new technologies (e.g., purchases of Zoom or Slack services) or new work practices (e.g., remote working using ICT). Many existing constructs either referencing broadly all forms communication technologies or focusing specifically on one ICT device (e.g., smartphone) or communication platform (e.g., email). It is important to note that different media may serve different purposes in work communications, such that the associated psychological experiences and outcomes may not be the same (Gadeyne et al. 2018). Smartphones and instant messaging systems allow for quick contact with coworkers and easy access to work; such constant exposure to work content via these messages may interrupt one's primary tasks at work and induce the urge to check and reply messages regardless of time and locations. Thus, it is important to explore whether individuals recalling ICT use with different media may influence empirical relationships. Other contextual factors, including extraorganizational stressors (e.g., COVID-19, which significantly changed working arrangements), cultural differences (e.g., accommodating technical issues in cross-national teams), and organizational norms around ICT use (e.g., observing other team members and coworkers' use; Matusik and Mickel 2011) may pose challenges to employees and organizations in adapting to technological changes and uses. In addition to adapting to the learning curves of new communication platforms, individual employees are expected to pick up new "soft skills" quickly (e.g., leading effective virtual communications in meetings; Stephens et al. 2020). These new expectations for workers mean that organizations are now expected to provide sufficient technical support and resources for employees and develop new policies and practices around working from home (Sinclair et al. 2020). Future research should address how contextual factors contribute to changes in well-being and productivity of employees and identify potential ways to improve ICT-related work experiences, especially during a critical time.

Building Better Concepts and Measures

After facilitating theoretical development, the ICT research needs to turn to building better ICT-related constructs. The literature in this area has sufficiently matured, it is time for ICT researchers to pause and focus on refining and integrating items from existing measures to assess key constructs in our ICT taxonomy, rather than continue to create new (and potentially redundant) items and measures. Failure to review existing measures increases the risk of committing jingle-jangle fallacies that already plague constructs in other occupational health research areas such as the work-life interface (see Casper et al. 2018). The *jingle fallacy* is the mistaken belief that two different

measures of a concept are the same because they both have the same name: For example, ICT demands can be measured as ICT workload or availability expectations, which have different relationships with outcomes. Alternatively, the *jangle fallacy* refers to an assumption that two measures are different because they have different labels. For example, the concepts of ICT resources and some dimensions of technostress inhibitors both may be assessing the technical supports for technologies provided by organizations. Our taxonomy serves as a useful guide for OHP researchers to navigate the proliferation of ICT constructs and inform decisions regarding the choice of ICT constructs and corresponding measures.

Importantly, we recognize several fundamental challenges in construct creation and measure development in ICT research that could be addressed in future research in terms of conceptual distinction, reducing redundancy, and external validity and generalizability. First, more research needs to ensure conceptual distinction from other similar constructs with respect to construct definitions. Specifically, verifying conceptual uniqueness is critical for ensuring that a definition has not been captured in other existing constructs. For instance, Becker et al. (2019) developed a new construct of organizational expectation for email monitoring and its measure, which appeared to be conceptually similar to a previously developed construct, availability expectation (Day et al. 2012). The issue of conceptual clarity also applies to the item-level, such that there must be an alignment between theory and actual items. Some ICT measurement approaches tend to mix individual reactions to ICT demands with motivations or expectations of the demands themselves (Hair et al. 2007; Salanova et al. 2013; Yun et al. 2012).

Second, research is needed to ensure empirical/measurement clarity with existing measures to reduce empirical redundancy (Le et al. 2010). For example, it is important to show whether all cyberbullying measures (e.g., Farley et al. 2016; Vranjes et al. 2018) assess the same thing or whether some measures are conceptually distinct from each other. This clarification would be informative when choosing a measure in future research. To address this issue, it is necessary to test both related ICT constructs as well as related non-ICT constructs to assess the 'value' of new constructs. For example, Day et al. (2012) examined whether an ICT-specific construct (ICT demands) added an incremental variance to explain well-being outcomes above and beyond its similar non-ICT construct (work demands). In a recent study on cyberaggression, coworker-enacted cyberaggression explained incremental variance in rumination and subsequently counterproductive work behavior above and beyond both face-to-face aggression and similar ICT-related mistreatment constructs (i.e., cyber incivility; Richard et al. 2020).

Third, research should continuously seek external validity evidence by improving the psychometric properties and utility of measures using various rigorous techniques. As technologies continue to evolve and change ways of working in various organizational settings, interpretations and meanings of ICT-use constructs may need to be evaluated to fit in a specific context. For instance, are the workplace telepressure items interpreted the same way across workers from different occupations or backgrounds? As many industries have adapted business models during the COVID-19 pandemic (e.g., adoption of telehealth for non-COVID-19 medical care), the adoption of ICT may alter how one would interpret an item of ICT-use constructs. (See Appendix Table 2 for specific recommendations to address these three challenges).

Building Better Interventions Once theory and measurement issues have been addressed, our taxonomy also can help build better interventions for improving occupational health outcomes. As an example, there is a common concern that organizations are not providing clear guidance or support for email management (McDowall and Kinman 2017). Understanding ICT constructs from the occupational stress perspectives can offer insights in designing effective email management interventions by pinpointing specific demands, resources, or motivations related to ICT use. A within-subject experimental study found that when participants were instructed to switch off online notifications and check emails for only three times a day ("batching" technique), they reported lower levels of perceived stress and distractions than when they were instructed to check as many times as they would like (Kushlev and Dunn 2015). However, this intervention did not improve other daily reports of "positive" experience, such as positive emotions, environmental mastery, state mindfulness, or perceived productivity. Scholarly understandings of a taxonomy of ICT-related concepts helps to clarify the mechanisms as to why (and when) batching may be effective; that is, the batching technique intervention is aimed at reducing exposure to ICT demands rather than at boosting ICT resources. Therefore, batching may not be a good fit for organizations wishing to boost positive (motivational) experiences rather than merely reduce negative (strain) ones.

Future research should identify the target of ICT and occupational health interventions. For example, in their qualitative study, Matusik and Mickel (2011) found that more than half of respondents described the pressure to respond to electronic messages coming from coworkers, direct supervisors, and even external clients or customers. Potential interventions may be designed to address the recipients of ICT messages, but also the senders (e.g., when to send messages, what medium to use, how to communicate explicitly about response expectations).

Additionally, intervention strategies in the popular media that focus on disconnecting from work (e.g., Kitchen 2018) ignore key positive emotions and task accomplishment experiences that arise from ICT use with positive motivational states (e.g., Ďuranová and Ohly 2016; Sonnentag et al. 2018). Thus, avenues for promoting positive ICT resources and motivational states (i.e., valuing and enjoying ICT connections) may be just as important as reducing ICT demands. Several studies have demonstrated that interventions may afford benefits of not only addressing specific ICT demands, but also enhancing psychological resources and positive outcomes. For instance, Soucek and Moser (2010) designed a comprehensive training intervention involving learning techniques to efficiently and effectively process information via emails, which reduced amount of problems associated with email use, work interruptions, and strain experienced, and increased one's knowledge about email functions (a form of individual-supplied resources). Based on Giumetti et al.'s (2013) experiment showing that workers experienced higher levels of positive affect and energy when interacting with a supportive supervisor via email, future interventions could implement a wait-list control design to assess the effectiveness of training supervisors on email etiquette (i.e., using more civil and supportive email messages) and increasing their awareness on the negative consequences of cyber incivility. The taxonomy can help to identify paths for future work in identifying key ICT resources and motivations to inform intervention strategies for "good connection" rather than just for "disconnection."

Summary

Given the current state of the literature on ICT-related terms and measures, the goal of this paper was to integrate the research on ICT and employee health and well-being to 'clean up' ICT terminologies and measures. Guided by the JD-R Model and SDT, we outlined a holistic taxonomy of ICT-related terms to classify various constructs in the five key areas of ICT demands, resources, motivation, use, and strains. We also used this taxonomy to provide the groundwork for building better theory, measures, and interventions in the ICT-use literature, which can help guide future ICT-related research based on recommendations for theory testing and psychometric improvement, as well as support practitioners looking for guidelines and best practices around ICT use in the workplace.

Appendix

Table 2 Key Psychometric Recommendations in ICT-Use Research

Psychometric Challenges	Recommendations and Examples
Ensuring Conceptual Distinction	• When developing new measures, first review current ICT-related measures and items to assess whether the construct exists (e.g., Shaffer et al. 2016). • Ensure conceptual distinction in comparison to existing constructs and measures not only in OHP literature, but also in other fields where ICT use has been studied (e.g., information systems, human-computer interaction) • Consider using objective measures of ICT-use constructs (e.g., amount of received and sent emails for ICT use) • Examine empirical overlap to reduce conflation of reactions or attributions and behaviors • Consult with subject matter experts to be informed with newly emerged technologies in the workplace and increase the validity and overall utility of a scale (e.g., interview human resources managers about components and characteristics of new ways of working; ten Brummelhuis et al. 2012)
Ensuring Empirical/Measurement Clarity	• Make an informed decision on types of response scales for close-ended items to resolve existing scales using different types of response anchors (Schwarz 1999) • Use multiple independent samples for item reduction and refinement, and carefully evaluate psychometric properties (e.g., continually examining a scale across several studies, Derks et al. 2014; Derks et al. 2015; evaluating between a new construct and established ICT-related constructs−ICT demands and general work and psychological constructs−workload and personality; Barber and Santuzzi 2015) • Continue assessing construct validity when adopting existing ICT-related measures for further evaluation using more advanced techniques to account for measurement errors (e.g., multitrait-multimethod matrix, confirmatory factor analysis, disattenuation formula; Shaffer et al. 2016) • Evaluate incremental predictive validity of ICT-specific constructs in predicting health outcomes above and beyond similar general non-ICT related constructs (see examples in Day et al. 2012; Farley et al. 2016)
Seeking External Validity Evidence	• Conduct replication using previously validated measures in a sample from a different source to ensure ICT-related constructs are applicable in various populations (e.g., demographics, occupations, sampling platforms, cross--cultural, multiple timepoints; Van Laethem et al. 2018) • Collect data using rigorous study designs to evaluate measurement equivalence of ICT-related constructs across groups (e.g., countries, industries) and multilevel structures • A meta-analytic approach may be adopted to examine measurement issues and nomological network of a specific construct when there are sufficient numbers of ICT-related studies

Declarations Not applicable.

Conflict of Interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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