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ABSTRACT

The recent COVID-19 pandemic has reiterated the importance of using ICTs not only for ensuring continuity of employee work and but also for facilitating innovation. However, extensive use of organizational ICTs presents the potential for employee monitoring, control, and surveillance, which could be viewed adversely by employees leading to negative outcomes. Motivated by this dilemma about the mixed influence of organizational ICTs on employee outcomes, we first draw upon the literature on spatial intrusion to identify the two dimensions of employee *technological spatial intrusion* (TSI) — *employee accessibility* and *employee visibility*. Next, taking a locus of causality perspective, we examine the mechanisms through which the two dimensions of TSI impact ICT enabled employee innovation. Our research suggests that TSI may advance or inhibit employee innovation depending on the interactional meaning that the employees attach to the experienced intrusions. We test the proposed research model via a survey of 163 employees from diverse organizations who regularly use ICTs for their work. Results indicate that employee accessibility generally has positive, while employee visibility has negative relationships with employee innovation. Further, we demonstrate that 'ICT usefulness perceptions' mediate the relationships between accessibility and ICT-enabled innovation. Our research is among the first to conceptualize TSI and theorize its impact on employee innovation. Demonstrating the positive and negative influence of TSI may help organizations to design technologies that are perceived as more useful by employees. Together, the results from our study have implications for undertaking technological assessments for facilitating employee innovation.

Keywords: employee innovation; locus of causality; technological spatial intrusion; accessibility; visibility; workplace technologies; usefulness

1. Introduction

The era of digital transformation continues to usher in new ubiquitous information and communication technologies (ICTs) that allow organizations to conduct business transactions with ease and efficiency, presumably resulting in enhanced outcomes for firms (Garrett, Spreitzer, & Bacevice, 2017). ICTs by providing constant connectivity, real-time communication, and immediate feedback may help create ambient conditions for employees and act as significant enablers of innovation within organizations (Spiezia, 2011). The current COVID-19 crisis has further precipitated the significant role played by technology in fostering innovation (Coccia, 2020; Ruokonen, 2020). Though ICTs can play a prominent role in facilitating innovation, they also intrude into employees' personal space[1] (both physical and virtual) enabling the potential for continuous monitoring of their actions and behaviors (Gartner, 2012; Lin, Kain, & Fritz, 2013; Zuboff, 2015). Such technological

[1] Refers to as the quiet, non-threatening, and self-regulated time and space (virtual/real) needed to perform cognitive tasks related to work without unwanted organizational interruptions and stressors.

intrusions into the personal space of the employees (termed as "technological spatial intrusions") are known to have negative impacts on employee performance (Cohen, 2008; Gartner, 2012; Sarker, Xiao, Sarker, & Ahuja, 2012). This creates a paradoxical situation, where the very same ICTs purported to enhance employee innovation by providing continuous connectivity and information exchange, may in fact have adverse employee outcomes (Dambrin, 2004; Nikayin, Heikkilä, de Reuver, & Solaimani, 2014; Xu, 2019). Against this backdrop of mixed outcomes, it will be theoretically and practically interesting to examine —how ICTs and the associated "technological spatial intrusions" (TSI) impact ICT enabled employee innovation (Palm & Hansson, 2006; Wright, et al., 2014)? The objective of our research is thus to theorize and empirically test the influence of technological spatial intrusions (TSI) experienced by the organizational employees on their innovation performance.

In our study, we address the above-mentioned research objective and contribute to the literature as follows. First, we conceptualize employee TSI as technological intrusions to the employee's integrated personal space (physical and virtual space surrounding the employee). Prior technology intrusion literature has so far examined intrusions either into the 'self' (in terms of personal data privacy intrusion) or into the 'architectural space' (in terms of the personal physical space intrusion) (Bernstein, 2012; Yin, Liu, & Lin, 2015). This does not adequately account for technology intrusions into both (self and architecture) simultaneously, and also an intrusion into the unobserved digital traces embedded within the employee's virtual space. Drawing from the literature on organizations (Bernstein, 2012), law (Cohen, 2008), and technology (Ayyagari, Grover, & Purvis, 2011; Dery, Kolb, & MacCormick, 2014; Pinsonneault & Heppel, 1997), we develop two key dimensions of TSI —namely, '*accessibility*' and '*visibility*'[2]. Second, we leverage the locus of causality perspective, described by the organismic integration theory that incorporates notions of individual control and agency, to hypothesize the relationship of TSI with ICT-enabled employee innovation (e.g. Bernstein, 2012; Patterson et al., 2005). Taking an interactional perspective, we acknowledge

[2] More details on the conceptualization of TSI factors are provided in the background literature section.

the role of employees' perceptions of *volition* in forming their experiences about TSI influencing their innovation outcomes differently. Third, we posit that individuals may have diverse notions about the 'usefulness of technology' and may thus interpret TSI either as an affordance or as a constraint. Specifically, we theorize for employee perceptions of the *usefulness of ICT* as a mediator in the relationship between TSI and ICT-enabled employee innovation. The mediation view enables us to verify the tenacity of the initial model suggesting that employees may not always view TSI as loss of autonomy; rather such intrusions may also be viewed by employees as useful tools for better work.

From a practical standpoint, our study can help organizations foster better participation from employees in organizational activities to enhance their innovation output (see Coccia, 2019a; Friedman & Reed, 2007; Smith & Tabak, 2009) and allow organizations to understand the perils of certain ICT tool designs and their deployment. This is notably meaningful during the current COVID-19 pandemic which calls for self-isolation and social distancing as effective measures to control the spread of the virus (Coccia, 2020; Sarmadi, 2020). Our study guides organizations to design employee interactions via technological tools that can serve as non-pharmaceutical intervention strategies to tackle future epidemics similar to COVID-19 (Coccia, 2020; Sarmadi, 2020).

The rest of the paper is organized as follows. In the next section, we provide background literature on ICT enabled innovation and spatial intrusion. We then, theorize and delineate the two technological spatial intrusion dimensions influencing ICT-enabled innovation. Next, we discuss the organismic integration theory to explain the locus of causality and describe how it helps to explain our predictions about the influence of TSI on ICT-enabled employee innovation. In the subsequent section, we present our research model and hypotheses, where we theorize the direct and mediated relationships of TSI with ICT-enabled employee innovation. The succeeding section describes our research method and results. Finally, we discuss the results followed by limitations and implications that our study offers for theory and practice.

2. Background literature

ICT enabled employee innovation

Innovations by firms are generally classified as product or process innovations (Centobelli, Cerchione, & Singh, 2019). Prior research has shown that at a macro level, the use of ICTs is linked to the extent of a firm's innovation (Spiezia, 2011). Recent literature on digital innovation further enlarges the definition as the use of digital technology during the process of innovating, which may describe, fully or partly, the outcomes of innovation (Nambisan, Lyytinen, Majchrzak, & Song, 2017). This definition allows researchers to look at the use of digital tools and ICTs for innovation by diverse or distributed agents including employees. At a micro level, leveraging individual context fit theories, studies have examined employee creativity as an outcome of efficient technology management (Chen, Chang, & Chang, 2015; Shirish, Boughzala, & Srivastava, 2019). Need for autonomy, workplace discretion, and time pressure are known to impact employee creativity in knowledge-intensive technological firms (Chen, et al., 2015; Shirish, et al., 2019). Structured ICT-enabled creativity processes are also known to influence digital innovations measured as ICT enabled innovations (Shirish, et al., 2019). Research has also shown that the enablers and constraints of innovation in workplace settings is not the technology *per se*, but the way technology is managed and used by employees (Montealegre & Cascio, 2017; Shirish, et al., 2019; Tarafdar, Cooper, & Stich, 2019). Thus, we examine ICT enabled employee innovation as the key dependent variable, which refers to using ICTs to collaborate, experiment, and explore new ideas as a process of digital innovation (Harvey, Lefebvre, & Lefebvre, 1993; Tarafdar, Tu, & Ragu-Nathan, 2010; Torkzadeh & Doll, 1999).

Generally, innovation encompasses creating new things that may follow nonstandard practices and thus implies *creative deviance*, which is primarily discretionary in nature (Rogers, 1995; Sia, Teo, Tan, & Wei, 2004; Zaltman, Duncan, & Holbek, 1973). ICT-enabled employee innovation extends this

conceptualization of innovation to discuss the role of ICT in enriching employee jobs by exploring new ways of performing tasks and interfacing with the customers.

Employee technological spatial intrusion in organizations

Technological spatial intrusion (TSI) is embedded in the context of using organizational technologies (Montealegre & Cascio, 2017). The present-day organizational ICTs have the potential for monitoring and tracking their employee activities, which is expected to make the organization safer, streamlined, and productive (see Nikayin, et al., 2014). However, such ICTs threaten to intrude into the personal space of employees—both physical and virtual. Their physical space is compromised by visual/location monitoring tools, and their virtual space is exposed by technologies that routinely record the material traces of employees' intellectual, emotional and relational movements. Such an overexposure of the employees during the conduct of routine professional activities may undermine their perceptions of autonomy and control in work.

In general, prior research has conceptualized employee intrusion in two ways – (1) 'information privacy', described by intrusions into employee's personally identifiable data and information (Bélanger & Crossler, 2011; Xu, Teo, Tan, & Agarwal, 2012; Yin, et al., 2015), and (2) 'architectural privacy', conceived as visual or acoustic intrusions into the physical space of the employee at work (Bernstein, 2012; Sundstrom, Burt, & Kamp, 1980). However, ICTs can record not only the personally identifiable employee information (data) and what the employee is doing in physical space (location/access/actions), but also trace and predict what the individual is thinking and doing in her/his virtual space (planning/thoughts/workflow) (Lorino, 2013; Nikayin, et al., 2014; Oldenburg, 1989). Prior literature on virtual social presence buttresses our idea that intrusion can happen in a subjective and situated personal space including the virtual space needed for unobstructed work (Animesh, Pinsonneault, Yang, & Oh, 2011; Schultze & Brooks, 2019). Thus, the need to feel a sense of control over one's personal space is quintessential to the successful use of technology in a predominantly virtual workplace.

We note that the current conceptualization of the degree of intrusion and its influence on user outcome is restricted to the degree of control over one's *private data* and/or perception of control over one's *physical space* (Anacleto & Fels, 2015). However, as discussed above, organizational ICTs can intrude into both self (private data) and physical space (architectural space) simultaneously and can also compromise the unobserved digital traces in the virtual space (personal space). In addition, the current conceptualization of technology intrusion is more from the perspective of what the technology does and to what extent it can compromise the data or architectural privacy. However, the individual's interpretation of the technological intrusion, i.e. whether it is beneficial or harmful for the individual, has not been explicitly theorized (Deci & Ryan, 2002; Ryan & Connell, 1989). Technological intrusions may be interpreted positively by the individuals because intrusions, in certain situations, as they may provide the employees with the necessary opportunities to work efficiently (Hinnant & O'Looney, 2003). Thus, we posit that it is important to theorize around the interactional meanings that employees attach to the technological intrusions rather than the presence of intrusion itself (Cohen, 2012; Yin, et al., 2015).

Conceptualizing employee technological spatial intrusion: accessibility and visibility

Motivated by the theoretical and practical dilemmas mentioned in the preceding section, the present study, guided by Cohen's (2008) work from the field of law, attempts to add to the conversation on intrusions to conceptualize employee TSI in context of today's workplace that uses general ICTs as backbone IT infrastructure. Further, we theorize the mechanisms through which TSI influences the key employee outcome of ICT-enabled innovation (e.g. Bernstein, 2012). We describe the TSI for employees as comprising of two dimensions (1) employee accessibility (i.e., the possibility of employees accessing and/or being accessed by colleagues/employer anytime and anywhere), and (2) visibility (i.e. the possibility of making employees' actions, behaviors, preferences, and work processes in physical and virtual space discernible and traceable to colleagues/employer) (Cohen, 2008).

Accessibility refers to the employee's ability to connect/disconnect from work/workers in real and technologically mediated (virtual) space. Accessibility is comparable to the notion of connectivity using smartphones for work and non-work activities as described by Dery et al. (2014). However, the assumption of connectivity by Dery et al. (2014) is about the ability to perform work and non-work tasks whereas *accessibility* extends this concept to performing work and non-work by accessing the physical as well as virtual space of the individual. Such altered space has also been conceived of in the social presence literature that is popularly used to study interactions in virtual contexts (Animesh, et al., 2011; Schultze & Brooks, 2019). This clearly illustrates the altered aspect of accessibility in the context of present-day workplace technologies.

Visibility, on the other hand, refers to the employee's situation to be exposed or remain hidden (and be anonymous) while executing different work processes —implying if an employee can be mapped to specific work traces both physical and virtual. Though the definition of visibility is much larger, notions of transparency, as described by Bernstein (2012), are also embedded. While the notion of transparency encapsulates only "low-level observable" activities, visibility additionally pertains to "traceability of intellectual, emotional and relational movements", which are hidden to physical observation but can be tracked in the virtual space of the individual through ICTs (Ravid, Tomczak, White, & Behrend, 2020; Tomczak, Behrend, Willford, & Jimenez, 2020). Because both technology-mediated 'accessibility' and 'visibility' together define the spatial existence of the employee in the organization and beyond (Anacleto & Fels, 2015), we conceptualize their intrusion as TSI which is an extension of Cohen's (2008) conceptualization of spatial intrusion. Appendix A provides more details on our conceptualization and how we extend the prior intrusion research.

Organismic integration theory, locus of causality, and spatial intrusion concerns

While the prior sections deliberated on the background theory for developing the research context and the key variables, the current section discusses the literature and theory that we use for building our hypotheses.

Stimuli do not cause behavior, but the affordances and constraints that individuals perceive from the stimuli enable them to psychologically self-regulate their behavior (Deci & Ryan, 1985; Malhotra, Galletta, & Kirsch, 2008). Several individual-level theoretical frameworks in technology management research can be used for our study as they use *interactional perspective* to examine the perception of the users in a situated context. For example, the needs-affordance framework (Karahanna, Sean, Yan, & Nan, 2018); self-determination theory (Baard, Deci, & Ryan, 2004; Chandra, Srivastava, & Joseph, 2017; Coccia, 2019b); interactional model of social presence (Schultze & Brooks, 2019). Further, consumer-level purchase outcomes have been examined using symbolic consumption literature that uses both the social dimension and environmental attributes of the virtual environments (Animesh, et al., 2011). These theories were specifically developed or used in voluntary technology use contexts, such as social media use and virtual worlds, and are therefore not readily adaptable to the context of our study.

Past research has also suggested the need to explain employee behavioral outcomes based on their psychological states in terms of their perceptions about their locus of causality (Deci & Ryan, 1985; Malhotra, et al., 2008; Ryan & Connell, 1989). Locus of causality pertains to the 'self' and is the degree to which the action that describes the relative autonomy of the act, is initiated from and/or endorsed by the 'self' (Ryan & Connell, 1989). The *organismic integration theory* precisely explains an employee's psychological state in terms of her/his perceptions of locus of causality and interprets if the employee senses autonomy, external pressure, or a combination of both (Malhotra, et al., 2008). In internal locus of causality, an employee would perceive herself/ himself as the "origin" of her/his behavior (autonomous and volitional), whereas in an external locus of causality, s/he would see herself/ himself as a "pawn" controlled by external forces (controlled and compulsive) (De Charms, 1968; Ryan & Connell, 1989). An individual's perceptions of volition and compulsion are functions of her/his beliefs about the locus of causality rather than the "external stimuli" (Malhotra, et al., 2008). 'Volition' is portrayed as an internal locus of causality (which is desirable) while 'compulsion' is represented as an external locus of causality (which is undesirable).

3. Hypothesis and Methodology

Grounding our discussion in the locus of causality perspective, we hypothesize that the perceptions that TSI evokes in the minds of the users determine their influence on ICT-enabled innovation. Figure 1 presents the research model (along with the control variables) developed for this study. We discuss each of the depicted hypothesis in the subsequent sections.

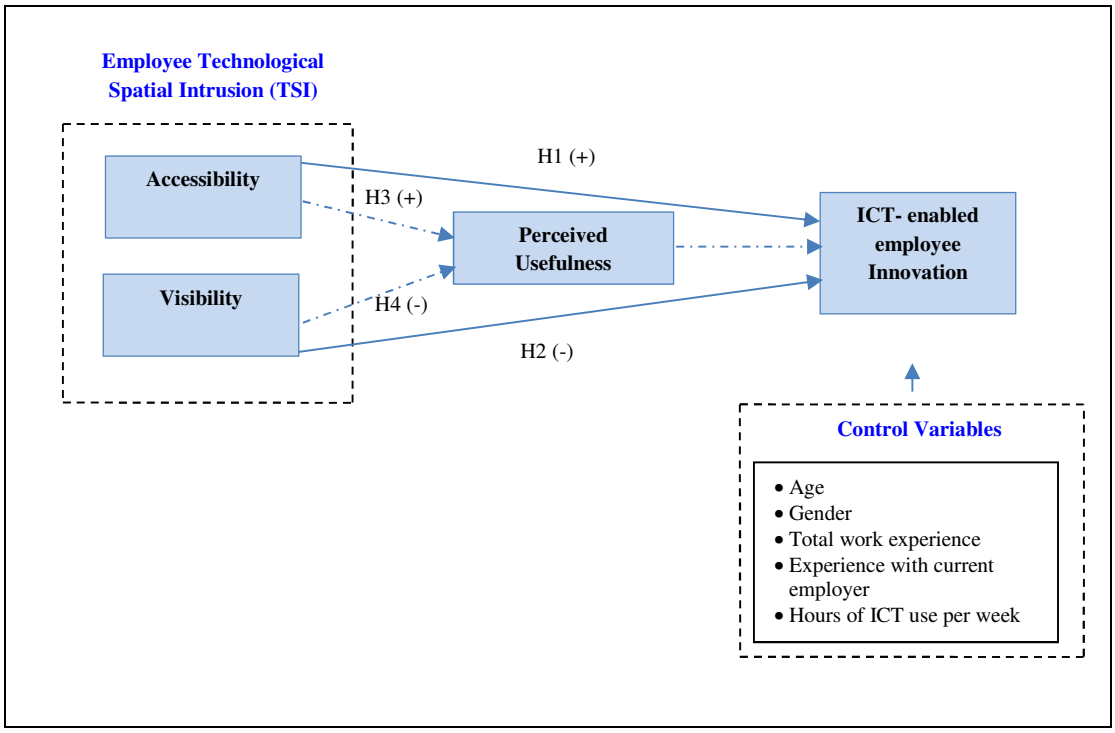

Figure 1. Employee Technological Spatial Intrusions - Research Model

3.1 Hypothesis development

Linking employee accessibility with ICT-enabled employee innovation

As discussed in the literature review section, many organizational ICTs tend to externalize employee's locus of causality (to employers and colleagues) by providing the employers and colleagues access to the employee's personal space (for monitoring and control). However, the very same technologies also allow employees to access external parties (employers and colleagues) as and when needed. This reverse accessibility serves to provide employees with a sense of volition (implying a perception of an internal locus of causality). The choice and possibility to access other employees and be accessed are often desirable, as enhanced access amongst colleagues would enable employees to be in continuous touch with each other, resulting in improved information flow

and knowledge exchange that can help in achieving innovation goals (Bernstein, 2012; Hansen, 1999; Jensen & Raver, 2012). Recent technology research claims that involvement in such reciprocal activities made possible by virtual environment arises not only out of a moral obligation to seek or provide an interlocking response to the others to satisfy task requirements, but also to validate one's agency of self-presentation (Schultze & Brooks, 2019). Employees can use accessibility opportunistically to reach out to their colleagues as and when required. This creates perceptions of autonomy at work through the possibility of having immediate feedback, enhanced mutual knowledge, efficient knowledge transfers, and shared understanding (Adler & Clark, 1991; Argote, 2012; Bechky, 2003). Moreover, accessibility may also strengthen the perceptions of an internal locus of causality by curbing the influence of external factors that can impede autonomy e.g. reducing lags between iterations at work, mitigating coordination problems, and decreasing social loafing (Karau & Williams, 1993). Also, despite the locus of causality being mixed (external and internal), accessibility through ICTs encourages feelings of reciprocity and gratefulness, which may help experience volition and joy at work (Algoe, Haidt, & Gable, 2008; Chai, Das, & Rao, 2011; DeSteno, Bartlett, Baumann, Williams, & Dickens, 2010). As employees get a chance to build upon the work of others in joyful reciprocity filled environment, they can be more innovative —creating new products, services, ideas, procedures and processes (Fehr, Fulmer, Awtrey, & Miller, 2017; Fredrickson, 2004; Lambert, Graham, & Fincham, 2009). Prior studies have also shown that creativity amongst employees is enhanced when they perceive that they have some degree of control over the process (e.g. Chen, et al., 2015; Lally, 1996) and if that control is over data traces and channel it is said to alleviate any negative technology spatial intrusion concerns (Anacleto & Fels, 2015). Such perceptions of control, autonomy coupled with the feelings of reciprocity and gratefulness will encourage them to focus on executing the intended ICT enabled tasks innovatively. Hence, we hypothesize:

H1: Employee accessibility is positively associated with ICT-enabled employee innovation.

Linking visibility with ICT-enabled employee innovation

Workplace surveillance tools, biometric devices, and ubiquitous computing result in continuous self-exposure of the employees (Brivot & Gendron, 2011). Even the use of collaborative workspaces such as virtual worlds via virtual agents violates the employee's personal space (Nassiri, Powell, & Moore, 2010). Though implemented to improve work efficiency and safety, ICTs tend to intrude into the personal space of the employee by exposing their physical and virtual workspaces. Such pervasive technologies make it difficult for the employees to hide their ICT usage and remain anonymous users of ICTs at work. In fact, it is very easy for others, especially employers, to identify ICT usage patterns of specific employees.

Clearly, in the case of visibility, the locus of causality is primarily external because of which employees may experience distraction (Thompson, Sebastianelli, & Murray, 2009). Innovation, in general, is associated with creating new things that require creative deviance and risk-taking, which may sometimes lead to failures (Hansen & Birkinshaw, 2007; Srivastava, Mithas, & Jha, 2013; Srivastava & Shainesh, 2015). It has long been concluded that an internal locus of causality aids creativity by enhancing the reliance on self and freedom from external control (Rogers, 1954). Control over self-perception, including information, leads to psychological empowerment which is essential for discretionary behaviors necessary for creative performance and innovation (Alge, Ballinger, Tangirala, & Oakley, 2006). However, an environment imbued with employee visibility externalizes the locus of causality to the employers making employees' actions open to evaluation by managers and other organizational members (see Ahuja & Galvin, 2003), it can thaw the basic needs of a creative employee (Karahanna, et al., 2018). Research on evaluation apprehension suggests that individuals often get worried when their work is being evaluated by others, more so if they are trying out new things.

Employees may not have a private creative space, and continuous evaluation may cause performance stress and inhibit them from taking risks (Thompson, et al., 2009) especially when ubiquitous supervision/monitoring is employed (see Jensen & Raver, 2012). In a situation where

employees perceive the potential of invasion into their personal space, they may not be motivated to try out new ideas and will retract from any potential innovative use of the technology. It would be safer and appropriate for them to conform to the observed learned behaviors and processes. Additionally, ICT induced visibility may encourage employees to engage in hiding behaviors, especially if they intend to try out something different (Patel, 2016). Violation of personal space decoupled with control perceptions is linked to reactions of anxiety, discomfort, and flight responses from individuals even in virtual settings (Nassiri, et al., 2010). The cognitive effort spent in securing a personal space through hiding their tasks will also influence their actual innovation performance adversely (Bernstein, 2012). Furthermore, the ubiquitous visibility of the employees will lead them to develop a tendency to share information only within their limited in-groups, restricting the flow of information and knowledge from other organizational members. This may also tend to limit employee creativity and innovation (Cohen, 2008). Thus, we hypothesize:

H2b: Employee visibility is negatively associated with ICT enabled employee innovation.

Mediating role of 'usefulness of ICT' between employee TSI and innovation

ICT enables employees to access other colleagues and to be in touch with them because of which they sense better control and autonomy over work processes. ICT enabled intrusions also protect employees against unfair work distributions and false accusations, giving them perceptions of reduced dishonesty and more fairness, helping in better task management, and creating a positive workplace (Allen, Walker, Coopman, & Hart, 2007). Prior studies have demonstrated that employees often perceive access through ICTs as useful for protecting them against lazy or incompetent colleagues (Findlay & McKinlay, 2003; Sewell & Barker, 2006). Because of the affordances and opportunities perceived through the technological spatial intrusion dimension of accessibility, employees may sense ICT to be a useful tool, which enables them to accomplish their tasks quickly and easily without compromising on the quality. The negative aspect of being accessible to others may be balanced out due to the feelings of reciprocity and gratitude experienced by employees as

they also have the option to reach out to others in times of need (Chang, Lin, & Chen, 2012; Posey, Lowry, Roberts, & Ellis, 2010; Yan & Tan, 2014). For example, in the current times of the COVID-19 crisis, employees are using technology to work remotely and stay accessible to their colleagues for work despite their privacy concerns (Chayomchai, Phonsiri, Junjit, Boongapim, & Suwannapusit, 2020). Consequently, employees self-regulate their interactions in a positive manner resulting in positive behavioral outcomes (Deci & Ryan, 2002; Malhotra, et al., 2008). Past literature has recognized the 'usefulness of ICT' as the key variable influencing the value of the ICT for the user (Venkatesh & Davis, 2000; Venkatesh, Morris, Davis, & Davis, 2003; Yin, et al., 2015). Hence, we suggest that employees view TSI of accessibility as a useful tool, which in turn positively influences the extent of their ICT enabled innovation. Thus, we hypothesize:

H3: The relationship between the TSI of accessibility and ICT enabled innovation is positively mediated by the perceived usefulness of ICT.

In contrast to accessibility, employee visibility is generally perceived negatively by employees because it diminishes their sense of autonomy and volition. As discussed in the prior sections, the locus of causality in the case of ICT enabled employee visibility is external, hence the spatial intrusion due to visibility may be viewed as dysfunctional by employees especially for the context of innovation, resulting in negative innovation performance (see Allen, et al., 2007; Findlay & McKinlay, 2003; Lane, 2003). Because employees perceive an externalized locus of causality due to visibility, they perceive ICT-enabled visibility as a constraint rather than as an affordance for attempting creative tasks. For example, recent research shows the concern of the employees that their information may be disclosed when using technology for work during the current COVID-19 pandemic (Chayomchai, et al., 2020). Hence, we suggest that TSI of visibility is viewed by employees as a tool that constrains their volition, freedom of choice and autonomy and makes them feel controlled, thereby fostering negative perceptions rather than usefulness for innovation-related outcomes. Even in virtual settings, individuals are discomforted when the invasion of personal space

occurs (Nassiri, et al., 2010). This in turn, negatively influences the extent of their ICT-enabled innovation. Thus, we hypothesize:

> *H4: The relationship between the TSI of visibility and ICT enabled innovation is negatively mediated by the perceived usefulness of ICT.*

3.2 Data and sources

For this research, survey method was employed. The sampling frame comprised senior organizational employees from the service sector because they are generally involved in executing knowledge-intensive jobs that encourage new initiatives and innovation. Survey invitations were sent out to nearly 700 senior-level employees from different organizations, who regularly use ICTs to accomplish professional tasks. The initial mailing list was prepared using alumni lists for executive programs from two leading business schools. Besides, few invitations were also sent out to employees who were referred to us by the initial sampling pool. The mailing list was meticulously prepared to include only those respondents whose nature of work required them to use ICT. An online link to the survey was attached to the email invitation, along with a note informing the participants of the voluntary nature of the survey participation and assuring them of confidentiality. A follow-up reminder was sent a week later, after which 185 responses were received, of which 163 were usable after discounting for incomplete surveys. Because the research involved self-reported responses by the survey respondents, the possibility of response bias, which may influence the responses of survey participants away from accurate responses, was controlled in the study (Nederhof, 1985; Srivastava, Chandra, & Shirish, 2015). The response bias was controlled by designing and administering the survey in a manner such that the respondents were unaware of the research hypotheses. It was further controlled by presenting a 7-point Likert scale to avoid loading on one type of response (Cook et al., 1970). Furthermore, as the survey participation was completely voluntary and the survey respondents were assured of confidentiality, any form of social desirability bias was also controlled for in the study (Nederhof, 1985).

Additionally, we used the procedure recommended by Armstrong & Overton (1977) to test for nonresponse bias. We compared early-returned questionnaires to late-returned questionnaires on the key research variables used in the study (see Chaudhuri & Holbrook, 2001; Compeau & Higgins, 1995; Poppo & Zenger, 2002). The assumption for this analysis is that late respondents share similar characteristics and response biases with non-respondents. Because no significant differences in the key research variables were found between the first and last quartile of the respondents, we concluded that there was no evidence of obvious response bias in the sample. Further, an outlier analysis conducted on the compiled dataset using Cook's distance statistic did not indicate any significant outliers (Cook & Weisberg, 1999). Hence, data from all the usable responses were used to test the research hypotheses.

Demographics

Table 1 provides the demographics of the survey respondents. Analysis of the respondent demographics shows that almost 77% of the respondents in our sample were male. The respondents were highly educated with nearly 80 percent of the respondents possessing a post-graduate degree or even higher. The average respondent age was 37.64 years (S.D. =6.75), and the respondents averaged 14.47 years (S.D. =6.76) of total work experience and 7.17 years (S.D. =5.62) of experience with the current employer. These high levels of work experience and educational qualifications indicate that most respondents were working at senior levels in their organizations (Dustmann & Meghir, 2005; Zwick, 2011). The average ICT use for professional work was 27.50 hours per week (S.D. =18.27) which shows that the sample population indeed used ICT for their work.

Table 1: Demographic profile of survey respondents

Demographic Variable	Category	Frequency [N=163]	Percentage (%)
Gender	Male	125	76.7
	Female	38	23.3
Age	20-29 years	20	12.3
	30-39 years	76	46.6
	40-49 years	60	36.8

	50+ years	7	4.3
Education	Doctorate	3	1.8
	Masters	126	77.3
	Bachelors	34	20.9
Total work experience	<10 years	39	23.9
	10-19 years	84	51.5
	20-29 years	37	22.7
	30+ years	3	1.8
Experience with current employer	0-5 years	79	48.5
	6-10 years	41	25.2
	11-20 years	41	25.2
	20+ years	2	1.2
Domain	Business	136	83
	Technical	24.0	14.7
	Administrative	3.0	1.8
Hours per week of ICT usage	<20 hours	53	33
	20-39 hours	62	38
	40-59 hours	36	22
	60+ hours	12	7

3.3 Measures

Validated scales from existing literature were adapted to the research context to formulate our questionnaire (Appendix B). To measure the items, we used a 7-point Likert scale ranging from 1 ("strongly disagree") to 7 ("strongly agree"). Items for the measure of technological spatial intrusion (TSI) were adapted from prior literature. Specifically, building on Cohen's (2008) concept of spatial intrusion, we describe TSI through 'accessibility' and 'visibility'. The concept of presenteeism and anonymity by Ayyagari et al (2011) fits well with our conception of TSI dimensions. Both accessibility and visibility have been adapted from the preexisting scales of Ayyagari et al (2011) and then contextualized to our study. The scales for accessibility correspond with presenteeism while scales for visibility correspond with anonymity from Ayyagari et al (2011). Because the concept of anonymity is opposite to being visible, we reverse coded our scales during the analysis stage to match our conceptualization. This helps us in having validated measurement scales for our research where psychometric properties have already been established. The items for ICT-enabled innovation

were also adapted from prior research –specifically from Tarafdar et al. (2010). Lastly, the scale of perceived usefulness was adapted from Moore and Benbasat (1991). Our strategy of adapting and using scales from prior research gave us the confidence about the psychometric and measurement properties of the items used.

3.4 Data analysis procedure

Validity and reliability

We checked for three types of validity: content validity, convergent validity, and discriminant validity. Content validity was established by checking for consistency between the measurement items and the existing literature. For determining the convergent validity, we examined the factor loadings of indicators comprising each construct, which exceeded the acceptable minimum of 0.50 (Appendix B). Convergent validity was further confirmed by observing the indicator loadings on each corresponding construct, which were higher than those across other constructs. Moreover, the composite reliability (CR) and the AVE (the ratio of the construct variance to the total variance among indicators) complied with the minimum threshold of 0.70 & 0.50 respectively, demonstrating convergent validity (Hair, Black, Babin, Anderson, & Tatham, 2006) (Appendix C). Besides, as Appendix B shows, the high Cronbach's alpha values, ranging from 0.74 to 0.97, confirm the reliability of all scales. Discriminant validity was indicated by the low cross-loadings of indicators on non-corresponding research constructs (Gefen & Straub, 2005) (Appendix C). Further, as recommended by (Fornell & Larcker, 1981), the values of the square root of the AVE (reported on the diagonals in Appendix D) were found to be greater than the inter-construct correlations (the off-diagonal entries in Appendix D), exhibiting satisfactory discriminant validity. Appendix B provides the means, standard deviations while Appendix D presents the correlations for all the research variables in the study. As all correlations among variables are below 0.80, there are no significant multicollinearity problems (Hair, et al., 2006).

Control variables and common method bias

Control variables of four different types were included in the research model to account for alternative explanations, namely: (1) respondent demographics of age and gender: for age, the number of years reported by the respondent and for gender, a dummy variable indicating male or female was used (2) respondent experience: total work experience and work experience with the current employer measured by the number of completed years (3) extent of ICT use: measured as the number of average hours of ICT use per week, and (4) ICT self-efficacy, which is a significant variable influencing technology-related outcomes (Venkatesh, et al., 2003).

Further, because all data were self-reported and collected through the same questionnaire with a cross-sectional research design, common method bias may be a concern. To alleviate such concerns, we adopted several procedural remedies and statistical controls that are described in Appendix E. Our analysis shows that the results of this study do not suffer from any confounds due to common method bias.

Endogeneity test

Though our research model is theoretically grounded in the locus of causality perspective as described in the organismic integration theory, we need to be confident about the hypothesized causation. To confirm the robustness of our proposed research model, it will be meaningful to ensure that accessibility and visibility are not endogenous predictors of the outcome variables.

To test if accessibility and visibility are endogenous regressors and whether an instrumental variable approach is necessary to mitigate endogeneity bias, we conducted the Durbin and Wu-Hausman test (Durbin, 1954; Hausman, 1978; Wu, 1973). The three instrument variables selected for the test were 'Social Factors', 'Perceived Behavioral Control', and 'Pace of Change'. The scales for the three variables are presented in Appendix F. The instrument variables satisfied the strength and validity requirements for being good instruments i.e. they were correlated with the two predictors but uncorrelated with the outcome variables.

The null hypothesis of the Durbin and Wu-Hausman test is that the regressors are exogenous. For innovation (p-value=0.2) as the outcome variable, the results fail to reject the null hypothesis suggesting 'accessibility' and 'visibility' are exogenous regressors, thereby disconfirming concerns of endogeneity confounding our results.

4. Results

Hypothesis testing

The research model examines the influence of two employee technological spatial intrusion (TSI) variables, namely, employee accessibility and visibility, on the ICT-enabled employee innovation (H1 and H2). A two-step hierarchical regression model was used for testing the hypotheses. We used SPSS for our analysis. In the first step, we introduced all control variables, and in the second step, we introduced the two employee TSI factors, i.e., accessibility and visibility. Following the guidelines outlined by Aiken and West (1991), we mean-centered all values before hypothesis testing to reduce collinearity. We also checked for multicollinearity of our predictors and calculated the variance inflation factor (VIF), and found no significant multicollinearity problems (Hair, et al., 2006; Kutner, Nachtsheim, & Neter, 2004). The stepwise regression results for hypothesis testing are presented in Table 2.

Table 2. Results of hierarchical regression analysis

		ICT-enabled Employee Innovation			
		Step 1		Step 2	
		Control variables		Main effects	
		β	**se**	**β**	**se**
Constant		**3.765****	**1.118**	**4.203****	**1.131**
Control Variables					
Age		-0.011	0.040	-0.044	0.040
Gender		-0.419	0.223	-0.408	0.214
Total work experience		-0.012	0.042	0.030	0.042
Experience with current employer		0.030	0.024	0.020	0.023
Hours of ICT use per week		**0.016***	**0.005**	**0.013***	**0.005**
Self-efficacy		**0.326****	**0.087**	**0.272****	**0.086**
Independent Variables					
Accessibility				**0.295****	**0.102**

Visibility			**-0.235****	**0.076**
R^2		**0.184***	**0.258****	
ΔR^2			**0.074**	
F		**5.879****	**6.701****	
ΔF			**7.660****	
*Notes: Significant figures are shown in boldface. n = 163. Figures in parentheses are standard errors. ** p<= 0.01 level; * p<=0.05 level.*				

Based on the results presented in Table 2, the control variables together explain 18.4% of the variance in innovation. Moreover, among the control variables, 'hours of ICT use per week' (β=0.016, p<0.05) and 'self-efficacy' (β=0.4326, p<0.01) have significant relationships with innovation. The high explained variance by the control variables indicates a reasonable choice of controls in the research model.

Upon incorporating the hypothesized effects of 'accessibility' and 'visibility' variables into the regression equation (step 2, main effects model), we observe a significant change in variance (ΔR^2) of 7.4%, compared to the variance explained by the model's control variables. We also observe that accessibility significantly influences innovation (β=0.295, p<0.01), thereby supporting H1. Further, visibility has a significant negative relationship with innovation (β=-0.235, p<0.01). Thus, H2 is also supported. Though the β values demonstrate the significant associations between the predictors and the outcome variables, there is not a noticeable difference in the β values of the variables significantly associated.

Mediation analysis

To test the mediation effects (H3 and H4), we used both the product of coefficients (Sobel test) and bootstrap confidence intervals: Preacher and Hayes test (Preacher & Hayes, 2004, 2008). The independent variable is accessibility, which is hypothesized as influencing ICT-enabled employee innovation through the perceptions of the 'usefulness of ICT'. Multiple regression analyses were conducted to assess each component of the proposed mediation model of accessibility and the outcomes mediated through the 'perceived usefulness of ICT'.

First, it was found that accessibility was positively associated with innovation (β=0.38, p<0.01). Next, it was found that accessibility was positively related to usefulness (β=0.61, p<0.01). Finally, the results indicated that the mediator 'usefulness' was positively associated with innovation (β=0.75, p<0.01). Because both the paths were significant, mediation analyses were tested using the Sobel test (Table 3, Upper Panel), which suggests that the level of accessibility has a positive influence on the level of innovation (Z = 5.90, p = 0.000) through perceived ICT usefulness.

The Sobel test assumes that the sampling distribution of the mediation effect is normal when it is often skewed and thus leads to biased estimates (Srivastava, Teo, & Devaraj, 2016). Methodologists (e.g. Hayes, 2009; Preacher & Hayes, 2004; Shrout & Bolger, 2002) therefore suggest that this analysis be supplemented with bootstrapping method with bias-corrected confidence estimates (Mackinnon, Lockwood, & Williams, 2004; Preacher & Hayes, 2004) as bootstrapping overcomes the problem by repeatedly sampling with replacement from the dataset and estimating the mediation effect in each resampled dataset. By resampling thousands of times, the sampling distribution for indirect effects (mediation) can be approximated and used to construct confidence intervals for the examined effects (Preacher & Hayes, 2008). If the confidence interval excludes zero, the indirect effect (i.e., mediation) is considered meaningful (Srivastava, et al., 2016). The present study achieved a 95% confidence interval for the mediation effect across 5,000 bootstrap resamples; these results appear in the lower panel of Table 2. The results of the mediation analyses (non-zero CI) confirmed the mediating role of the 'usefulness of ICT' in the relationship between accessibility and innovation (β=0.46, CI=0.30 to 0.63). In addition, results indicate that the direct effect of accessibility on innovation (β=-0.08, t=-0.80, p>0.05) becomes non-significant when controlled for usefulness, suggesting full mediation through the usefulness of ICT. The results together provide support for H3.

Next, we had also hypothesized the negative mediating effects of usefulness on the relationship between visibility and ICT-enabled employee innovation. We used both the product of coefficients (Sobel test) and bootstrap confidence intervals: Preacher and Hayes test (Preacher &

Hayes, 2004, 2008) as summarized in Table 3. The Sobel test (Table 3, Upper Panel) results confirmed the non-significant mediating influence of perceived ICT usefulness on the relationship between visibility and innovation (Z = 0.47, p = 0.637). The non-significant mediating role of the 'usefulness of ICT' in the relationship between visibility and innovation (β=0.03, CI=0.00 to 0.12) was yet further confirmed through the Preacher and Hayes test which highlighted the presence of zero in the CI as shown in the lower panel of Table 2. Hence H4 was not supported.

Table 3. Mediation Analysis

Test of the indirect effect of usefulness on ICT enabled employee innovation			
	Product of Coefficients		
		ICT-enabled Employee Innovation	
		Z-test	Significance
Accessibility		**5.90**	0.000
Visibility		0.47	0.637
	Bootstrap Confidence Interval		
		ICT-enabled Employee Innovation	
		β	Bias-Corrected Confidence Intervals
Accessibility		**0.46**	0.303 to 0.632
Visibility		0.03	0.000 to 0.116

The mediation hypothesis provides a pertinent result because it shows that TSI may not always lead to negative innovation performance. The employee innovation is largely dependent on employee perceptions of the affordances and usefulness from the specific TSI which is highly context-dependent (Leonardi, 2011). For example, accessibility has a positive influence on the ICT-enabled outcome of employee innovation. Yet, in the context of our research, a spatial intrusion due to visibility is perceived negatively by employees in the sense of being a negative influence on innovation. The mediation test provides a possible mechanism through which TSI of accessibility influences employee innovation positively.

5. Discussion and implications

5.1 Discussion

We sought to investigate the impact of two TSI dimensions of 'accessibility' and 'visibility' on ICT-enabled employee innovation. We found support for our proposed model. We found that the TSI

factor of accessibility has a significant positive relationship, while the TSI factor of visibility has a significant negative relationship with ICT-enabled employee innovation.

Furthermore, we found significant mediating effects of employee perceptions of the 'usefulness of ICT' on the relationship between accessibility and ICT-enabled employee innovation. We had also hypothesized for the negative mediation influence of employee perceptions of usefulness of ICT on the relationship between employee visibility and ICT-enabled employee innovation. However, employees possibly tend to display mixed opinions about visibility that may influence innovation not only negatively (as discussed in the argument for H2) but also positively. This is because even though the distraction due to employee visibility may weaken the employees' initiative and limit employee innovation (Shaiken, 1985; Torkzadeh & Doll, 1999), enhanced visibility may keep the employees positively motivated due to enhanced employee recognition, demonstration of achievements and personalization when working remotely (Bitner, Brown, & Meuter, 2000; Fairbank & Williams, 2001).

It also mitigates the possibilities of insider threats by finding irregularities and patterns hidden in employee behavior (Kim, Oh, Ryu, & Lee, 2020). As our sample is mostly senior-level employees who are involved with creating work practices to encourage new initiatives, such visibility protects them from security offenses making them feel psychologically safer at work (Patel, 2016; Upton & Creese, 2014). They can embrace collaboration and healthy employee relationships and trust, which would eventually lead to enhanced innovation performance (Tomczak, et al., 2020). In some cases, employees may use visibility to take advantage of a social control mechanism, whereby an organization can build-in opportunities to leverage this information. One study has also shown that employees display positive outcomes when they are watched by peers (Mas & Moretti, 2009) or monitored using video (Iedema & Rhodes, (2010). Because of both negative and positive influences of visibility on ICT-enabled employee innovation, the mediating role of the 'usefulness of ICT' between employee visibility and ICT-enabled employee innovation was not supported. We observed these effects after controlling for respondent demographics and work experience as well as

respondent's ICT usage patterns of 'extent of ICT use' and 'ICT self-efficacy'. Our model explained a 25.8% variance in innovation.

5.2 Implications for research

First, though TSI can potentially afford action possibilities that either *reinforce* or *constrain* self-regulatory behaviors, not many studies have considered the existence of both these possibilities. Prior intrusion literature acknowledges the right to perceived control over intrusions as an essential ingredient for the preservation of the sense of self-identity (Simms, 1994) but views the 'self' as a static self without any agency of its own. Hence, any kind of intrusion (informational or architectural) is expected to have negative performance consequences. In contrast to prior studies, our study conceives a broader notion of the 'self' — as the phenomenal center of personal experience (Ryan & Connell, 1989) that needs the unique spatial existence to be self-deterministic (Deci & Ryan, 2002). This is similar to Cohen's (2008) conceptualization of the 'self and its intrusion' in the legal literature. Adapting this concept from the field of law, we propose — that depending on the volition (and not compulsion) that the employee experiences, TSI could also be leveraged opportunistically leading to positive consequences. Specifically, we propose two dimensions of TSI in organizational ICT environments, namely, employee accessibility and employee visibility. This conceptualization of TSI variables is a significant contribution to technology literature as it opens avenues for explicitly examining TSI as an essential element to all technological assessment and forecasting scenarios that the present-day workplace environments must undertake.

Second, situating our arguments in the locus of causality perspective, we theorize and test the mechanisms describing the influence of TSI concerns on ICT-enabled employee innovation. As TSI is a major barrier to ICT-enabled employee innovation performance, organizations need to understand this phenomenon, specifically in terms of the individual's locus of causality (i.e. the experienced degree of volition or compulsion). The mechanisms explained through the locus of causality perspective can systematically guide and inform future research on the spatial intrusion

phenomenon and support the sociotechnical perspective necessary for responsible and ethical technical assessments.

Third, our research clearly demonstrates that the factors constituting TSI may have different influences on employee innovation. TSI cannot be judged as universally bad (or good). In fact, some forms of TSI may support innovation, depending on the contextualized employee's perceptions of locus of causality over the use of invasive ICTs. Yet, the boundary conditions to this research and the optimal amount of TSI until which the spatial infringements are viewed favorably remains to be empirically determined and is thus a ripe topic for research (Snyder, 2010). Future research, could perhaps explicitly model locus of causality and examine how the TSI is viewed at different levels of locus of causality and their consequent impacts on innovation outcomes (Malhotra, et al., 2008). It would also be interesting to view spatial intrusions as stressors and investigate their influence on job strain or other negative employee outcomes. Examining how the imbrications of humans and technologies pan out under different structural assurances (or proxy control mechanisms) provided by the organization/peers can also be an interesting line of future research enquiry (Xu, et al., 2012).
Fourth, through mediation analysis, we establish that intrusive ICT can be perceived as 'useful' despite the possibility of them breaching the employee's personal space. This is particularly interesting as it explains the mechanisms for some of the counterintuitive relationships of TSI with employee innovation in the context of our research. Employee perceptions of ICTs as useful tools clearly explain the mechanisms for such relationships, providing deeper insights for understanding TSI using an 'affordance' lens (Leonardi, 2011; Shirish, et al., 2019). Moreover, from the results, we also see that TSI is not *always* perceived as harmful (or useful). It is the employee's internal psychological perception of autonomy and control that shapes the behavioral outcomes. As upcoming technologies are expected to become more pervasive, future research can examine other conditions under which TSI can be perceived as meaningful by the employees. Researchers can also take leads from this work to address TSI concerns using control-agency theory or affordance and

constraint theory, to explore contextual factors influencing the relationships between TSI and employee innovation.

5.3 Implications for practice

This research not only adds extensively to the body of knowledge by offering theoretical implications but also has far-reaching implications for practitioners, human resource managers, and society in general. First, employee intrusions—specifically, TSI—have not been examined extensively in technology management literature. In the context of present-day organizational environment, managers must understand the influence of technology intrusions into employee's personal space, especially when undertaking technological assessment and forecasting of emerging technological policies, practices, and interventions with organizations. The current study is one of the first modest steps in that direction. It informs practitioners about the key role that TSI can play in effectuating employee innovation and that these concerns need to be explicitly considered during the formulation of organizational policies and technological assessment frameworks. The study can help managers strategize their employee ICT use policies.

Second, the results from this study highlight that TSI does not have a universally accepted unfavorable impact on employee innovation. TSI of certain kinds might be acceptable to employees and can have a positive influence on innovation. Our analysis based on the locus of causality perspective helps unravel some of these nuances. For example, accessibility has positive while visibility has a negative influence on innovation. Apart from practice-based interventions, the influence of perceived TSI can also be managed by having technological designs that explicitly offer the possibility to enhance one's perception of causality and control over the use of the technology (Anacleto & Fels, 2015). For example, while using Instant Messaging (IM), users can be provided with the autonomy over their visibility status (by displaying their desired status —offline or busy, even when they are online). Depending on the job context, employees can be provided with more (or less) autonomy for achieving the desired innovation performance. Technology managers need to consider the salient role of perceived locus of causality in influencing employees' TSI concerns. They can

consider providing governance mechanisms that offer the desired perceptions of internal/external locus of causality to employees, resulting in varied employee innovation performance.

Third, our mediation analysis demonstrates that employees perceive technology-enabled accessibility as a 'useful' technological attribute helping them perform better in terms of employee innovation. Prior research has shown that technology perceptions can be altered by organizational practices (Leonardi, 2011). Hence, there is a need to understand the nature of the intrusion and its acceptability by employees. Further, it is also important to determine the optimal level of intrusion even for the acceptable spatial intrusions such as accessibility. Managers need to understand that there may be a limit to the extent of perceived usefulness of providing 'accessibility' through technology after which it may become dysfunctional. This result is particularly important when undertaking ethical technological assessments that care for employee well-being and concerns within organizations. In the context of COVID-19 crisis, we witness that employees' remote use of ICTs have increased out of compulsive reasons, however, this long term dependence on firm's digital infrastructure use not only comes at the cost of employee's TSI concerns but it is important to address what green IT audits may be needed to take into account large scale environmental damage inflicted by such technological practices (Medappa & Srivastava, 2017).

Fourth, for technological intrusions that are expected to have a negative influence on innovation performance, such as visibility, managers need to carefully consider and meticulously design policies that will provide adequate motivational reasons demonstrating some personal meaningfulness in the intrusion. This can perhaps enable a psychological change in the perceptions of the employees leading to a positive appraisal of potentially invasive technological concerns and its subsequent acceptance/use within the organization at a faster pace. Such a situation will be beneficial for both the organization as well as employees. For instance, if the organization wants to increase the use of workplace ICTs for operational/safety reasons (Patel, 2016), managers should supplement their actions/policies with internal communication campaigns to make employees understand the dark side of cyberattacks and the vulnerability of individuals to such cybercrimes in the absence of

'visible' transactions (Upton & Creese, 2014) so that visibility intrusions are perceived positively by the employees. In addition, the organizations can keep their employees positively engaged and motivated through visibility by recognizing their services and achievements even when they are remote. This becomes particularly pertinent in the current scenario of COVID-19 when employees working remotely from their offices need constant assurance that ICT should not be viewed as a deterrent or a control measure but rather a medium for them to showcase their achievements and services to the organization. This would keep the employees intrinsically motivated at work, thereby reinforcing their innovation performance outcomes (O'Reilly III, Chatman, & Caldwell, 1991; Prendergast, 2008). The findings from this study can help organizations better appreciate their employees' TSI concerns in order to enhance their innovative capabilities.

6. Conclusion

6.1 Limitations and directions for future research

Certain limitations should be considered while interpreting our results. First, the data for this study were self-reported and thus may be subject to the respondent's personal memory and biases. Our sample size is not large for generalization. However, our results are robust because we checked the acceptable smallest sample size to detect the effect of regression analysis at $p<0.05$ using G*Power (Faul, Erdfelder, Buchner, & Lang, 2009). The desired power level is typically 0.80, but the researcher performing power analysis can specify the higher level, such as 0.90. The power analysis results for our study revealed the smallest acceptable sample size of 74 for the power level of 0.95 which means that that there is a 95% probability our research does not have any type II error arising due to sample size. Second, the study is limited to measuring accessibility and visibility using the concepts of presenteeism and anonymity from preexisting scales (Ayyagari, et al., 2011). However, guided by the overreliance on technology in businesses for working remotely and connecting with others during the current coronavirus situation, future studies may extend this conceptualization to measure accessibility as an intrusion during non-work hours and visibility as an opportunity such as gaining reputation and image by employees. Considering the positive aspects that visibility is a rich

avenue for future research. Third, the study was cross-sectional, and the respondent's perceptions and intentions were measured at a single point in time. These limitations can result in response bias and common method bias. To mitigate these biases, we controlled for response bias and adopted several procedural remedies to alleviate common method bias. We also conducted statistical tests to ascertain that the common method bias did not confound our results (Appendix E). To further negate such possibilities, future research can conduct a longitudinal study with similar objectives and a bigger sample size to complement the findings and obtain finer results. Fourth, technostress or workplace stress may be part of the underlying mechanism resulting in the negative employee innovation performance. The objective of our research was to understand the role of human agency in interpreting TSI and its consequent influence on employee performance. Consistent with this socio-technical research objective, we grounded our work in the locus of causality perspective which we use as the latent theoretical mechanism explaining the relationship between the key constructs. Inclusion of TSI perceptions is an important element that needs to be added to ethical and responsible technological assessment frameworks. Specifically measuring the actual locus of causality perceptions of employees could be a complementary addition when organizations need to undertake the technological assessment in an idiosyncratic context such as the introduction of a specific type of intrusive technology in a well-defined work context. Future research can examine the TSI using stress and other motivational theories or examine the locus of causality perceptions specifically to study this phenomenon. Fifth, the items for innovation reflect the employees' perceptions rather than independent assessments by a supervisor or a peer, which would portray real objective/independent performance. Nonetheless, several past studies using survey method have measured performance based on self-reported perceptions rather than using objective/independent performance measures (Igbaria & Tan, 1997; Tarafdar, et al., 2010; Torkzadeh & Doll, 1999). However, we do acknowledge that measuring performance using perceptions brings in a certain degree of subjective bias, which is a limitation of our research method. Sixth, the results of this study apply to the use of ICTs in general within the workplace

context. Future research can study a similar concept within a narrower context and a specific technology to better understand the applicability of specific spatial intrusion concerns. This will particularly help in identifying contextual limitations and boundaries to explain and predict negative spatial intrusion beliefs. Despite the above-mentioned limitations, we believe that the findings from our study can help organizations better appreciate the technological spatial concerns of their employees in relation to their innovation capabilities. However, we agree that more research in this important area is certainly warranted in the future.

Technology has become an indispensable tool for employee innovation and a fundamental organizational need. Its role is even more pronounced for organizations worldwide as working from home has become a precedent in the wake and continuation of the Covid-19 pandemic. However, employees are often concerned about the technological intrusion into their personal space. It becomes inordinately crucial for organizations to introduce the technologies in a manner such that the employees use it opportunistically to work efficiently rather than fretting about its intrusiveness. Our study is a modest attempt to guide the researchers and practitioners on strategizing their technology use policies to intensify ICT-enabled employee innovation.

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8. Appendices

8.1 Appendix A. Situating the concept of TSI within intrusion literature

Employee Intrusion	Informational Dimension (Old)	Spatial Dimension (Revisited)	
Employee Intrusion Literature	Employee Informational Privacy intrusion (e.g. Bélanger & Crossler, 2011)	Employee Architectural Privacy intrusion (e.g. Bernstein, 2012; Sundstrom, et al., 1980)	**Employee Technological (Situated) Spatial Intrusion (Novel)**
Perspective on intrusion	Information privacy and architectural privacy is viewed as a fixed condition that can be deduced to a core essential (i.e., having control over personal data or not having control over personal data or having isolated physical space or not having one)		It is a breathing room to engage in a socially situated process of boundary conditions.
Conditions of exposure and its relation to intrusion	Informational practices that enable accessibility of private information leads to transparency intrusions to selfhood.	Information practices that enable physical visibility of real self-lead to transparency intrusions to selfhood.	Information practices that allow both technological accessibility and/or technological visibility lead to the transparency of the highest order i.e., complete exposure of self.
	Lower levels of transparency intrusions concerns	The higher level of transparency and visibility intrusions may be expected	The highest level of transparency and exposure may be expected.
Interstitial space within information processing practices of organizations	Not recognized	Partially recognized	Fully recognized
Primary expectations	Expectancy to control personal information of the self.	Expectancy to control physical attributes of the environment to control physical embodied spaces and through that to control personal information of the self.	Expectancy to control informational and embodied physical and virtual aspects of one's situated experience of personal space[3].
	Intrusion concerns or exposure is conceptualized	Physical architectural design or conditions of exposure is	Network Architectural Design or Conditions of exposure is conceptualized.

[3] Refers to as the quiet, non-threatening and self-regulated time and space (virtual/real) needed to performance cognitive tasks related to work without unwanted organizational interruptions and stressors.

		conceptualized	
Intrusion interests	Interest is in avoiding or limiting data trails made visible to others through information accessibility.	Interest in avoiding exposure through the arrangement of physical space	Interest in avoiding or selectively limiting exposure concerns to the structure of experienced space that is often networked.
The conceptual role of technology	The intrusion may or may not be mediated by technology	The intrusion may or may not be mediated by technology	Intrusions are always mediated by technology
Perceptions on the subject of the intrusion (i.e. the employee)	Objective construction of the subject. Subject not an agent of self.	Relates to physical embodiment personal space. Subject not an agent of self.	Relates to physical and virtual embodiments of personal space. The subject is the agent or 'origin' of self.
Contextual boundaries to intrusion perception	Dichotomous Private vs Public.	Dichotomous Private vs. Public	No such distinction. Work boundaries are often blurred.
Self and personal space fundamental assumptions	Static	Dynamic self-perception but static spatial perceptions.	Dialectic, dynamic, relational, and situated self and embodied spatial perceptions. Modulated by situated affordances/constraints perceived by the subject
	Viewed as a person	Viewed as a physical being	Viewed as a self that is a phenomenal center of personal experience and agency.
	Does not recognize or rely on subjectivity;	Recognizes subjectivity partially but does not rely on it. Embodied sense of self.	Emergent and embodied sense of self that relies on subjectivity. "This self can evolve in ways to produce a robust sense of agency, supportive and resilient network of relational ties, depending on the nature of the constraints that are in place and how tightly they bind"(Cohen, 2008).
	Self is assumed to be a liberal – autonomous self.	Self is assumed to be a liberal-autonomous self.	Self is assumed to be a post-liberal self. The situated subject exercises a deliberate, playful agency and exploits environment serendipity. It includes both autonomous/heteronymous behaviors performance in the everyday lives of an employee in the context of any technological spatial intrusions' conditions of exposure.
Dimensions	Psychological	Spatial but limited to physical	Psychological and spatial including both physical and virtual intrusions to personal space.
	Information processing intrusion practices on employee personally identifiable	Visual and acoustic organizational intrusion practices on employee's physical identity in work settings.	Information processing and visual and acoustic organizational intrusion practices on employees' virtual and physical identifies within and outside of work settings.

	information identity.		

Note: Table created by authors using the concept of technology intrusion from Cohen (2008; 2012), and locus of causality and self-determination perspective described by Deci and Ryan (1985).

8.2 Appendix B. Research constructs- Means, Standard deviations and reliability assessment

Key Variables	**Mean**	**Standard Deviation**
ICT-enabled employee Innovation (Cronbach's α=0.95) (Based on Tarafdar, et al., 2010; Torkzadeh & Doll, 1999)	5.05	1.31
ICTs help me to…		
… identify innovative ways of doing my job.		
… come up with new ideas relating to my job.		
… try out innovative ideas.		
Technological Spatial Intrusion (Ayyagari, et al., 2011)		
Accessibility (Cronbach's α=0.97)	5.74	1.00
The use of ICTs enables others to have access to me.		
ICTs make me accessible to others.		
The use of ICTs enables me to be in touch with others.		
ICTs enable me to access others.		
Visibility (Cronbach's α=0.94)	4.59	1.25
It is easy for me to hide how I use ICTs. (R)		
I can remain anonymous when using ICTs. (R)		
It is easy for me to hide my ICT usage. (R)		
It is difficult for others to identify my use of ICTs. (R)		
Usefulness (Cronbach's α= 0.96) (Moore & Benbasat, 1991)	5.34	1.12
Use of ICTs enables me to accomplish tasks more quickly.		
Use of ICTs improves the quality of my work.		
Use of ICTs makes it easier to do my job.		
Use of ICTs enhances my effectiveness on the job		
Control Variables		
Self-efficacy (Cronbach's α= 0.74) (Compeau & Higgins, 1995; Venkatesh, et al., 2003)	4.77	1.13
I believe I can use ICT for my job if I have a lot of time to carry out the task for which ICTs are provided.		
I believe I can use ICT for my job if I have the built-in help facility for assistance		
Age	37.64	6.76
Gender	0.80	0.44
Total Work Experience	14.47	6.77
Work Experience with current employer	7.17	5.62
Hours of ICT use per week	27.50	18.27

8.3 Appendix C. Factor Analysis, Composite Reliability (CR), Average Variance Extracted (AVE)

	Accessibility	**Visibility**	**Usefulness**	**Innovation**	**Self-efficacy**

Accessibility 1	.911	.121	.245	.128	.058
Accessibility 2	.910	.079	.237	.135	.106
Accessibility 3	.933	.057	.195	.102	.026
Accessibility 4	.934	.095	.211	.091	.111
Visibility1	.031	.867	-.041	.035	.088
Visibility2	.014	.934	.033	-.135	-.016
Visibility3	.147	.937	.031	-.107	-.046
Visibility4	.118	.935	.041	-.090	-.045
Usefulness1	.374	.053	.811	.308	.066
Usefulness2	.153	.066	.856	.260	.239
Usefulness3	.350	-.065	.823	.263	.217
Usefulness4	.346	.021	.787	.363	.181
Innovation1	.151	-.096	.302	.859	.103
Innovation2	.145	-.073	.278	.903	.110
Innovation3	.107	-.152	.263	.900	.102
Self-efficacy 1	.164	-.038	.106	.148	.876
Self-efficacy2	.034	.033	.340	.093	.819
CR	0.96	0.96	0.89	0.92	0.84
AVE	0.85	0.84	0.67	0.79	0.72

8.4 Appendix D. Correlations

	Accessibility	**Visibility**	**Usefulness**	**Innovation**	**Self-efficacy**
Accessibility	**0.922**				
Visibility	0.160*	**0.919**			
Usefulness	0.547**	0.037	**0.820**		
Innovation	0.287**	-0.185*	0.602**	**0.888**	
Self-efficacy	0.262**	-0.007	0.469**	0.336**	**0.848**
Note: Shaded numbers in bold represent the square root of AVE					

8.5 Appendix E. Common method bias analysis.

Because all data are self-reported and were collected through the same questionnaire during the same period with a cross-sectional research design, common method variance—that is, variance which is attributed to the measurement method rather than the constructs of interest—may cause systematic measurement error and further bias the estimates of the true relationships among theoretical constructs. Method variance can either inflate or deflate observed relationships between constructs. In a critical review of common method bias in behavioral research, Podsakoff et al. (2003) provide recommendations to alleviate common method bias. They suggest:

1. using procedural remedies during questionnaire design, and
2. performing statistical controls.

We followed Ayyagari et al. (2011) to incorporate both of these suggestions. For procedural remedies, we assured our respondents of their anonymity and that there was no right or wrong answer. We also carefully designed our questionnaire to avoid the use of ambiguous or unfamiliar terms, vague concepts, and 'double-barrelled' questions (Ayyagari, et al., 2011).Next, for statistical control, we performed statistical analysis to assess the severity of common method bias in the data. First, we performed Harman's one factor test (Podsakoff & Organ, 1986). All the variables in the study were loaded into exploratory factor analysis, and we examined the factor solution to determine the number of factors necessary to account for the variance in the variables (Podsakoff, et al., 2003). The test revealed the presence of four distinct factors with eigenvalues greater than 1.0, rather than a single factor. The test indicated the presence of four factors accounting for 86% of the total variance, and of these the first factor accounted for merely 25% of the variance. Since a single factor did not emerge and one general factor did not account for most of the variance, we conclude that common method bias is not a significant problem with the data (Podsakoff, et al., 2003).

Though these results suggest that method bias might not pose a severe threat, it should be noted that Harman's test is only a diagnostic test and does not actually control for method bias (Ayyagari, et al., 2011). Therefore, based on the recommendations of Podsakoff et al. (2003) and IS articles (Ahuja, Chudoba, Kacmar, McKnight, & George, 2007; Liang, Saraf, Hu, & Xue, 2007), we introduced a common method factor whose indicators included all the principal constructs' indicators. This common method factor linked to all of the single-indicator constructs which were converted from the observed indicators. For each single-indicator construct, we examined the coefficients of its two incoming paths from its substantive construct and the method factor. These two path coefficients are equivalent to the observed indicator's loadings on its substantive construct and the method factor and can be used to assess the presence of common method bias. Common method bias can be obtained by testing the statistical significance of factor loadings of the method factor and comparing the variances of the observed indicator explained by its substantive construct and the method factor (Williams, Edwards, & Vandenberg, 2003). As shown in Table 1b below, the squared values of the method factor loadings were interpreted as the percentage of indicator variance caused by method, whereas the squared loadings of substantive constructs were interpreted as the percentage of indicator variance caused by substantive constructs. If the method factor loadings are insignificant and the indicators' substantive variances are substantially greater than their method variances, we can preclude the possibility of common method bias.

As shown in Table E1, the average substantively explained variance of the indicators is 0.863, whereas the average method-based variance is 0.000. The ratio of substantive construct variance to common method variance is about 86:1. Further, most method factor loadings are not significant, indicating that the common method is not a serious concern for this research (Liang, et al., 2007). These tests helped us preclude the possibility of common method bias contaminating the results of this research.

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Table E1. Common method bias analysis

Construct	**Indicator**	**Substantive Factor Loading (R1)**	**$R1^2$**	**Method Factor Loading (R2)**	**$R2^2$**
Accessibility	ACCE1	0.926***	0.857	0.047	0.002
	ACCE2	0.919***	0.845	0.043	0.002
	ACCE3	0.921***	0.848	-0.065	0.004
	ACCE4	0.947***	0.897	-0.026	0.001
Visibility	VISB1	0.855***	0.731	0.003	0.000
	VISB2	0.945***	0.893	-0.045	0.002
	VISB3	0.952***	0.906	0.024	0.001
	VISB4	0.947***	0.897	0.018	0.000
Innovation	INOV1	0.893***	0.797	0.064	0.004
	INOV2	0.964***	0.929	-0.001	0.000
	INOV3	1.002***	1.004	-0.062	0.004
Usefulness	USFL1	0.899**	0.808	0.047	0.002
	USFL2	1.034**	1.069	-0.120	0.014
	USFL3	1.001**	1.002	-0.048	0.002
	USFL4	0.841**	0.707	0.116	0.013
Average		**0.929**	**0.863**	**-0.000**	**0.000**
*Note. *p < .1; **p < .05; ***p < .01*					

8.6 Appendix F. Scales for the instrumental variables.

Social Factors (Thompson, Higgins, & Howell, 1991)
I use ICTs because of the proportion of co-workers who use technology.
The senior management has been helpful in the use of ICTs.
My boss is very supportive of the use of the ICTs for my job.
In general, the organization has supported the use of ICTs.
Perceived Behavioural Control (Ajzen, 2002; Taylor & Todd, 1995)
I have control over using the available ICTs.
I have the resources necessary to use the available ICTs.
I have the knowledge necessary to use the available ICTs.
Given the resources, opportunities and knowledge it takes, it is easy for me to use the available ICTs.
Pace of Change (Heide & Weiss, 1995; Weiss & Heide, 1993)
I feel that…
…there are frequent changes in the features of ICTs.
… characteristics of ICTs change frequently.
… the capabilities of ICTs change often.
…the way ICTs work changes often.