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Abstract

Current research has established a clear negative impact of technological sources of stress on work-related outcomes. This study proposes that the invasion of technology into the private sphere is not always perceived negatively by individuals per se. The authors used structural equation modeling with a sample of 479 employees in Germany to test whether techno-invasion (technology invading personal life) can lead to emotional exhaustion as well as eustress (positive stress). In doing so, we advance our understanding of the dual effects technology has on an individual's life. The study further examines to what extent individuals themselves and their resources are responsible for the effects of technological stressors on stress responses. Our empirical results confirm that techno-invasion increases both positive and negative stress responses. Individual resources as mediators are shown to play a key role in the stressor-response relationship. Unexpectedly, the six tested resources do not have similar effects on stress responses. The authors discuss practical implications and future research directions.

Keywords: Techno-invasion, stress responses, emotional exhaustion, eustress, resources.

Introduction

Individuals' responses have been shown to be a deciding factor concerning whether causes of stress (stressors) have positive or negative effects. However, research on the importance of individuals' responses when dealing with technology stressors is still in its infancy. The bulk of recent research refers to the mere use of ICT (information and communication technologies), which is also referred to as telework, e-work or telecommuting, and its effects on work-related outcomes (Dewett & Jones, 2001; Chudoba, Wynn & Watson-Manheim, 2005; Gajendran & Harrison, 2007; Boswell & Olson-Buchanan, 2007; Diaz, Chiaburu, Zimmerman & Boswell, 2012). Yet it neglects the aspect of how technology impact makes individuals feel. Therefore, we shift our focus to ICT-induced stress and its effect on individuals' stress perceptions.

ICT use is gaining importance in everyday life (Clayton, Beekhuyzen & Nielsen, 2012) and can be interpreted positively as it enables virtual work across boundaries (Chudoba et al., 2005; Watson-Manheim, Chudoba & Crowston, 2012), flexibility, the ability to stay connected during and after normal working hours (Diaz et al., 2012; Standen, Daniels & Lamond, 1999), and increases efficiency and communication (Dewett et al., 2001). However, a growing number of recent studies focus on the negative perceptions of individuals dealing with ICT (Tu, Wang, Shu, 2005; Tarafdar, Tu, Ragu-Nathan & Ragu-Nathan, 2007; 2011; Lee, Chang, Lin & Cheng, 2014). This phenomenon (known as techno-stress) describes an individual's inability to deal with ICT in a healthy manner. It reflects various facets and technological characteristics such as techno-overload, techno-complexity, techno-invasion, or techno-insecurity (Ragu-Nathan, Tarafdar, Ragu-Nathan & Tu, 2008; Yin, Davison, Bian, Wu & Liang, 2014). In this regard ICT is perceived negatively as having deleterious effects on individuals' work-related outcomes such as job satisfaction, commitment and productivity (e.g. Ragu-Nathan et al., 2008; Tarafdar et al., 2007). The authors of nascent academic research have interpreted techno-stress solely as negative and non-beneficial while neglecting the possible positive stress responses (Tarafdar, Gupta & Turel, 2013). Responses, also known as interpretations, appraisals or beliefs, form an integral part of several models, such as the transaction model of stress (Lazarus & Folkman, 1984), the holistic stress model (Simmons & Nelson, 2007) the challenge-hindrance stressor framework (Cavanaugh, Boswell, Roehling & Boudreau, 2000), the Stressor-Emotion Model of Counterproductive Work Behavior (Spector & Jex, 1998), Holahan & Moos's coping theory (1987) and the conservation of resources theory

(Hobfoll, 1989). The lowest common denominator of these models is that they allow dual effects on stress perceptions. Although some research has tried to capture the dual effects of ICT on work-related outcomes, more work is required (Barley, Meyerson & Grodal, 2011; Day, Scott & Kelloway, 2010).

We concentrate on techno-invasion as a special factor of techno-stress, which describes the excessive use of ICT, a state in which employees can be reached at any time and are compelled to always be connected (Tarafdar, Tu & Ragu-Nathan, 2010; Tarafdar et al., 2011). Techno-stress acts as an umbrella for all the deficiencies that result from ICT use. Our focus on a specific characteristic of this techno-stress construct allows us to treat ICT use in a differentiated way. With reference to Ayyagari, Grover & Purvis (2011) the ICT-induced invasion of privacy is aggravated by pressure at work. As a consequence we choose to concentrate on the intrusive aspect of ICT and on how techno-invasion affects stress responses. Individuals' resources are a key operating mechanism to help respond to the threat while promoting their capability to resist negative ICT-induced stress (Hobfoll, 2002). The role of resources is especially important in the working environment. Resources can flourish but also decrease due to job demands and techno stressors. With reference to Hobfoll's conservation of resources theory (COR) (Hobfoll, Freedy, Lane & Geller, 1990), in this paper we categorize selected variables as resources and demonstrate their role within an individual's field of responses. We assume that these resources may help to overcome the impact of techno-invasion and act as a "stress resistance armamentarium" (Hobfoll, 2002, p. 312). The resources we want to shed light on are work-home stability, perceived supervisor support, optimism, success, autonomy, and meaning. By creating optimal conditions within oneself, such as optimism and meaning, as well as a balanced personal life through work-home stability, individuals can activate their resources so they can flourish and cope with stressors such as techno-invasion. However, Hobfoll's COR theory (1990) also contains environmental factors which we must take into account to pursue a holistic approach. Therefore, we also include resources inside the work environment such as perceived supervisor support, autonomy and success opportunities. Each of these factors may act as a single mechanism that is employed by the individual to deal with the exhausting effect of techno-invasion and create a supportive work environment that helps the individual to handle challenges in a positive way. Altogether, the factors may interactively help individuals to perceive a more positive stress response.

This paper aims to answer the following fundamental questions on techno-invasion and its effect on individuals. Firstly, is the intrusion of technology into one's private space always perceived as a disturbing factor? If not, under which circumstances is technology-invasion perceived in a positive way? Secondly, which mechanisms or resources influence the effects of techno-invasion on stress responses? And thirdly, how can individuals and organizations reduce negative responses and promote positive responses to techno-invasion?

We contribute to the literature in several ways. We develop a theoretical framework for the consequences of techno-invasion to allow for both positive and negative responses of techno-invasion. Rather than relying on stressors to provide a link between other stressors and work-related outcomes (Diaz et al., 2012), we focus on negative and positive stress responses, i.e., emotional exhaustion and eustress. Eustress, a positive stress response, mainly results from positive interpretations of stressors (Le Fevre et al., 2003a) and thus focuses on positive responses, while emotional exhaustion, a negative stress response, focuses on negative interpretations resulting from an excessive depletion of resources (Gorgievski & Hobfoll, 2008). However, besides direct effects we also include psychological and environmental resources as mediators in our framework. These resources or mechanisms are influenced by techno-invasion.

The paper is organized as follows. First, we discuss prior literature. Next, we develop a research model and our research hypotheses. The methodology and data are presented, then we empirically test our model. We conclude by discussing the results and the implications of our study.

Theoretical Framework

No consensus has been reached yet regarding the dominant stress theory. While Lazarus & Folkmans' (1984) theory is that perceptions, and therefore the cognitive-focused concept, are predominant, Hobfoll (1989) gives due emphasis to both environmental and psychological factors. According to his well-established COR theory (Hobfoll, 1989, p. 516; Hobfoll & Lilly, 1993), resources are defined as "objects, conditions, personal characteristics, or energies that are valued by the individual" or that serve as a means of obtaining that which is valued by the individual and therefore prevent from being exhausted. The COR theory's basic principle is that every individual is eager to maintain and protect his/her resources and fears he/she will potentially or actually lose these

resources due to a demand. Human motivation is directed towards the maintenance and accumulation of these resources, which may be located at different levels in one's work and personal environment. Thus, this causal connection indicates that stress or emotional exhaustion occurs when resources are lost or threatened. As our focus is on the individuals and their environmental influences, we look specifically at the personal characteristics and environmental conditions and how they are affected by the stressor and how they affect the responses themselves. Stressors are events or properties of events that create stress responses (Cartwright & Cooper, 1997). With reference to Hobfoll (1989), stressors or demands such as techno-invasion are not unequivocally positive or negative and therefore can evoke eustress or exhaustion depending on one's personal appraisal process. While the individual's responses have been subject of prior research, there is still no overarching framework that includes ICT-induced stress.

The framework places the responsibility of stress on individuals in that they appraise a stressor and subsequently respond to it according to their own interpretations and actions (McGowan, Gardner & Fletcher, 2006). The development of a positive psychological approach, which has emerged from findings that even in hard times, some individuals remain positive (Seligman & Csikszentmihalyi, 2000), has led to a greater emphasis on promoting positive psychological aspects (Luthans, 2002a; 2002b). One such positive psychological aspect, eustress, was first coined by Selye (1956; 1975) and captures the idea of positive stress. Positive stress results in healthy positive feelings and embodies a process of exploring potential gains. Quick, Quick, Nelson and Hurell (1997) define eustress as good health and performance and focus on the positive and constructive outcomes of the response. Le Fevre, Matheny and Kolt (2003a; 2003b) develop a series of tenets, where stress is a combination of eustress and negative stress, and where stressors resulting in eustress and negative stress depend on an individual's response to a stressor. Others define eustress in terms of an actual stress response rather than as the outcomes of this response (Nelson & Simmons, 2003). There, eustress is described as the process of real or anticipated resource gain, while exhaustion is seen as the end-state of a long-term process of resource loss. Here, eustress and exhaustion are not seen as opposite poles of a continuum but as two different states.

Our stressor of interest, techno-invasion, is one of five components of techno-stress (Tarafdar et al., 2007). The empirical evidence on techno-stress, which is stress induced by technology, highlights the negative outcomes of technology. Tarafdar et al. (2007)

hypothesize a negative relationship between techno-invasion and productivity, stating that "continual connectivity", and never being "free of technology" (p. 304) lead to decreased productivity. Further, they hypothesize a negative relationship with role stress, as "ICTs enables extensions of the workday", "one has to respond to e-mail" and "not connecting actually becomes disquieting" (p. 309). Ragu-Nathan et al. (2008) also show a direct negative relationship between techno-stress and job satisfaction with a similar reasoning, however without stressor responses. Altogether, the techno-stress literature paints a bleak picture of technology stressors while neglecting the positive aspects.

Although early studies have examined the dual aspects of stressor interpretations and responses, including positive stress responses (Cooper, Dewe & O`Driscoll, 2001; Lazarus, 1966; Lazarus & Folkman, 1984; McGrath, 1976; Selye, 1956), this area has been seldom explored as a whole (Edwards & Cooper 1988; Cavanaugh et al., 2000; Le Fevre et al., 2003a; 2003b). Techno-stress is stress induced by technology, but the creators of this stress may not always be regarded as negative. We explore this possibility further in the next section before we develop our hypotheses. We also want to shed light on whether an individual's response to an ICT induced-stressor depends on their set of personal and environmental resources.

Techno-invasion and its effects on stress responses

As shown in our literature review, the connection between demands and technology-induced stress responses has not been fully explored. The development of our hypotheses is based on the COR theory (Hobfoll, 1989) and builds on stress responses, i.e., exhaustion and eustress, to explore the stressor-response relationship.

It is not technologies that create stress but rather how individuals use them and interpret them. Excessive use is one major source of stress. While some individuals feel exhausted by this permanent compulsion, others are addicted to maintaining a virtual connection or virtual "sense of presence" (Subramaniam, Nandhakumar & Baptista, 2013, p. 479). Excessive use may result when individuals feel the need to respond to messages and become uncomfortable when they are not connected (Ragu-Nathan et al., 2008; Tarafdar et al., 2007). This can become problematic as technology enables work to spill over more easily into one's home life (Murray & Rostis, 2007), making it difficult to fulfill one's family obligations (Major, Klein & Ehrhart, 2002; Boswell & Olson-Buchanan, 2007) and constraining individuals' recovery, family and leisure time (Sonnentag, 2001). At the

same time, this constant connectivity, or inability to escape from technology and an invasion of one's personal space (Tarafdar et al., 2007), means that technologies are seen as a source of negative stress.

The use of ICT is a great enabler of work outside normal working hours (Ammons & Markham 2004; Kugelmass, 1995). Golden (2011) investigates the effects of teleworking outside normal working hours and finds that teleworkers have stronger conflicts between domains. Therefore, not only can technology-assisted work outside one's workplace potentially reduce job satisfaction, its ability to create stress may be even greater when this work is done outside of normal working hours, which is the case with techno-invasion.

Prior literature mostly focuses on these negative relationships between stress and responses, with these relationships having been examined both theoretically (Beehr & Bhagat, 1985; Katz & Kahn, 1978; McGrath, 1976; Jamal, 1990) and empirically. Having established that there is a positive relationship between techno-invasion and exhaustion, we hypothesize that

H1. Techno-invasion is positively related to emotional exhaustion.

The hypothesis above and the literature cited focuses mainly on negative stress responses, neglecting the positive stress response. Techno-stress is not defined as being purely negative; in fact it may lead to positive stress. Prior studies (e.g., Ragu-Nathan et al., 2008; Tarafdar et al., 2007; 2013) seem to interpret techno-stress in general and techno-stress creators only in negative terms, for example, as "stress caused by an inability to cope with the demands of organizational computer usage" (Tarafdar et al., 2010, p. 304). The authors thus do not consider positive responses. Even the term "techno-invasion" implies purely negative consequences, as an invasion is defined as entry by force.

While technology is typically viewed as an "electronic leash", technologies have also been interpreted as giving employees the option to work outside regular working hours, (Boswell & Olson-Buchanan, 2007, Diaz et al., 2012; Nansen, Arnold, Gibbs & Davis, 2010; O'Driscoll, Brough, Timms & Sawang, 2010); they can be used to benefit an individual personally; and they can be seen as a "constant companion" for work activities regardless of time and space (Chudoba et al., 2005; Golden & Geisler, 2007). Individuals

who are techno-addicts do not solely interpret techno-invasion as a negative aspect; instead, they recognize the benefits of 24/7 availability and connectivity.

Individuals can appreciate ICT for the benefits it offers (Diaz et al., 2012). ICT enhances an individual's ability to work (Day et al., 2010). Those with strong ambition and job involvement may view ICT as more rewarding and as an asset (Boswell & Olson-Buchanan, 2007; Day et al., 2010). ICT allows individuals to communicate with others and keep up to date on work matters, which can give them more flexibility and control (Bélanger & Allport, 2008) and can positively impact their productivity (Diaz et al., 2012; Golden & Geisler, 2007; Mazmanian, Orlikowski & Yates, 2006).

As a counter-argument to techno-invasion consuming resources at home and creating conflicts, work spillover from technology may be interpreted positively if work is viewed as an emotional refuge (Hochschild, 1997). Although technology may create stress through work spillover and problems with fulfilling family obligations, if work is viewed as an emotional refuge, individuals may not feel that it creates negative stress. Accounting for work-family conflicts, Diaz et al. (2012) find that technology use outside working hours can increase an individual's job satisfaction, although they do not clearly state whether this stems from the work or home domain.

When individuals interpret technology positively, which strongly influences the roles a stressor has (Lovallo, 1997), this can lead to positive stress (eustress), with eustress having been found to be "primarily a result of positive perception of stressors" (Le Fevre et al. 2003a, p. 729). The literature on eustress is far more underdeveloped than that on negative stress (O'Sullivan, 2011). However, there are individuals who consider demands that are placed on them to be an exciting challenge rather than a burden (Hobfoll, 1989).

Therefore, we hypothesize that

> *H2. Techno-invasion is positively related to eustress.*

Techno-invasion and its effects on and connection to resources

We illuminate the role of resources in general, considering especially how individuals can mobilize them to combat stressors. Intrinsic motivation in facilitating personal development and extrinsic motivation to achieve work goals are the two main criteria when it comes to categorizing resources, which demonstrates their relevance to

ameliorating one's working conditions. Many mainly psychology-based studies focus on the theoretical (Voydanoff, 2004; Hobfoll, 2001; Demerouti, Bakker, Nachreiner & Schaufeli, 2001) and empirical influence of resources (Valcour, 2007; Crawford, LePine and Rich, 2010; Xanthopoulou, Bakker, Demerouti & Schaufeli, 2007; Fagerlind, Gustavsson, Johansson & Ekberg, 2013). Thus resources have positive impact on engagement and commitment but a negative impact on disruptive outcomes such as burnout (Bakker, Demerouti & Euwema, 2005). In the following section we concentrate on personal characteristics and environmental factors as indicators of different kinds of resources.

Personal characteristics

Optimism

Optimism is said to be a form of positive appraisal and adjustment to stressful life events linked with the belief that things may take a turn for the better (Karademas, 2006; Brissette, Scheier and Carver, 2002). According to Carver, Scheier and Segerstrom (2010, n.p.), optimists "benefit from their natural tendency to see things in the best light, and they appear to engage more productive effort in the sorts of problem solving".

However, stressful demands such as techno-invasion may affect optimistic individuals in a way that, although they are very optimistic in general, their personal optimism level may drop. Previous research, increasingly in health psychology contexts, has identified a negative relationship between optimism and depressive symptomatology and stress (Brissette et al, 2002; Wrosch & Scheier, 2003) as well as positive relationship with subjective well-being (Ho, Cheung & Cheung, 2010). In addition, its mediating role has also been recognized by prior research (Karademas, 2006), with optimism regarded as a positive form of appraisal. Therefore, we hypothesize:

> *H3(a). Techno-invasion is inversely related to optimism; 3(b) optimism is inversely related to emotional exhaustion; and 3(c) optimism is positively related to eustress*

Work-home stability

Kanter (1977) stated that it is a fallacy to separate work and home. These areas are both permeable or, more precisely, inexorably linked. In this context Kreiner, Hollensbe and Sheep (2009) refer to around 180 papers that discuss the work-family conflict and attempt

to solve this Gordian knot. So while considerable research has been done on this tension, still the results are inconsistent. The permeability of work and family boundaries is difficult to handle in practice and often leads to a dilemma for employees.

The work-family conflict as a construct is also linked to a multitude of variables, many with negative connotations, such as conflict, job dissatisfaction, turnover, work-life balance and telecommuting (Gajendran & Harridson, 2007; Golden, Veiga & Simsek, 2006; Ten Brummelhuis & Bakker, 2012; Allen, Herst, Bruck & Sutton, 2000). Very few studies focus on the relationship between ICT use and the work-family conflict, with most measuring this multi-layered construct using the single-item measure "telecommuting", which seems to give no sufficient overview. Ayyagari et al. (2011) is the only study to specifically include the work-home conflict in their research on stressors that are linked to ICT use and telecommuting. The work-home conflict as an extension of the work-family conflict construct includes the work-home interface as a whole, comprising life circumstances, family responsibilities, home, and personal life of individuals (Kreiner, 2006; Bacharach, Bamberger, & Conley, 1991).

It seems to be a logical assumption that new avenues such as more frequent ICT use are on the one hand conducive to increased accessibility and productivity, but on the other detrimental to the work-life balance as a whole, meaning it not only affects the family-related aspects of one's personal life, but the entire picture. Creating work-home stability plays a major role in an employee's work-life balance, which is impacted by techno-invasion as it offers them an opportunity to spend time with their loved ones and hence is perceived as a stress-reducing resource.

Therefore, we hypothesize:

> *H4(a). Techno-invasion is inversely related to work-home stability; 4(b) work-home stability is inversely related to emotional exhaustion; and 4(c) work-home stability is positively related to eustress.*

Meaning

Individuals are generally eager to search for meaning in their lives, but they differ in terms of the intensity of that search. The questions "where have I been?", "where am I?" and "where am I going?" (Steger & Dik, 2009) are an expression of the search for significance in one's life. The search for meaning reflects the importance of understanding one's own level of life fulfillment and vitality, but also one's self-reflection. Although meaning was

a research topic several years ago, over the last 40 years there has been little empirical research on the subject (Steger, Kashdan, Sullivan & Lorentz, 2008), so its role as a possible preventer of negative stress perception remains largely unexplored.

Nowadays, with everyone searching for ways to overcome their daily work-related obstacles as well as inner peace, this construct is gaining in importance. This is because it acts as a predictor of individual well-being and mental health (Ho, Cheung & Cheung, 2010).

The search for meaning in one's life is rather complex and comprises various perspectives. Some authors believe that the search for meaning only begins after individuals are about to lose or have already lost their meaning. Others state that the search for meaning is a natural part of the human ambition to widen one's horizon (Steger et al., 2008). Some simply suggest that life-affirming as well as deficit-based motivations may trigger the search for meaning (Reker, 2000). Another explanation refers to individualism, stating that every individual has different reasons for embarking on his or her individual search for meaning.

We suggest that techno-invasion may act as an (unhealthy) motivation which results in decreased meaning in life and therefore the loss of this resource, which is responsible for maintaining well-being and eustress and diminishing negative stress. We thus hypothesize:

> *H5(a). Techno-invasion is inversely related to meaning in life; 5(b) meaning is inversely related to emotional exhaustion; and 5(c) meaning is positively related to eustress*

Environmental factors/conditions

According to Hobfoll (1989, p. 517), environmental-related resources or conditions are described as "resources to the extent that they are valued and sought after". It is not necessarily the conditions themselves that are primarily relevant to one's individual stress resistance capacity; instead, the roles linked to these conditions are a relevant factor as mediators. Although status-related resources are said to have only limited benefit, the ecological interplay should be taken into account.

Autonomy

Within a work context the most important aspect of job autonomy is "the room for self-determination". Karasek (1979) already mentions its important role as a valuable resource that can improve an individual's workplace. This is in line with Gajendran & Harrison (2007), who state that the pure use of ICT for telecommuting is positively related to autonomy. Techno-invasion, indicated by an excessive use of ICT, leads to a reduction in job autonomy. Therefore, ICT may impact a user's personal life in a way that their individual freedom to choose how, when and where to complete a task is negatively affected.

According to Littman-Ovadia, Oren and Lavy (2013) and Den Hartog & Belschak (2012), job autonomy helps generate desired work outcomes. Kirmeyer and Shirom (1986) and Karasek (1979) state that job autonomy and the related freedom to make one's own choices in particular prevent negative outcomes such as exhaustion and depression, even in the presence of tremendous stressors. Grandey, Fisk and Steiner (2005) as well as Golden et al. (2006) confirm this statement and find that job autonomy acts as an interaction component and therefore buffers against strain. This is also suggested by Tarafdar et al. (2011), who assume that autonomy is another mechanism that can alleviate the effects of stressors. Therefore, we hypothesize:

> *H6(a). Techno-invasion is inversely related to autonomy; 6(b) autonomy is inversely related to emotional exhaustion; and 6(c) autonomy is positively related to eustress.*

Supervisor support

Interactions between employees and their supervisors play a crucial role within the work environment. This feature is defined as "the degree to which employees form general impressions that their superiors appreciate their contributions, are supportive and care about their subordinates' well-being" (Cole, Bruch & Vogel, 2006, p. 466). Supervisors are also seen as spokespersons of the organization, which means that employees equate their supervisors with the organization and therefore form global perceptions (Eisenberger, Stinglhamber, Vandenberghe, Sucharski & Rhoades, 2002) regarding their opinions and understanding. Supervision is an important resource for employees. Gajendran & Harrison (2007) find a negative connection between employee and supervisor due to ICT use, arguing that the quality and frequency of social interaction diminishes due to ICT. Techno-invasion would hence aggravate this effect. The buffering effect of supervisory support as a resource is demonstrated by O'Driscoll, Poelsmans,

Spector, Kalliath, Allen, Cooper & Sanchez (2003) in the context of the work-family conflict and its negative effect on psychological strain. They find that supervisor support decreases the negative impact of the work-home conflict. Thus we adapt our study accordingly and hypothesize:

> *H7(a). Techno-invasion is inversely related to perceived supervisor support; 7(b) perceived supervisor support is negatively related to emotional exhaustion; and 7(c) perceived supervisor support is positively related to eustress.*

Success

Techno-invasion may result in increased organizational citizenship behavior which leads to better performance (Podsakoff, Blume, Whiting & Podsakoff, 2009). Further research in other areas also corroborates a similar relationship, showing that, for example, longer working hours have both financial and psychological rewards (Brett & Stroh, 2003). Conversely, Tarafdar, Pullins and Ragu-Nathan (2015) find that technostress creators such as techno-invasion decrease performance. The perception of being successful is a resource that is primarily gained through one's contextual environment and is a decisive factor regarding stress responses. As Green (1993, also see Brett & Stroh, 2003, p. 69) states, "our daily tasks give our lives coherence; by contrast, the lack of work denies our basic humanity". Success is often intertwined with work accomplishments (Brett & Stroh, 2003) and thus the feeling of being successful can be a major resource when it comes to facing stressful influences such as techno-invasion. Being successful offers challenging opportunities, which lead to positive stress responses and decreased exhaustion thanks to positive experiences. We therefore hypothesize:

H8(a). Techno-invasion is inversely related to success; 8(b) success is inversely related to emotional exhaustion; and 8(c) success is positively related to eustress.

Method

Sample and Procedure

This study is based on a survey conducted with an employment services provider that specializes in recruiting IT professionals. Therefore, the database contains a relatively large number of people that work in the IT sector (37%) or have IT/ICT expertise (37.6%). To collect data, we first developed a self-report questionnaire. To avoid any

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misinterpretations, ambiguities or irritations on the part of the respondents to the final version, we conducted an initial online pre-test and sent an invitation link to a sample of n = 37 participants in April 2013. After the pre-test, we e-mailed persons whose contact data were held in the database of a recruitment company in Germany. Personal announcements were followed two weeks later by personal invitations that were sent to a database of clients in June 2013. Each member of the target group was sent a personalized e-mail with a direct link to the questionnaire plus a access code. A total of 877 participants responded to the invitation. The final sample consisted of 479 participants, all of whom completed the questionnaire. 71.4% (n = 342) of respondents in the sample are male. On average, participants were 45.42 years old (*SD = 9.97)* and worked 42.70 (*SD = 10.61*) hours per week. 63.5% of participants have a university degree: 49.7% hold a master's degree, 8.8% a bachelor's degree, 1.7% an MBA and 3.3% a Ph.D. 19.8% have the German secondary school diploma known as *Abitur*, while 16.9% have completed secondary school.

Measures

Generally, a seven-point Likert scale was used, ranging from 1 (strongly disagree) to 7 (strongly agree). All measures show high reliabilities.

Techno-invasion. We measured this variable by using the four-item subscale of Tarafdar et al.'s (2007) validated techno-stress scale. First, we asked each respondent the following question: "The information and communication technology that influences my daily workflow the most is __". A total number of n = 334 stated "e-mail" only or at least put e-mail at the top of their list. N = 37 stated "telephone", n = 22 explicitly stated "smartphone", n = 33 wrote "internet" and n = 19 stated "laptop/PC". Next, we assessed techno-invasion items on a seven-point Likert scale (e.g., "Due to this technology I spend less time with my family" and "Due to this technology I feel my personal life is being invaded").

Emotional exhaustion. This variable was measured using the validated emotional exhaustion five-item subscale of Maslach & Jackson (1981). Emotional exhaustion is also seen as overload (Barley, Meyerson & Grodal, 2011) which is similar to role overload as used by Tarafdar et al. (2007). An example item is "Over the last three months, I have felt burned out or stressed from my work".

Eustress. We used five items on the scale developed by O'Sullivan (2011). Again, we used a seven-point Likert scale, ranging from 1 (never) to 7 (always). Two example items are "How often do you feel that stress positively contributes to your ability to handle your job problems?" and "How often do you feel motivated by your stress, in general?"

Job autonomy. We measured this variable using the four-item scale by Esser & Olsen, 2011 and McGinnity & Calvert, 2009. An example item is "Please say how much the management at your work allows you to decide how your own daily work is organized".

Optimism. Optimism is a part of Luthans`s twelve-item scale for psychological capital (e.g., Lurhans, Avolio, Avey & Norman, 2007). We used the two-item subscale for optimism (e.g., "Referring to my work I always look on the bright side of things regarding my job."

Meaning in life. We used the scale by Steger, Frazier, Oishi & Kaler (2006) and asked participants to evaluate items such as "I am searching for the meaning in my life" by using a seven-point Likert scale, ranging from 1 (not at all true) to 7 (exactly true).

Work-home stability. We measured this variable by using the reversed scale by Kreiner (2006) on a seven-point Likert scale (e.g, "The demands of my work interfere with my home and personal life (reversed)").

Success. We measured the extent to which participants think they are successful by using a two-item scale by Abele & Wiese (2008). An example item is "Please indicate how successful you think you are in comparison to your team?".

Control variables. We controlled for gender, ICT experience, and marital status.

All constructs were first factor analyzed, providing initial unidimensionality and discriminant validity across factors. As our factor analysis revealed several factors for our measure of eustress, we checked for scale reliability and build the factor including loadings above 0.5, totaling five items. Our final factor analysis resulted in nine factors, with factor loadings above 0.5 and no cross-loadings above 0.4. This is shown in Table 1 (Appendix).

Data Analysis

To test our proposed research model as shown in Figure 1, we used the structural equation modeling (SEM). To test the suitability of the model, we provided a selection of goodness-of-fit indices. The composite reliability (CR) was found to have a value over 0.6 according to Bagozzi & Yi (1988). The convergent validity measured by using the

average variance extracted (AVE) was over 0.5, while composite reliability exceeded AVE (Fornell & Larcker, 1981). To control for discriminant validity, we measured the maximum shared variance as well as the average shared square variance and found it to be less than AVE. To avoid any multicollinearity problems we tested the variance inflation factor (VIF). All variables had a value of between 1 and 2, therefore we have no multicollinearity concerns in our study with reference to Diamantopoulos, Riefler and Roth (2008).

Results

Table 2 provides information regarding the reliability measures: Cronbach's alpha, means, standard deviations, correlations as well as a validity check.

Table 2. *Means, standard deviations, Cronbach`s alpha and intercorrelations of the Variables*

Variable	Mean	SD	CA	1	2	3	4	5	6	7	8
(1) Techno-invasion	3.28	1.61	0.85								
(2) Emotional exhaustion	3.79	1.38	0.88	0.34**							
(3) Eustress	3.81	1.34	0.91	0.13**	0.03						
(4) Autonomy	5.42	1.26	0.82	-0.05	-0.34**	0.13**					
(5) Supervisory support	5.32	1.48	0.92	-0.09	-0.28***	-0.03	0.44**				
(6) Optimism	5.31	1.07	0.83	-0.05	-0.38**	0.16**	0.33**	0.22**			
(7) Work-home stability	3.99	1.55	0.94	-0.60**	-0.43**	-0.04	0.10	0.14**	0.18**		
(8) Meaning	2.81	1.40	0.90	0.11*	0.30**	0.13**	-0.19**	-0.11*	-0.27**	- 0.13**	
(9) Success	5.56	1.23	0.91	0.05	0.09	0.11**	0.13*	-0.13**	0.19**	-0.05	0.04

*** = p < .001 sig.; ** = p < .05 sig.; * = p < .1 sig; n.s. = not significant

Model overview and assessment

The structural equation model is estimated as displayed in Figure 1. The fit indices are shown in Table 3. A detailed analysis is demonstrated in Table 4 (Appendix).

Figure 1. *Research model of techno-invasion, resources and stress responses* For clarity and simplicity, disturbance terms were omitted in this figure.
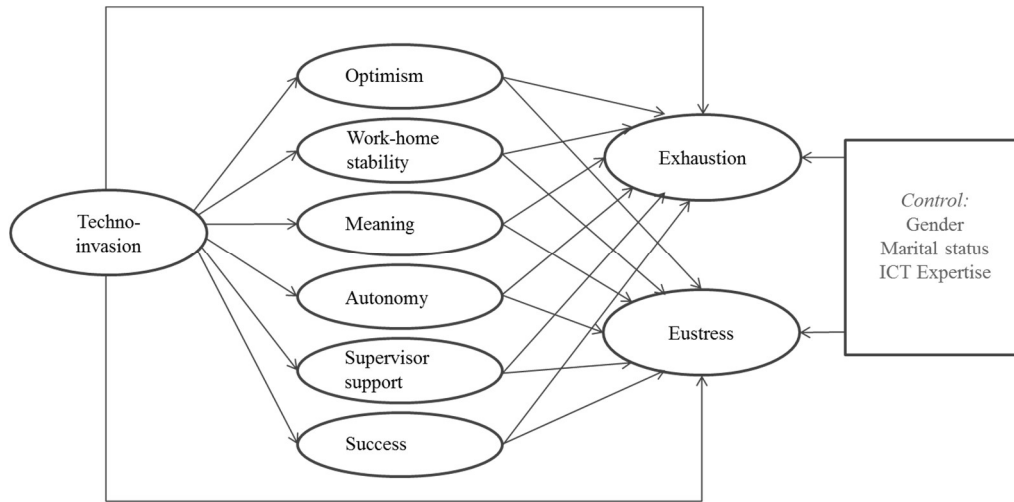
We include several observed variables to control for the influence of gender, marital status, and ICT expertise. These variables are treated like the other exogenous variables. The model fit statistics of the initial model are all in the satisfactory range. Our chi square/df ratio of 2.606 lies in the satisfactory range between 1 and 3 (Homburg & Giering, 1996), p < .001. The root mean squared error of approximation (RMSEA) of .058 for our model is below the general consensus of 0.06 (Hu & Bentler, 1999). The comparative fit index (CFI) for our model is .91 and the Tucker-Lewis index (TLI) is .90, where values greater than or equal to .90 are indications of good fit (Homburg & Baumgartner, 1995). Therefore, our model is suitable for testing our hypotheses.

Table 3. *Fit Indices for Model Comparison (AMOS)*

Model	χ2	df	CFI	TLI (NNFI)	RMSEA	Δχ2	Δdf
Model 1	1,797.84	690	.91	0.90	.058		
Model 2	1,655.20	680	.92	0.91	.055	142.64	10
Model 3	1,574.46	660	.92	0.91	.054	80.74	20

Note. *df* = degrees of freedom; CFI = comparative fit index; TLI (NNFI) = Tucker-Lewis index; RMSEA = Root mean square error; *Δ χ2* = change in chi-square; *Δ df* = change in degrees of freedom.

Hypothesized relationships

The effects of techno-invasion on stress responses: Hypotheses 1 & 2

Hypothesis 1 states that techno-invasion is positively related to emotional exhaustion. Our results show support for this (.47, *SE* = 0.04, t = 8.35, p < .001). Hypothesis 2 states

that techno-invasion is positively related to eustress. We can confirm this hypothesis as well (.11, *SE* = 0.03, t = 2.29, p < .05). By confirming both Hypotheses 1 and 2, we show that techno-invasion can lead to both positive and negative stress responses. This highlights the non-mutual exclusivity of the responses and shows the dual effect of techno-invasion through stress responses.

The effects of techno-invasion on personal characteristics and conditions: Hypotheses 3a-8a

It is also of interest to show the indirect effects. Here, we conduct various mediation analyses (Mckinnon, Fairchild & Fritz, 2007) due to the impact of personal characteristics and conditions that link techno-invasion and stress responses. First, we check for the effect of techno-invasion on each proposed intervening variable separately, followed by the involvement of multiple simultaneous mediators with reference to Preacher & Hayes (2008). Within the initial model we test the influence of techno-invasion on each of the resources and receive the following results. We conduct a Sobel test (1982) to test the significance of the mediation effects. Hypothesis 3a states that techno-invasion is inversely related to optimism. We can support this hypothesis   (-.12, *SE* = .04, t = - 2.21, p < .05). This is equally true as regards Hypothesis 4a, which states that techno-invasion has a negative impact on work-home stability (-.68, *SE* = .05 ,t = -13.28, p < .001). Hypothesis 5a refers to the connection between techno-invasion and meaning in life. We find no evidence that techno-invasion decreases the search for meaning (.13, *SE* = .05, t = 2.63, p < .05); instead, it increases the search for meaning. Regarding environmental factor autonomy (Hypothesis 6a) and supervisor support (Hypothesis 7a) we can state that both are influenced negatively by techno-invasion (-.16, *SE* = .04, t = - 3.08, p < .05; -.13, *SE* = .05, t = -2.45, p < .05). Hypothesis 8a states that success is negatively affected by techno-invasion. We cannot confirm this hypothesis (.06, *SE* = .04, t = 1.27, p > .1, n.s.).

Mediating effects of personal characteristics: 3 b & c -8 b & c

Hypotheses 3 b & c to 8 b & c predict that the resources function as a mediator within the stressor-response model. Therefore, we test the partially mediating effects of optimism, work-home stability, meaning, autonomy, perceived supervisor support and success to

see if and how they influence individual stress perceptions. We thus examine the path between the proposed intervening variable and the resources on the positive and negative stress response. Our first personal characteristic, namely optimism, decreases emotional exhaustion (-.23, *SE* = .04, t = -4.59, p < .001). Moreover, optimism as a resource also fosters positive stress responses, which is in line with Ho, Cheung & Cheung (2010) (.16, *SE* = .04, t = 3.14, p < .05). Emotional exhaustion is perceived as less severe in the presence of a stable work-home interface (-.29, *SE* = .05, t = -4.67, p < .001). We find no indication that work-home stability interacts with perceived eustress (-.07, *SE* = .05, t = 1.12, p > .1, n.s.). As for the role of the search for meaning, we cannot confirm Hypothesis 6b that meaning is inversely related to emotional exhaustion (.17, *SE* = .03, t = 3.72, p < .001). Hypothesis 6c assumes that meaning increases positive stress. We can confirm this hypothesis, as our results show that meaning is also positively related to eustress (.22, *SE* = .04, t = 4.34, p < .001). Since autonomy has been used as a mediator in previous studies (Gajendran & Harrison, 2007), we can confirm that autonomy acts as a partial mediator and decreases emotional exhaustion (-.20, *SE* = .05, t = -4.26, p < .001). Hypothesis 6 c, which suggests that autonomy increases eustress, is also significant (.15, *SE* = .05, t = 3.01, p < .05). We reject the hypothesis that perceived supervisor support acts as a partial mediator with a negative effect on emotional exhaustion and a positive effect on eustress (-.06, *SE* = .04, t = -1.49, p > .1, n.s.; -.10, *SE* = .04, t = -2.04, p < .05). Hypotheses 8 b & c assume that success, as an environmental factor, decreases the negative stress response (exhaustion) and increases the positive stress response (eustress). We cannot confirm these relationships. Success has no influence on either negative or positive stress responses (.02, *SE* = .04, t = 0.38, p > .1, n.s.; .07, SE = .04, t = 1.41, p > .1, n.s.).

Discussion

The objective of this study is to develop a further understanding of the circumstances under which technology can both positively and negatively impact individuals' stress responses by conducting a specific analysis of partial mediation effects of personal characteristics and environmental factors. Using structural equation modeling and a unique dataset of employees in Germany, we find that techno-invasion indeed leads to both emotional exhaustion and eustress, which means that techno-invasion can lead to a positive or negative stress response. Overall, these results show the dual aspect that technology can have and the importance of individual perception as a link between technology and outcomes, and should guide future research on stressor-response

relationships. Resources are identified as playing a central role within this dynamic process. The results suggest that one's feeling of techno-invasion has an impact on one's overall positive and negative perceptions of stress. This is a strong indicator for the power of techno-invasion. Stress evoked by invasive ICT use affects how individuals feel about stress in general, either in a good or bad way.

Theoretical Implications and Future Research

Our model assigns a key role to individuals and their stress responses in terms of whether they response to technology with positive or negative stress or both. Specifically, we incorporate dual stress responses in the stressor-outcome relationship, i.e., emotional exhaustion and eustress, to further understand the conditions under which techno-invasion can have both positive and negative stress effects. By undertaking this research, we combine early theorizing, such as in the COR theory (Hobfoll & Freedy, 1993) with current empirical work on technology stressors (e.g., Ragu-Nathan et al., 2008). In this context, resources, personal characteristics, and environmental factors are a principal axis that mediates the stressor-response relationship. In line with Zhao, Lynch & Chen (2010) we find complimentary as well as competitive mediators that influence the relationship between stressor and responses. It is interesting that primarily personal characteristics play a major role in affecting stress responses while environmental factors and conditions play a minor role. This is highlighted in our results, which demonstrate that personal characteristics have a complimentary effect on negative stress responses.

The necessity of this study is borne out by the lack of research on the dual impact of ICT (Barley et al., 2011; Day et al., 2010) and a concentration within the academic literature on purely negative impacts, where techno-stress and its sub-constructs, such as techno-invasion, are thought to only induce negative stress (Tarafdar et al., 2010). Although stressors have been shown to have dual effects on stress responses, there is no study on techno-evoked stress as a stressor. Our results, along with earlier theorizing, show that techno-invasion can indeed lead to both positive and negative forms of stress. Therefore, it may be better to think of techno-invasion as techno-encroachment, as encroachment embodies the advancement of technology beyond its former limits while advancing into the home domain, which does not have to be interpreted as solely negative.

We also add to the expanding results on eustress. With limited results based on technology stressors, our results add to this dimension. Technology is shown to be a potential source

of eustress in that technology can give individuals options or opportunities (Diaz et al., 2012; Golden & Geisler, 2007), enable positive stress, and enable individuals to meet all demands in both their work and family domains.

Our results have implications for future research on stressors and are not only limited to technological stressors. Assigning stress responses a key role for other technological stressors, such as techno-stress and its other components, may reveal similar patterns, highlighting dual responses, for example, in regard to general technology use.

We do not explore moderators in this model. The holistic stress model (Simmons & Nelson, 2007) points to individual traits, such as self-esteem, optimism and hardiness, while the IS literature (e.g., Ragu-Nathan et al., 2008) emphasizes situational factors or primary approaches, and other literature emphasize secondary approaches (e.g. Le Fevre, 2003b). As limited work exists specifically on the moderators between stressors and positive stress, the moderators in our model represent an interesting avenue for future research.

Another avenue of research is to incorporate interpretations directly. In our paper we highlight the responses in forms of exhaustion and eustress. We do not incorporate interpretations explicitly, but rather responses to stressors. However, as eustress is found to be mainly due to positive stress interpretations (Le Fevre et al., 2003a) this may not affect our conclusions. We choose to use stress responses because, as highlighted by Reivich & Shatté (2002), most individuals believe that events, or stressors, lead to outcomes and do not realize their relationship with beliefs or interpretations. If individuals do not understand themselves, we, too, would find it challenging to understand them.

Limitations

As we use cross-sectional data and therefore cannot study temporal effects, it is important to study these effects as individuals may interpret and respond to ICT differently over time. If we had used panel data, this could have helped to minimize common method variance problems (Podsakoff, MacKenzie, Lee & Podsakoff, 2003). However, to address the common method bias we conduct several tests recommended by Podsakoff et al. (2003) to prevent any bias. In line with Ayyargari et al. (2011) we use procedural remedies while designing the survey such as the guaranteed anonymity of the participants, a pre-test to prevent any wording problems, and choose two different main topics for the

survey to psychologically separate between dependent and independent variables. Moreover, we use statistical controls such as Harman's single factor test to test whether a single factor explains a large part of the total variance within the model. This is not the case in our study, as 36% (unrotated factor solution) is clearly below the critical 50% explanatory value. We also conduct the common method factor test (Homburg & Klarmann, 2009), which confirms our assumption that we have no common method bias within this study, as the common variance value of the common method factor on the paths is only 10% per item. Although it seems to be a limitation that we use self-reported data, this could be the best way to gain an insight into the individual perspective and perceptions that are the focus of our study. Individuals themselves perceive technology as an impact and feel exhausted or eustressed by it. Therefore, we state that a self-report on one's `s personal feelings demonstrates these perceptions in an accurate way.

Practical Implications

Overall, these results suggest that managers should focus more on an individual's stress responses (Cooper et al., 2001). This insight echoes that of Le Fevre et al. (2003b), where a first intervention should be with secondary approaches to stress management that concentrate on the individual in the organization. These secondary approaches include relaxation techniques, meditation techniques, hypnosis, and biofeedback training (Quick et al., 1997). Here, it is important to concentrate on developing optimism, autonomy and meaning as these resources foster positive stress responses. This is in stark contrast to the IS literature which favors support, discussion, and communication (Nelson & Kletke, 1990; Wastell & Newman, 1993), i.e., primary approaches that focus on organizational processes and moderate the relationship between ICT stressors and work-related outcomes.

Conclusion

The objective of this study is to further our understanding of the dual effects of ICT use on work-related outcomes, specifically techno-invasion on stress responses, by assigning a key role to individuals' interpretation responses. Using the COR theory of stress and extending the model within the techno-stress literature, we place responsibility of these dual effects on individuals and how they interpret technological stressors and respond to them depending on their resources. An individual's stress can lead to a negative response

and negative stress, namely exhaustion, or to a positive response and therefore positive stress, namely eustress. We test our model using data relating to employees in Germany. The results demonstrate that techno-invasion indeed evokes both positive and negative stress. We also accentuate the role of personal characteristics and environmental factors as partial mediators within this relationship. Resources such as autonomy and optimism are shown to promote eustress and reduce emotional exhaustion simultaneously. Work-home stability leads to a decrease in emotional exhaustion but does not evoke a positive stress response. Perceived supervisor support and success have no significant influence on either distress or eustress. The role of meaning is somewhat ambiguous in this context, as this resource increases distress and eustress. Overall, our findings provide a better understanding of ICT use and highlight the importance of the self.

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Appendix

Tables

Table 1. *Factor loadings*

	Techno-invasion	Eustress	Emotional Exhaustion	Optimism	Work-home stability	Meaning	Autonomy	Supervisor support	Success
TI1	0.91								
TI2	0.82								
TI3	0.75								
TI4	0.64								
EU1		0.93							
EU2		0.89							
EU3		0.89							
EU4		0.73							
EU5		0.66							
EX1			0.89						
EX2			0.88						
EX3			0.77						
EX4			0.73						
EX5			0.59						
OP1				0.92					
OP2				0.92					
WH1					0.91				
WH2					0.90				
WH3					0.90				
WH4					0.82				
WH5					0.79				
ME1						0.86			
ME2						0.82			
ME3						0.82			
ME4						0.80			
ME5						0.69			
AU1							0.75		
AU2							0.64		
AU3							0.77		
AU4							0.80		
SSU1								0.96	
SSU2								0.94	
SSU3								0.83	
SSU4								0.72	
SU1									0.69
SU2									0.69

Blanks represent absolute loadings of less than 0.4.

Table 4. *Structural equation model (AMOS)*

Structural estimates	Model 1 (initial)	Model 2	Model 3
	$\chi^2/df = 2.606$	$\chi^2/df = 2.434$	$\chi^2/df = 2.386$
	$\chi^2 = 1797.84$	$\chi^2 = 1655.20$	$\chi^2 = 1574.46$

	$df = 690$ TLI = .90 CFI = .91 RMSEA = .058	$df = 680$ TLI = .91 CFI = .92 RMSEA = .055	$df = 660$ TLI = .91 CFI = .92 RMSEA = .054
Techno-invasion →Emotional Exhaustion	.47 (8.35)***		.18 (2.90)**
Techno-invasion →Eustress	.11 (2.28)**		.17 (2.38)**
Techno-invasion → Optimism	-.13 (-2.91)**	-.12 (-2.21)**	-.11 (-2.14)**
Techno-invasion → Work-home stability	-.69 (-13.46)***	-.67 (-13.28)***	-.67 (-13.24)***
Techno-invasion → Meaning	.14 (2.92)**	-.13 (-2.58)**	.13 (2.55)**
Techno-invasion →Autonomy	-.18 (-3.36)**	-.13 (-2.63)**	-.16 (-3.01)**
Techno-invasion →Supervisor support	-.14 (-2.67)**	-.13 (-2.45)**	-.12 (-2.37)**
Techno-invasion →Success	.06 (1.18) *	.06 (1.27) n.s.	.06 (1.26) n.s.
Optimism → Emotional Exhaustion		-.22 (-4.39)***	-.23 (-4.58)***
Optimism → Eustress		.17 (3.23)**	.16 (3.14)**
Work-home stability → Emotional Exhaustion		-.42 (-8.01)***	-.29 (-4.67) ***
Work-home stability → Eustress		-.04 (-0.84) n.s.	.07 (1.13) n.s.
Meaning → Emotional Exhaustion		.18 (3.85)***	.17 (3.72)***
Meaning → Eustress		.23 (4.44)***	.22 (4.34)***
Autonomy → Emotional Exhaustion		-.21 (-4.50)***	-.20 (-4.26)***
Autonomy → Eustress		.14 (2.77)**	.15 (3.01)**
Supervisor Support → Emotional Exhaustion		-.07 (-1.61) n.s.	-.06 (-1.49) n.s.
Supervisor Support → Eustress		-.11 (-2.11)*	-.10 (-2.04)**
Success → Emotional Exhaustion		.03 (0.60) n.s.	.02 (0.38) n.s.
Success → Eustress		.08 (1.58) n.s.	.07 (1.41) n.s..
Δ χ2		142.64	80.74
Δ df		10	20

Control Variables (only signif.)			
Gender→ Eustress	.10 (2.15)**	.13 (2.85)**	.14 (3.01)**
Marital status → Emotional Exhaustion	-.10 (-2.31)**	n.s	n.s
Marital status→Optimism	.11 (2.78)**	.11 (2.30)**	.11 (2.29)**
Marital status→Meaning	-.24 (-5.03)***	-.24 (-5.02)***	-.24 (-5.02)***
Gender→Autonomy	-.10 (-2.14)**	-.10 (-2.07)**	-.10 (-2.07)**
Gender→Supervisor support	.10 (1.94)*	.10 (2.00)*	.10 (2.03)*
Gender→Success	-.16 (-3.25)**	-.16 (-3.25)**	-.16 (-3.25)**
ICT Expertise→Supervisor support	.10 (1.98)**	.10 (1.95)*	.10 (1.96)*

Note. *df* = degrees of freedom; TLI (NNFI) = Tucker-Lewis index; CFI = comparative fit index; RMSEA = Root mean square error; *Δ χ2* = change in chi-square; *Δ df* = change in degrees of freedom.

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