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THE TECHNOSTRESS TRIFECTA - TECHNO EUSTRESS, TECHNO DISTRESS AND DESIGN: AN AGENDA FOR RESEARCH

Monideepa Tarafdar

Lancaster University Management School, *Lancaster University, Lancaster, UK*

Cary L. Cooper

Alliance Manchester Business School, *University of Manchester, Manchester, UK*

Jean-François Stich

ICN Business School, CEREFIGE, *Nancy, FR*

Abstract: Technostress - defined as stress that individuals experience due to their use of Information Systems - represents an emerging phenomenon of scholarly investigation. It examines how and why the use of IS causes individuals to experience various demands that they find stressful. The literature on technostress is nascent, but shows evidence of high research momentum and currency, and of rapidly accumulating a large number of facts in different conceptual directions. This paper develops a framework for guiding future research in technostress experienced by individuals in organizations. We first review and critically analyze the state of current research on technostress reported in journals from three relevant literatures– information systems, organizational behaviour and organizational stress. We then develop our framework in the form of the 'technostress trifecta' - techno-eustress, techno-distress and Information Systems design principles for technostress. The paper challenges three key ideas imbued in the existing technostress literature. First, it develops the argument that, in contrast to negative outcomes, technostress can lead to *positive outcomes such as greater effectiveness and innovation* at work. Second, it suggests that instead of limiting the role of IS to that of being a stress creator in the technostress phenomenon, it should be *expanded to that of enhancing the positive and mitigating the negative effects of technostress* through appropriate design. Third, it lays the groundwork for guiding future research in technostress through an *interdisciplinary framing that enriches both the IS and the organizational stress literatures* through a discourse of disciplinary exchange.

Keywords: Technostress, Techno-Eustress, Techno-Distress, Organizational Stress, IS Design.

1. INTRODUCTION

Technostress - defined as stress that individuals experience due to their use of Information Systems (IS) - represents an emerging area of scholarly investigation in IS (e.g. Ragu-Nathan et al. 2008; Ayyagari et al. 2011). Stress embodies the condition of imbalance experienced by an individual between the demands of a given situation and his or her ability to meet them (e.g. McGrath 1976; Cooper et al. 2001). The phenomenon of technostress investigates how and why *the use of IS* causes various demands, which the individual appraises as threats that he or she finds unable to meet, and faces adverse consequences. It provides a conceptual link between the IS and work stress literatures. It is cross-disciplinary in nature, and exemplifies what Orlikowski and Barley (2001) refer to as 'complementarity' between disciplines, in this case between IS and organizational psychology.

The phenomenon of technostress is relatively new, but rapidly evolving; new systems, devices, applications, and measurement methods emerge continually and reveal novel aspects of it in existing and emerging contexts of use. It finds wide-ranging practical relevance as evidenced by mention in practitioner writing[1] and even legislation[2]. Equally importantly, it has high research momentum and currency, as demonstrated by an increasing number of articles in leading IS journals. The IS literature on technostress is relatively nascent - scholarly empirical work was first reported in a mainstream IS journal only about ten years ago. However, it shows evidence of rapidly accumulating a large number of facts in different conceptual directions. Given these considerations, the primary objective of this paper is to develop a framework for guiding future research on the phenomenon of technostress. In order to do this, it is necessary to conduct a review of the literature. A secondary objective is therefore to critically analyze the state of current research on technostress.

In laying out directions for future research, the paper challenges current ideas in the technostress literature in three ways. First, it develops the argument that, in contrast to the much examined negative outcomes, technostress can be harnessed as motivation for *positive outcomes such as greater effectiveness and innovation* at work. Second, it suggests that in addition to being a stress creator, the role of IS in the technostress phenomenon should be *expanded to that of enhancing the positive and mitigating the negative effects of technostress* through appropriate design. Third, it lays the groundwork for guiding future research in

[1] See for example http://www.bbc.co.uk/news/business-36517644 and https://www.salon.com/2016/05/30/plugged_in_and_stressed_out_technology_is_killing_the_work_life_balance/

[2] See for example http://money.cnn.com/2017/01/02/technology/france-office-email-workers-law/

technostress through an *interdisciplinary framing that enriches both the IS and the work stress literatures* through a discourse of disciplinary exchange.

In Section 2, we review the literature in technostress. In Section 3 we analyze its key themes key themes, and identify less-understood and under-researched, yet relevant aspects. Section 4 presents our framework for future research and identifies research questions, in the form of the 'technostress trifecta' that constitutes techno-eustress, techno-distress, and IS design for tackling technostress. Section 5 presents discussions and concluding comments.

2. LITERATURE REVIEW

Technostress is a *process* that includes: (1) the presence of **technology environmental conditions**; which are appraised as (2) demands or **techno-stressors** that are taxing on the individual; which set into motion (3) **coping behaviors** in response; that lead to (4) negative psychological, physical and behavioural **outcomes** for the individual. The **primary appraisal process** influences the relationship between technology environmental conditions and techno-stressors. The **secondary appraisal process** influences the relationship between the techno-stressors and coping behaviours. This framing has provided the conceptual foundation for understanding technostress. It finds its theoretical basis in the Transactional Theory of Stress (e.g. Cooper et al. 2001; Lazarus and Folkman 1984; McGrath 1976),

We conducted a literature review of relevant papers from the three disciplines of IS, organizational behaviour (OB) and organizational psychology. The literature review included the following considerations – (1) selection of disciplinary corpus, keywords and journals; (2) article selection through initial query run and backward and forward search; (3) article classification. These steps are presented in detail in Appendices A, B and C. To describe here briefly, for each discipline, we selected the set of leading journals and searched for relevant keywords in titles, abstracts and keywords of all articles published since 1995, to generate an approximately 20 year (1995-2016) horizon for our search. The starting year of 1995 is prior to the uptake of pervasive, mobile, multi-device and multi-application use of IS, which are key drivers of technostress. A total of 173 articles were retrieved and analysed. We find that the articles covered the following aspects of technostress: **Technology Environmental Conditions, Techno-Stressors, Coping Behaviors, and Outcomes.** Table 1 tabulates and describes each concept, as it emerged collectively from the papers in our corpus that covered it. We describe them next.

Table 1. Literature Review

Concept	Definition	Details	References
Technology environmental conditions	Characteristics of IS used by individuals in the organization that have the potential to create a demand in the individual	Ubiquity, Reliability, Ease of use, Mobility, Presenteeism, Technology created interruptions	Ayyagari et al. 2011 Galluch et al. 2015,
Techno-Stressors	IS stress creators appraised by the individual as threatening	Techno-insecurity, Techno-overload, Techno-invasion, Techno-uncertainty, Techno-complexity	Barber and Santuzzi 2015 Barley et al. 2011 D'Arcy et al. 2014 Day et al. 2012 Galluch et al. 2015 Maier et al. 2014 Reinke and Chamorro-Premuzic 2014 Sprigg and Jackson 2006 Tarafdar et al. 2007
	Factors affecting the level of techno-stressors	Attitude towards IS, workload, work complexity, digital literacy and user involvement	Barber and Santuzzi 2015 Barley et al. 2011 Chen et al. 2009 Korunka and Vitouch 1999 Tarafdar et al. 2010
Outcomes (also referred to as 'Strain')	Non-beneficial or adverse consequences emanating from a direct relationship with the various techno-stressors	Job-related negative outcomes	Tarafdar et al. 2007 Ragu-Nathan et al. 2008 Sprigg and Jackson 2006
		IS use related negative outcomes	Barber and Santuzzi 2015 D'Arcy et al. 2014 Maier et al. 2014 Tarafdar et al. 2010
		Well-being related negative outcomes – feeling burned out, drained etc.	Aiello and Kolb 1995 Ayyagari et al. 2011 Barber and Santuzzi 2015 Barley et al. 2011 Brown et al. 2014 Chen et al. 2009 Day et al. 2012 Galluch et al. 2015 Korunka and Vitouch 1999

			Reinke and Chamorro-Premuzic 2014
			Srivastava et al. 2015
			Sykes 2015
		Physiological outcomes, e.g. stress hormones	Galluch et al. 2015
			Tams et al. 2014
		Factors decreasing the level of outcomes	Day et al. 2012
			Fuglseth and Sørebø 2014
			Ragu-Nathan et al. 2008
			Soucek and Moser 2010
			Sykes 2015
			Yan et al. 2013
Coping Behavior	In response to IS security related techno-stressors	Disengagement with IS security requirements	D'Arcy et al., 2014
	In response to implementation/use of an application	Adaptation of IS use	Beaudry and Pinsonneault 2005
Moderators of the stressor-outcome relationship	Factors influencing the relationship between techno-stressors and outcomes	Technology self-efficacy, technology competence, neuroticism, agreeableness, extraversion, control over access to task related information, opportunity for taking a break	Galluch et al. 2015
			Soucek and Moser,2010
			Srivastava et al. 2015
			Tarafdar et al. 2015

Technology environmental conditions: These are characteristics of IS that have the potential to create a demand in the individual - namely, ubiquity, reliability, ease of use, mobility and presenteeism. They also include IS related events such as system breakdown and technology created interruptions (Ayyagari et al. 2011; Galluch et al. 2015).

Techno-Stressors: These are stressors appraised by the individual as damaging. Overload from the use of IS, techno-overload, forces the user to do more in order to use the technology (Reinke and Chamorro-Premuzic 2014; Tarafdar et al. 2007), to adhere to extra organizational security requirements regarding its use (D'Arcy et al. 2014), or attend to expectations of others when using applications such as social media (Maier et al. 2014). Techno-invasion is the stressor where the user feels non-work time to be invaded by work demands (Tarafdar et al. 2007), is faced with expectations of constant availability and

immediate response, and has privacy invaded by surveillance and monitoring (Barber and Santuzzi 2015, Day et al. 2012, Sprigg and Jackson 2006). Individuals experience techno-uncertainty as a stressor when they feel that IS change quickly (Tarafdar et al. 2007), important technology related decisions are not communicated to them (Barber and Santuzzi 2015; Day et al. 2012), and they do not have control over IS use policies around, for instance, IS security (D'Arcy et al. 2014). Techno-insecurity embodies the feeling of insecurity that individuals face when they feel that others may know more about new technologies than they do (Tarafdar et al. 2007). Techno-complexity is the stressor that individuals experience because they have to constantly learn how to use IS (Barber and Santuzzi 2015; Barley et al. 2011; Day et al. 2012; Sprigg and Jackson 2006; Tarafdar et al. 2007), find it difficult to understand IS use policies (D'Arcy et al. 2014) or may be faced with too many interruptions, complications and hassles in using IS (Barber and Santuzzi 2015; Galluch et al. 2015). Factors that affect the level of techno-stressors include the attitude of the individual's towards IS (Barley et al. 2011), workload, work complexity, digital literacy and user involvement (Barber and Santuzzi 2015; Chen et al. 2009; Korunka and Vitouch 1999; Tarafdar et al. 2010, 2015).

Outcomes: Outcomes have been studied as non-beneficial or adverse consequences emanating from a direct relationship with the various techno-stressors. They have also been referred to as 'strain'. Job related outcomes include lack of job satisfaction and organizational commitment, turnover intentions, role overload, role conflict (Ragu-Nathan et al. 2008; Tarafdar et al. 2007), job-related anxiety and depression (Sprigg and Jackson, 2006). Outcomes relating to use of IS include lack of IS-enabled innovation and productivity, low end user satisfaction (Tarafdar et al. 2010), discontinued use (Maier et al. 2014), resigned or unwilling compliance with use requirements such as quick response to email (Barber and Santuzzi 2015), and non-adherence to IS use requirements (D'Arcy et al 2014). Well-being related outcomes include exhaustion, burnout and strain (Aiello and Kolb 1995; Ayyagari et al. 2011; Barber and Santuzzi 2015; Barley et al. 2011; Brown et al. 2014; Chen et al. 2009; Day et al. 2012; Korunka & Vitouch 1999; Reinke and Chamorro-Premuzic, 2014; Srivastava et al. 2015; Sykes 2015; Galluch et al. 2015,). Physiological outcomes include the incidence of stress hormones such as alpha amylase (Galluch et al. 2015; Tams et al. 2014).

Factors that decrease or inhibit the extent of these negative outcomes include IS management mechanisms such as literacy facilitation, technical support, end user involvement, innovation support, co-worker support and support manuals (Day et al. 2012; Fuglseth and Sørebø 2014; Ragu-Nathan et al. 2008; Soucek and Moser 2010; Sykes 2015; Yan et al. 2013).

Coping Behaviors: Coping behavior in response to organizational IS security related techno-stressors includes disengagement with IS use requirements (D'Arcy et al. 2014). Coping behaviors in response to the organizational implementation of an application include adaptation of IS use by individuals (Beaudry and Pinsonneault 2005).

Moderators of the techno-stressor - outcome relationship: We find a number of factors that moderate the relationship between techno-stressors and adverse outcomes. Negative moderators include the individual's technology self-efficacy, technology competence (Tarafdar et al. 2015) and positive moderators include the personality orientations of neuroticism, agreeableness, and extraversion (Srivastava et al. 2015). The individual's control over whether he or she can access information relating to a task or take a break from the task has both positive and negative moderating effects (Galluch et al. 2015).

3. ANALYSIS OF THE LITERATURE

We analyse in this section, the key aspects of the literature that reports on technostress.

Technostress as a dark side phenomenon: The overarching and exclusive premise of the literature regarding technostress is that of a phenomenon associated with negative consequences. The literature explains only how demands from the technology environmental conditions are appraised as stressful in a threatening and negative way. The techno-stressors are appraisals of the technology environment as *threatening* and the outcomes examined are *adverse consequences*. However, the stress literature (e.g. Selye 1956, Lazarus 1966) suggests that individuals can appraise environmental conditions as *both threatening and challenging*; the respective outcomes can be *damaging* and *beneficial* respectively. Not all stressors are detrimental to the individual. In addition to presenting difficulties and threats, stressors can also enthuse and encourage individuals in positive ways. The IS literature does not explain how the demands from the technology environment can be appraised as challenging and motivating, leading to potentially positive outcomes. As reinforcement of the practical relevance of this literature gap, we are beginning to see employees responding to IS characteristics such as reliability, ubiquity and mobility, by challenging themselves to leverage these for greater work flexibility[3]. There is a need for IS research to examine and explain the positive facet of technostress.

[3] See for example - http://destinationinnovation.economist.com/2016/12/06/technology-wellbeing-and-work/

IS use as a cause of technostress: The literature considers the use and implementation of IS as *triggers and causes* that set in motion the process of technostress. However, we did not find a single study in our literature review where the role of IS in *helping to mitigate negative outcomes* from technostress was examined. Yet, we see are beginning to see instances in practice, of IS applications such as 'email personal assistants' that prioritize email (e.g. Kokkalis et al. 2013) and machine learning algorithms that filter spam email. Such applications can potentially help people to deal with techno-stressors such as techno-overload. This line of investigation has the potential to explain issues relating to sensing, measuring and monitoring the presence of technostress and providing adaptation cues through the design of persuasive IS. The current technostress literature does not provide an understanding of design principles for such IS. We thus do not know *how IS that could evaluate and affect key variables of the technostress process, can be designed*.

Fragmented investigation: The process described in Section 2 has been the predominant organizing theoretical basis for studying technostress. However, as we see in Table 1, all aspects of the process have not been investigated. For instance, studies have not examined primary or secondary appraisal, that is, the influencers of the relationship between environmental conditions and techno-stressors or between techno- stressors and coping behaviors. These are serious knowledge gaps because of which we do not know how and why an individual perceives IS to be stressful, or how and why they consider particular coping behaviors.

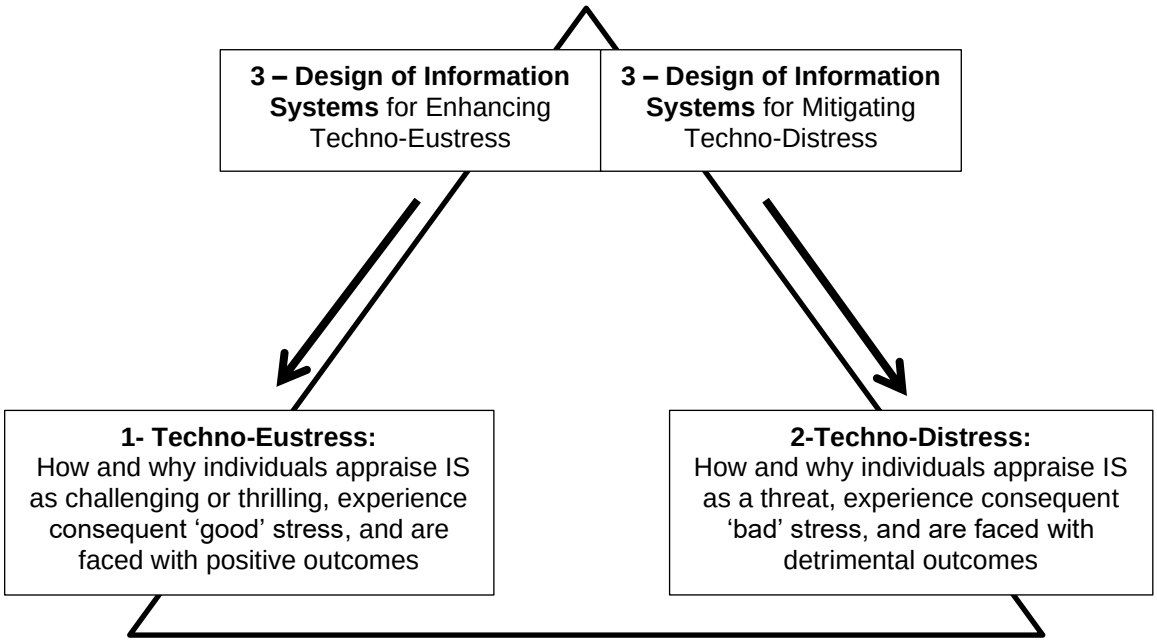
Lack of cross-disciplinary theoretical enrichment: Finally, we find that the study of technostress in the IS literature has referenced theoretical concepts from the organizational stress literature. However, studies in the latter have treated the stress creating effects of IS use in a black box fashion, without investigating how and why the use of IS causes stress, and the *key IS related variables and processes that constitute technostress*. As a result, distinctive aspects of the phenomenon of technostress have not been incorporated into the understanding of organizational stress. This presents a substantive and exciting opportunity to develop the technostress literature in a way that furthers mutual and cross-disciplinary theoretical enrichment between the fields of IS and organizational stress.

4. FRAMING FUTURE RESEARCH– THE TECHNOSTRES TRIFECTA

We present our framework for guiding future research in technostress in the form of a trifecta as shown in Figure 1. Its first aspect is **techno-eustress**, which explains how individuals

appraise IS as challenging or thrilling, and experience consequent 'good' stress which motivates them to engage in coping behaviours that lead to positive outcomes. Its second aspect is **techno-distress**, which explains the processes by which individuals appraise IS as a threat, experience consequent 'bad' stress, and are faced with detrimental outcomes. The third aspect explains **how IS can be designed**, for respectively enhancing techno-eustress and mitigating techno-distress. We next identify key research questions that future research should investigate for each aspect of the trifecta. We also suggest potential directions of enquiry for researchers to engage with these questions.

Figure 1: The Technostress Trifecta



4.1. Techno-Eustress

Techno-Eustress is the phenomenon that embodies the positive stress that individuals face in their use of IS. As shown in the top half of Figure 2, individuals appraise the characteristics of IS as challenges that they are motivated to tackle, activate coping behaviors to master the challenges, and achieve affirmative and positive outcomes. When the individual appraises a challenge stressor, he or she feels motivated in a positive way to overcome the challenge and experiences the process of 'eustress' or 'good' technostress.

Figure 2: Techno-Eustress and Techno-Distress

Note: Boxes marked with an asterix have been covered in the literature

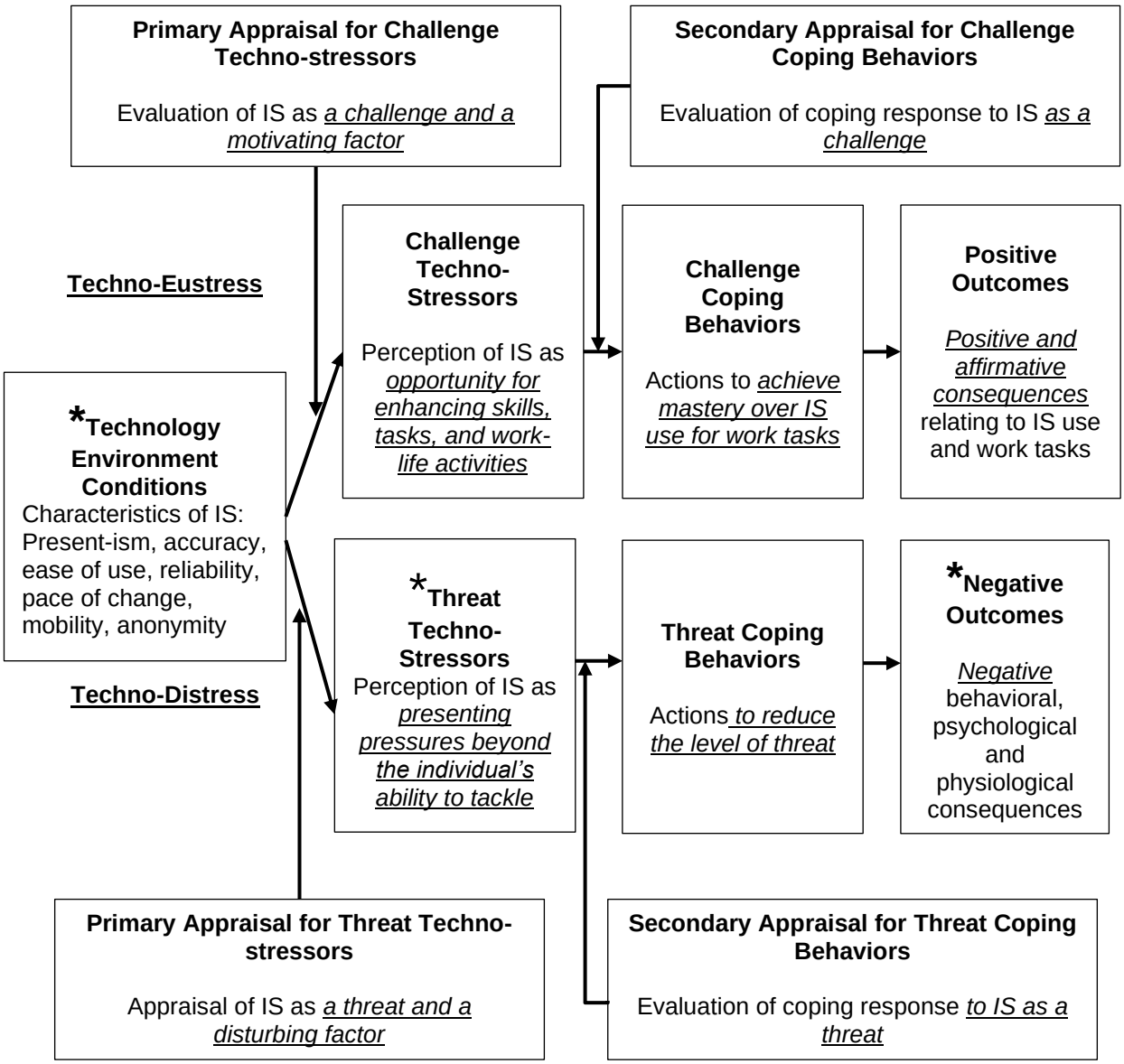


Table 2. Agenda for Research in Technostress

Trifecta Aspect	Research Questions	Potential Directions for Enquiry

Techno-Eustress		
Challenge Techno-Stressors: Perception of IS as *opportunity for enhancing skills, tasks, and work- life activities*	What demands do individuals experience from use of IS that they find thrilling, enjoyable or motivating?	*Demands that present opportunity for the use of IS for*: learning, enhancing skills, accomplishing tasks more effectively, enhancing performance, fulfilling career ambitions
Primary Appraisal for Challenge Techno-Stressors: Evaluation of IS as *a challenge and a motivating factor*	What individual and organizational factors increase the likelihood that the characteristics of IS are perceived as challenge techno-stressors?	*Individual*: e.g. hardy personality, open to experience, personal innovativeness with IT *Organizational*: e.g. culture of innovation and high user involvement in IS
Challenge Coping Behaviors: Actions to *achieve mastery over IS use for work tasks*	What coping behaviors are activated to deal with challenge techno-stressors that help individuals achieve mastery over IS use for work tasks?	*IS use related coping behaviors*: e.g. experimentation and exploration with IS *Task related coping behaviors*: e.g. task innovation, productive multi-tasking, flexible switching across devices and work-home boundaries
Secondary Appraisal for Challenge Coping Behaviors: Evaluation of coping response to IS *as a challenge*	What factors increase the likelihood of the individual activating challenge coping behaviors in response to challenge techno-stressors?	*Individual factors*: e.g. technology competence, intrinsic motivation to use IS *Organizational factors*: e.g. expectations regarding client interaction *Role related factors*: e.g. occupation specific roles such as frontline service, knowledge work
Positive Outcomes: *Positive and affirmative* consequences relating to IS use and work tasks	What are the positive outcomes relating to task and use of IS?	*Task related*: e.g. improved efficiency, productivity, innovation, performance, *Use of IS related*: e.g. heightened flow, enjoyment and immersion while using IS. *Job related:* work flexibility, work engagement and work autonomy
Techno-Distress		
Primary Appraisal for Threat Techno-Stressors: Appraisal of IS as *a threat and a disturbing factor*	What factors increase the likelihood that the characteristics of IS are perceived as threat techno-stressors?	*Individual*: e.g. obsessive compulsive personality, neurotic disposition, low technology self-efficacy *Organizational*: e.g. culture of surveillance, expectations of work-related availability outside work, low user control over IS use
Threat Coping Behaviors: Actions *to reduce the level of threat*	What coping behaviors are activated to deal with threat techno-stressors that help individuals reduce the level of threat?	*IS use related*: e.g. learning how to use IS, accomplishing IS-mediated tasks, seeking related training and assistance, avoiding or stopping IS use *Task related*: changing IS-mediated tasks to fit with the technology, temporarily stepping away from the IS-mediated task

		Affect related: rationalizing and reinterpreting the threat in a positive light
Secondary Appraisal for Threat Coping Behaviors: Evaluation of coping response *to IS as a threat*	What factors increase the likelihood of the individual activating threat coping behaviors in response to threat techno-stressors?	*Technology support*: e.g. troubleshooting/ help desks, IS awareness programs *Social support*: e.g. peer socialization around IS *Work practices support*: e.g. flexible working schedules
Designing IS to tackle Technostress		
Leverage challenge techno-stressors and reduce threat techno-stressors	What IS design features motivate and empower users to leverage challenge techno-stressors? What IS design features provide simplicity and clarity to help individuals reduce threat techno-stressors?	*Features that strengthen thrill, enjoyment, competitiveness*, e.g. gamification to enhance enjoyment, allowing users to install, control and modify applications *Features that make it simple to use IS* e.g. e.g. easy navigation, consistent functionality, opt-out options, clear information, information prioritization
Design IS to help the individual in executing challenge and threat coping behaviors	What IS design features motivate the individual to engage in challenge coping behaviors? What IS design features assist the individual in threat coping behaviors?	*Features that support emergent use,* e.g. flexibility in features and interfaces to support workarounds, experimentation and model building *Features that provide calming and distraction*, e.g. easily understood help menus and use guidance, positive feedback regarding IS use, options to take a break from IS use
Design IS to enhance positive outcomes and diminish negative outcomes	What IS design features provide psychological reinforcement for improved performance, to accentuate positive coping outcomes? What IS design features provide persuasion to attenuate negative coping outcomes? How should context-salient outcomes be measured?	*Features that*: Identify behavioral and physiological parameters that indicate positive and negative outcomes Measure and track positive and negative outcomes Provide helpful and relevant feedback in an unobtrusive and non-interfering manner that help to attain goals regarding outcomes Consider the distinctive particulars of the task, application, and occupation/role

Challenge stressors: The individual experiences 'challenge' stressors when the characteristics of IS are perceived to present the opportunity for enhancing the individual's skills, tasks, and work life (Cooper et al. 2001; Lazarus 1966). Recent studies show for instance that individuals can push themselves to learn how to use apps on smartphones and tablets to enhance their flexibility across different tasks, contexts and the work-home boundary (e.g. Diaz

et al. 2012; Leung 2011; Ohly and Latour 2014). It is important to understand what these challenge stressors are in order to evaluate the ways in which the individual can feel challenged. We thus ask the question: *What demands do individuals experience from the characteristics of IS that they find thrilling, enjoyable or as opportunity to learn to accomplish tasks more effectively?*

Primary Appraisal for Challenge Stressors: Particular individual and organizational characteristics increase the likelihood that the characteristics of IS are perceived as challenge stressors. These factors strengthen the relationship between technology characteristics and the challenge perceived by the individual due to them. In terms of individual-specific characteristics, certain personality characteristics included in the 'big five' (Goldberg 1990) may be pertinent. For instance, individuals with a hardy personality, characterized by alertness, ambition and competitiveness, are intrinsically motivated to achieve and perform at high levels. They interpret environmental conditions as challenges that can be leveraged for positive work outcomes (Kobasa 1979, Janis 1977). Such individuals may perceive IS characteristics such as presentism and reliability as enablers for accessing and processing information when they need it, and for increasing their ability to be flexible and productive (Boswell and Olson-Buchanan 2007; Ohly et al. 2015). Or, individuals who are open to experience, actively try out and seek new situations, think creatively and unconventionally or show high levels of innovativeness with IS (Agarwal and Pradad 1998). They may perceive IS functionality as an opportunity for innovative use. They would evaluate IS characteristics such as pace of change, sophistication, and flexibility as opportunities to creatively use and experiment with new IS functionalities and features; they would thus be challenged by them to enhance their work.

Particular aspects of organization culture can aid in the primary appraisal for challenge techno-stressors. For instance, a culture of innovation makes it acceptable to take risks (Amabile et al. 1996). In organizations having such a culture, flexibility of IS may be seen as an opportunity for the creative use of technology for work tasks, and the pace of change of IS, as a challenge for using new technologies for innovative work processes. Additionally, a culture of involvement enables influential roles for users in IS planning, development, and implementation (Doll and Torkzadeh 1989). In such a culture, users are familiar with the system, understand how to use its features, and make better assessments about task-technology fit (Beaudry and Pinsonneault 2005). Armed with this knowledge, they may perceive technology characteristics such as flexibility, as opportunities that challenge them to improve their tasks, by using IS in different ways.

Understanding what these personal and organizational factors are, is necessary to explain what helps in the appraisal of challenge stressors, so that we ask: *What individual and organizational factors increase the likelihood that the characteristics of IS are perceived as challenge stressors? How do these factors strengthen the relationship between technology characteristics and challenge techno-stressors?*

Challenge Coping Behaviors: A key psychological concept critical to dealing with challenges is that of mastery, which denotes the successful meeting and dealing with difficulties (Murphy 1962). Mastery focuses the individual's actions toward leveraging the opportunities associated with the challenge, for achievement and fulfilment (Folkman 1984, Lazarus 1966). Challenge coping represent these actions. They are activated when the individual experiences challenge techno-stressors. They can be related to the individual's use of IS and the task.

IS use-related coping behaviors can focus on experimenting with different types of use such as - exploring and trying new features (Barki et al. 2007; Jasperson et al. 2005; Beaudry and Pinsonneault 2005), using more features (Sun 2012), and uncovering new uses for existing features (Jasperson et al. 2005; Singletary et al. 2002). They would entail proactively 'stretching' and learning to use new IS (DeSanctis and Poole 1994; Orlikowski and Gash 1994). Task related coping behaviors are focused on innovations in task and work practices using IS (Majchrzak and Cotton 1988). Task innovation could include, for instance, developing new solutions for customers using a customer relationship management system (Tarafdar et al. 2015). Work practice innovation could include discretionary and mindful smartphone use for work-related tasks at home to achieve flexibility (Fenner and Renn 2010), productive multi-tasking during meetings when the individual is not directly contributing or speaking, by working simultaneously on other IS-mediated tasks (Ohly et al. 2015), use of IS to engage in back and forth between different types of communications and interactions during the course of the workday to accomplish various tasks (Wajcman and Rose 2011). Recent research supports such scenarios and suggests that boundaries across different work tasks can be blurred in a constructive and helpful way (e.g. Leung 2011) through the use of IS. We therefore ask: *What IS use related and task related coping behaviors are activated to deal with challenge techno-stressors that helps individuals achieve mastery over IS use for work tasks?*

Secondary appraisal for challenge coping behaviors: Secondary appraisal for challenge coping increases the likelihood that individuals evaluate and engage in various challenge coping behaviors. Factors that could influence secondary appraisal are the

individual's technology skills, organizational norms regarding particular tasks, and the individual's organizational role.

In terms of technology skills, individuals with high technology competence, that is, those who can use IS productively and with ease (Tarafdar et al 2015), are likely to be motivated and stimulated by and thrive on, creative and exploratory uses of IS. Similarly those with a high intrinsic motivation to use IS (Ryan and Deci 2000) would proactively engage in IS use for the fun and challenge it provides. Recent findings show that intrinsic motivation may be a positive factor in people using smartphones for changing their work practices (Ohly and Latour 2014). Organizational expectations and norms regarding how particular tasks should be regarded are likely to be important to secondary appraisal because they influence how individuals use IS to accomplish their tasks (DeSanctis and Poole 1984; Orlikowski 1992). In organizations where prompt and constant interaction with high-value and demanding clients is expected, employees may attune their work practices toward maximum availability and would accordingly use IS to ensure that they can be reached by clients (Mazmanian et al. 2013). These sorts of organizational expectations influence the likelihood that the individual reacts to the challenge stressors by engaging in IS use and task related coping behaviors that enable them to achieve mastery over their work. In terms of the individual's role, frontline roles such as call center management and customer service require support to the customer. Individuals in such roles are likely to engage in coping behaviors that enable them to answer questions from and engage in communication with customers (Wajcman and Rose 2011). As another example, knowledge workers need to keep abreast of latest developments in their fields. Individuals in such roles may respond to challenge stressors by using IS to receive information alerts from important journals and databases.

We thus ask the following questions: *What individual, organizational and role related factors increase the likelihood of the individual activating challenge coping behaviors in response to challenge techno-stressors? How do these factors strengthen the relationship between challenge techno-stressors and challenge coping behaviors?*

Positive outcomes: Outcomes beneficial to the individual are expected to occur in the techno-eustress process. Such outcomes embody affirmative and positively reinforcing impacts for the individual. They could include, for example, improved performance, increased efficiency and enhanced innovation at work tasks through the use of IS. Recent studies show that when employees in frontline roles use IS under positive or motivating pressures, the result can be increased efficiency (e.g., reducing time and effort, work faster, make fewer errors) and effectiveness (e.g., improving the quality of services, upselling), which results in improved

performance (Wajcman and Rose 2011). When the individual engages in challenge coping behaviors such as experimentation and problem solving with IS, he or she is able to better leverage IS for increased task efficiency, and experience a general overall positive feeling while using IS. Challenge coping outcomes thus may include heightened flow or enjoyment and immersion in the use of, and an overall positive feeling towards, IS. Positive outcomes relating to the individual's overall job could include enhanced work flexibility, greater overall work engagement and an improved sense of work autonomy (ter Hoeven and van Zoonen, 2015).Understanding what these positive outcomes are, is essential to assessing the benefits of techno-eustress, so that we ask: *What are the positive outcomes relating to task and use of IS?*

4.2. Techno-Distress

In contrast to Techno-Eustress, Techno-Distress is the phenomenon that embodies the negative stress that individuals face in their use of IS. As shown in the bottom half of Figure 2, individuals appraise the characteristics of IS as threatening and presenting pressures beyond their ability to tackle. Such perceptions activate coping behaviors to reduce the level of threat techno-stressors, such as avoiding use of IS or sub-optimal IS use. The outcomes are detrimental. As we see in Table 1 and Figure 2, the literature has investigated the following aspects of Techno-Distress: Threat Techno-stressors and Negative Outcomes. The other aspects have however not been adequately attended to and present opportunity for further research.

Primary Appraisal for Threat Techno- Stressors: While threat techno - stressors have been discussed in the literature (e.g. Ragu-Nathan et al 2008, Ayygari et al 2011, Day et al. 2012), why and how individuals appraise threat techno- stressors has not been explained. Particular individual and organizational characteristics increase the likelihood that the characteristics of IS are perceived as threat techno- stressors. For instance, individuals with obsessive compulsive personalities or neurotic dispositions tend to interpret environmental conditions as threat stressors (Bolger and Zuckerman 1995; Chang 1998) because they are likely to be anxious, paranoid, and prone to negative reactions to situations. They have a tendency to perceive difficult situations as threatening (Lauriola and Levin 2001; Spector et al. 2000). Such individuals may perceive the reliability and presentism of IS as requirements for being available for work round the clock, feel insecure about missing out on important matters if they are not, and feel disturbed by the blurring of boundaries between work and home, thus strengthening the relationship between IS characteristics and threat techno-stressors. Additionally, individuals with low self-efficacy are likely to appraise greater job demands as threats (Schaubroeck and Merritt 1997). Low technology self-efficacy (Compeau and Higgins

1995) therefore could reduce the individual's confidence in dealing with IS characteristics such as flexibility and pace of change and increase the perception of threat associated with them.

In terms of characteristics of the organization, a surveillance prone culture implies IS enabled monitoring of employees, which can generate in them, fears of job insecurity, loss of privacy, and infringement of personal space (Fairweather 1999; Zuboff 1988, 2015). This is especially relevant for example, for organizations that monitor and record keystroke information, call center type telephone conservations with clients for assessing task speed and accuracy, and e-mail and Internet use (Miller and Weckert 2000; Stanton and Weis 2000). In such organizations, IS characteristics of reliability and anonymity can be perceived as enablers of even greater surveillance, further enhancing these fears (Coovert and Thompson 2005; Fairweather 1999). Organizational expectations of availability for work, outside of work hours may force individuals to respond immediately to communication such as email, texts or social networking applications (Barber and Santuzzi 2015). Individuals in such organizations may perceive reliability and presentism as threatening conditions that compel them to stay connected to and be available for work all the time. The extent to which individuals are in control over their own IS use enables them to choose when and how they use IS, such that they feel less threatened and overwhelmed by the IS characteristics.

We thus frame the following research questions: *What individual and organizational factors increase the likelihood that the characteristics of IS are perceived as threat techno-stressors? How do these factors strengthen the relationship between technology characteristics and threat techno-stressors?*

Threat Coping Behaviors: A second under-researched aspect is that of threat coping behaviors. These are actions to reduce the level of threat of techno-stressors stressors. They could include three kinds of behaviors – altering the task in the context of which the threat techno-stressor is experienced, changing the way in which the stress inducing IS is used, and changing one's cognition about the threat techno-stressor. Coping behaviors for altering tasks could include adjusting or changing the work procedures such that they fit they better fit with the technology (Majchrzak et al. 2000) and stepping away from the technology mediated task for a while and engaging in a different activity before returning. Coping behaviors relating to IS use could be learning how to use IS to the extent required for accomplishing tasks, seeking related training and assistance, or avoiding or stopping use (Beaudry and Pinsonneault 2005). The intent of IS use in this way would not be for innovation or improvement, but for merely getting the task done. Changing the outlook toward a threat techno-stressor would involve

reinterpreting and viewing it in a positive light and rationalizing or minimizing its supposed significance such that it appears less threatening. Such coping could include attitudes expressed by remarks such as 'The system is not really as bad as it is made out to be' (Beaudry and Pinsonneault 2005).

We thus ask the following research questions: *What coping behaviors (e.g. IS use related, task related, affect related) are activated to deal with threat techno-stressors that help individuals reduce the level of threat?*

Secondary Appraisal for Threat Coping: Secondary appraisal for threat coping increases the likelihood that individuals engage in threat coping behaviors in response to threat techno-stressors. While many negative outcomes have been examined, there is no understanding of how coping behaviors that influence those outcomes are activated. Factors that could influence secondary appraisal for threat techno-stressors should provide a supporting organizational environment (Fenlason and Beehr 1994; Lim 1996; O'Driscoll et al. 2010) in which users can engage constructively with IS related tasks even as they face threat techno-stressors. They include social support, technology support and work process support.

Social support from co-workers and friends includes good personal relationships through which they can empathize, understand and support each other in the context of IS use (Salanova et al. 2013; Zorn 2002). Such socialization encourages peer learning and helps individuals to share their experiences of IS use and make positive attributions to it. Technology support includes organizational mechanisms that help employees understand IS and how they can be used. They could include help desk type mechanisms for resolving technical faults (Beas and Salanova 2006; Ragu-Nathan et al. 2008) as well as programs that make individuals aware of issues surrounding IS use such as work life balance and help them become aware of options such as filtering email and switching off devices, as responses to threat stressors (Salanova et al. 2014). Work process support includes tractability in the individual's work organization such as for instance, provision of flexible schedules through teleworking (Leung 2011; Salanova et al. 2013; Salanova et al. 2014). Such support helps individuals choose their own ways of doing IS mediated tasks in response to threat techno-stressors.

Understanding these sorts of support would shed light on conditions for the individual to improve their outlook, in response to threat techno-stressors. We ask the following questions: *What factors increase the likelihood of the individual activating threat coping behaviors in response to threat techno-stressors? How do these factors strengthen the relationship between threat techno-stressors and threat coping behaviors?*

4.3. Designing IS to tackle Technostress

The third component of the technostress trifecta explains how IS can help mitigate techno-distress and enhance techno-eustress. Individuals can use such IS at three possible points of the techno-eustress and techno-distress process : (1) when they face challenge or threat techno-stressors; (2) when they execute challenge or threat coping behaviors; and (3) when they experience positive or negative outcomes. Future research should examine the design principles for such IS at each of these points as we explain below.

Designing IS to leverage challenge techno-stressors and reduce threat techno-stressors: It is essential to understand the design principles for IS that help individuals deal with challenge and threat techno-stressors, so that appropriate interventions can be effected at the very start of the techno-distress and techno-eustress process. Design features that stimulate and empower users to enhance their skills and performance using IS would help individuals leverage challenge techno-stressors by strengthening their perceptions of enjoyment, motivation and thrill. From the gaming literature we know that features that motivate users include IS that are fun and interesting, and encourage progress by presenting information about the individual's performance (Gerling et al. 2011). Such features can include tips, examples and suggestions about the possibilities of various types of use of the IS that can pique the individual's interest. Additionally, design features that allow users to install, control and modify features empower them to use IS to leverage the challenge stressors.

Features that might help mitigate the perception of threat stressors could include a simple design interface that is easy to navigate so as to minimize techno-complexity relating to IS use, consistent application performance and functionality that would reduce techno-uncertainty, information prioritization features that would decrease techno-overload, and information on data collected that would reduce techno-insecurity. For example, if a user feels threatened due to loss of privacy, informing employees of what data is collected and providing a design feature to opt out can reduce that threat. Overall, design features that provide simplicity and clear/adequate information can reduce the extent of threat stressors (Johnson and Wiles 2003).

Thus we ask: *What IS design features stimulate and empower users to leverage challenge techno-stressors? What IS design features provide simplicity and clarity to help individuals reduce threat techno-stressors?*

Designing IS to aid in challenge and threat coping behaviors: Once the individual has appraised a threat or challenge techno-stressor, the next opportunity to intervene is by providing IS that assist with the individual's respective coping response. Challenge coping

behaviors include task and IS use innovation using IS. Such innovation involves emergent interactions between task, technology and user, which are not scripted in advance, but arise through discussion, experimentation, adaptations, model building and workarounds, individually or in groups, as users figure out how to use the IS effectively and efficiently. It involves complex work processes that depend on the discretion of the user (Stein et al. 2013) and are enacted through multiple devices and sources of data, as users interact with task and technology to engage in innovation for both task and IS use (Alter 2008). Thus, systems which are designed to support emergence, flow and engagement may help execute challenge coping behaviors effectively (Alter 2013, Campbell and Pisterman 1996). Such systems could, for example, support the individual in workarounds, creative changes, experimentation and model building, by providing flexibility in features and interfaces.

Threat coping behaviors include individuals adjusting their task and use of IS, under feelings of distress and discomfort. The focus is on learning how to use the IS effectively and applying it to their work, often only to satisfy the minimum requirements of use (Stein et al. 2013). Helpful interventions can be those that calm and/or distract the individual (Weiser and Brown 1997). Calming interventions are IS features that provide easily understood help menus and use guidance to ease the individual's anxiety. Another calming mechanism could be to provide system generated feedback that reassures the individual about their outcomes regarding task adaptation or system use. For example, in an ERP system, this could be by providing a message through the system that communicates to the user that they successfully accomplished a given task (e.g. invoicing) by completing a specific IS use action (e.g. data entry on multiple screens into multiple tables) (Yim and Graham 2007). Regarding distraction interventions, any features that nudge users at the point of use, to take a break, switch off, step away or do something different, help to make their threat coping responses more effective. Thus we ask: *What IS design features support emergent use to assist in challenge coping behaviors? What IS design features provide calming and distraction to assist in threat coping behaviors?*

Designing IS to enhance positive outcomes and diminish negative outcomes: Finally, individuals can also use IS at the end of the techno-eustress and techno-distress processes, at the point where they experience positive and negative outcomes. Challenge outcomes are positive and desirable, such as improved performance, enhanced innovation and greater mastery. The goal of the IS should be to ensure that they continue. Design features that make individuals aware of these positive outcomes and reinforce their benefits can help do that. Positive outcomes can be directed towards task mastery, innovation and improved performance. It may be possible to translate such outcomes into parameters that the system can

measure and communicate to the individual. An example of this could be of a call center application that keeps track of calls handled and generates congratulatory messages to users when calls are handled with increasing effectiveness and efficiency over time. Such messages could let individuals know, if they so choose, that their performance has improved, thus reinforcing their mastery.

In the case of negative outcomes, persuasive systems can measure negative outcomes, provide diagnostics, and suggest persuasion cues (Fogg 2003). Negative outcomes regarding users' emotions could be measured through for instance, eye-tracking devices, wearables, and instruments that track physiological parameters such as saliva etc. Such measurements can be processed by the system, and if the threshold exceeds a certain level specific to the individual, appropriate feedback can be given to him or her if he or she so chooses. For example, if a user is multitasking on several different application screens and is experiencing the threat stressor of techno-overload, then the resulting negative outcome could be an increased heartbeat or eye movement. This can be sensed by the persuasive system and the user presented with a screen message which suggests to them to reduce the number of applications or to take a break. Such IS could gather information about the individual's current state, process it by comparing against his or her target conditions, and feed it back to provide assistance on the task at hand (Derrick et al. 2011, Oinas-Kukkonen and Harjumaa 2009). They could also provide a history of outcomes that individuals can understand the situations under which they become distressed. Such a framing provides the opportunity for detecting a negative or distressful outcome, selecting an adjustment or intervention, implementation of the intervention and revisiting the outcome. These sorts of persuasive IS can be applied in the context of different techno-distress situations, such as multi-tasking on smartphones, and IS generated interruptions through email and other communication applications. It is important to keep in mind however that such persuasion itself should not happen in an obtrusive, undesired, and consequently stressful manner (Dennison et al. 2013; Kuonanoja et al. 2015).

The salience of an outcome depends on the context of the particular application and use situation in which the technostress process unfolds and is examined. For example, if the study is about techno-distress experienced by physicians and nurses in using an Electronic Health Record application, pertinent outcomes could be their efficiency in completing patient documentation tasks; on the other hand, for techno-distress experienced by professional salespeople for the use of a CRM application, a relevant outcome could be the development innovative solutions for the customer using the CRM. Further, 'chronic' outcomes such as burnout may be more salient to understanding the long term impact of threat stressors such as

technology related overload, whereas 'episodic' physiological variables such salivary alpha-amylase more germane to studying the threat stressors due to real-time IT driven interruptions, multi-tasking, and breakdowns. Studies to date have established relationships between techno-distress and *general stress related outcomes* such as job satisfaction and commitment. As the literature develops and matures however, positive and negative outcomes that relate closely to *the specific technostress situation* – i.e. to the combination of tasks, applications and occupational particulars – should be theorized and measured, to reveal the distinctive nature of *technostress related consequences*.

Thus we ask the following questions: *What IS design features provide psychological reinforcement for improved performance, innovation and mastery to accentuate positive coping outcomes? What IS design features provide persuasion to attenuate negative coping outcomes? How should context-salient outcomes be examined?*

5. DISCUSSION

Stress embodies both the positive and negative and requires careful study - '…. *not afraid to enjoy the stress of a full life, nor too naïve to think they can do so without intellectual effort'* (Selye 1956). Technostress is a young, and interdisciplinary phenomenon, and an embodiment of the emerging, contextual and messy relationship between IS use and well-being (Lundberg and Cooper 2011). It is therefore important to provide guidance for coherently developing an understanding of this phenomenon, going forward. The framework developed in this paper helps to take a big-picture and unified view of technostress that explains how this phenomenon has unfolded in the literature, and to identify areas where current understanding is scarce and future research is needed. As we see from Figure 2, there is remarkable opportunity for future research to tackle interesting questions. Our exposition of key areas where future studies could be directed, brings together the conceptual domains of IS design, use and management, organizational behavior and organizational stress, suggesting that the study of technostress should draw from the richness contained in all of them. In particular we challenge three key ideas imbued in the existing literature – that technostress is primarily a phenomenon that has negative and detrimental consequences, that the role of IS in the technostress process is limited solely to that of a stress creator, and that research in technostress primarily draw from the reference disciplines of OB and organizational stress. We suggest instead that going forward, our enquiry of technostress should reveal how beneficial outcomes can come from technostress, how appropriately designed IS can alleviate the negative and

accentuate the positive aspects of technostress, and how research on technostress can inform the literatures of OB and organizational stress.

Dark Side and Bright Side: Technostress is experienced differentially by the individual, depending on whether IS characteristics are appraised as challenge or threat stressors. Each kind of experience of stress has *distinct* appraisal and coping processes associated with it. Techno-eustress introduces a new theoretical aspect to the phenomenon of technostress. With the rise of the millennial work force, current (and future) employees are using (will use) IS in ways that previous generations did not (Vodanovich et al. 2010). They experience the possibilities of using technology in unexpected and innovative ways for executing work-life activities. Further, new forms of work arrangements have emerged over the past decade such as virtual teams, teleworking and hot-desking (Coovert et al. 2009). In order to make such arrangements effective it is important to understand how technology poses motivational challenges that can be potentially mastered to enhance work processes and outcomes. Going forward it is important to understand how individuals experience and react to the thrill and difficulty of new technologies for innovation, creativity and improved performance. We lay out research questions that need to be addressed for understanding techno-eustress and provide directions for such enquiry.

IS Design to Tackle Technostress: We show how, in addition to being a cause of techno-stress, use of IS can be a means to its mitigation. This is an argument for a new and unexplored theoretical role for IS in the phenomenon of technostress. Developing this argument, we suggest that IS can be designed to deliver appropriate interventions for detecting, measuring and reducing (enhancing) the negative (positive) outcomes of techno-distress (techno-eustress). This line of research is quite uncharted. It offers scope for incorporating design science into technostress research, to investigate how applications, devices and wearables can be designed for measuring and monitoring technostress outcomes and providing adaptation cues, potentially in real time. Further, the possibility of measuring physiological outcomes offers methodological opportunities for and neuro science with technostress research. These embody new perspectives for the technostress literature. They are also of significance to the organizational stress literature which is beginning to acknowledge that IS can create stress, but does not identify coping and mitigation mechanisms *facilitated by IS design and use*. As Hamborg and Greif (2009, p. 225) suggest "the designs of workstations, hardware and software components …… are important factors related to stress".

Cross – disciplinary Framing: So far, research in technostress (based in the IS discipline) has primarily drawn from research in the OB and organizational stress disciplines.

Through our research questions, we suggest future research directions that focus on key *IS-based concepts and relationships* (involving applications/devices, their contexts of use, IS enabled work tasks, and IS design) that constitute technostress. In doing so we advocate applying *bodies of knowledge unique to the IS discipline including information systems management, design and use* (Baskerville and Myers 2003) to the understanding of stress from IS use, and speaking to the audience that examines the phenomenon of *stress* and that includes scholars outside the IS discipline. Our framing thus embodies a cross-disciplinary attribution wherein we suggest that future research in technostress could both *draws from* and *informs* the OB and organizational stress literatures. This is particularly important because the literature on organizational stress has not yet explained how the phenomenon of stress is theoretically informed by the particularities of IS use, design or management (Hamborg and Greif 2009. We thus seek to guide future research in technostress in ways that would mutually enrich (Oswick et al. 2011) the cognate literatures in IS, OB and organizational stress.

In conclusion, technostress is a rich phenomenon. Our (re)framing for future research, thus necessarily covers a number of aspects. Yet, it is also a fledgling and rapidly growing phenomenon. We see it as important to take stock of current understanding and focus the thrust and efforts of future research on novel, less-understood, under-researched conceptual and practically relevant areas. We hope this paper is a constructive and timely attempt in that direction.

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APPENDICES

Appendix A: Methods for Literature Review

This section presents the methods for our review of the literature that addresses stress due to use of IS. Specifically, it describes how the corpus of articles was collected, selected and reviewed, based on guidelines provided by Webster and Watson (2002). The process is summarized in Table A1 below.

Table A1. Summary of the Review Method

Stage	Activity	Description
1	**Selection of disciplinary corpus for article review**	Information Systems (IS), Organizational Behavior (OB), Organizational Stress (Stress)
2	**Selection of keywords and design of search queries**	Keywords searched for in article titles, abstracts and keywords. See Table 2
3	**Selection of journals for query**	See Table 2
4	**Query runs**	Queries ran on the EBSCO engine using the databases *Academic Search Complete, PsycInfo, and Business Source Premier*. The date of the query was January 07, 2016. • IS Query: 107 articles retrieved • OB Query: 15 articles retrieved • Stress Query: 47 articles retrieved • **Total**: 169 articles retrieved Results were imported in a reference management software Email alerts and RSS feeds were set up to retrieve future publications which were also included
5	**Rejection of articles that were not about technology -related stress, strain, coping or appraisal**	• IS Query: 96 articles rejected (11 retained) • OB Query: 14 articles rejected (1 retained) • Stress Query: 40 articles rejected (7 retained) • **Total**: 150 articles rejected (19 retained)
6	**Backward and forward search**	• Articles cited in the articles initially retrieved (i.e. backward search): 2 additional articles • Articles having cited the articles initially retrieved (i.e. forward search): 3 additional articles • **Total**: 5 additional articles
7	**Classification of articles**	See Tables 3 and 4
	Total	24 articles in the review corpus

Selection of disciplinary corpus: First, we selected the disciplinary corpus that would form the focus of our search. Given the cross-disciplinary nature of the phenomenon of technostress, it was important to cover journals from the relevant fields. Studies of organizational stress have been reported in journals from the organizational behavior (OB) and

psychological stress disciplines. The phenomenon of technostress has been studied in the IS discipline. Our search for relevant papers therefore covers articles from these three disciplines.

Selection of keywords: We find that each of these disciplines has its own distinct lexicon for describing stress from use of IS. Articles in OB journals mention stress due to information and communication technologies but not 'technostress', which is more widely attributed in the IS discipline. On the contrary, keywords that capture Information Systems (IS) or Information Technology (IT) or Information and Communication Technology (ICT) may not be relevant or helpful for articles from IS journals due their disciplinary focus. As a result, we ran separate investigations for each discipline, with the query for each investigation having a distinct and different set of keywords, as shown in Table A2. For the IS journals, we searched for articles containing either technostress-related keywords or simply stress-related keywords. We used both the keywords 'techno*' and 'stress*' (i.e. 'technostress', 'technological stress', 'technostressor' etc.). As IS articles are likely to be related to technology already, we also considered articles containing simply the keywords 'strain', 'coping', or 'stress*' (i.e. 'stress', 'stressor', 'stressful' etc.). Such queries would, for instance, capture articles on stress that individuals experience related to IS use or implementation , although such articles may not have used the words 'technostress'. For the OB and Stress journals, due to their disciplinary focus, it would be irrelevant to search for articles containing the keyword 'stress' but not 'technology'. These journals primarily focus on work structures and arrangements enabled by technology such as teleworking and virtual work, as well as on widely used office communication applications such as email. We thus required articles in these journals to contain both a stress-related keyword (stress*, strain or coping) and a technology-related keyword. The technology-related keywords included technology, ICT, teleworking, email or virtual work.

Table A2. Corpus of Journals for the Review

Discipline	Journal	Query
Information Systems	European Journal of Information Systems Information and Management Information Systems Journal Information Systems Research Journal of the Association for Information Systems Journal of Information Technology Journal of Management Information Systems Journal of Strategic Information Systems Management Science MIS Quarterly Computers in Human Behavior * Information Technology and People*	(techno* AND stress*) OR stress* OR strain OR coping
Organizational Behavior	Organization Science Administrative Science Quarterly Academy of Management Review Academy of Management Journal Organization Studies Human Relations	(techno* OR ICT OR telework* OR telecommut* OR "e-mail" OR electronic* OR "virtual work") AND (stress* OR strain OR coping)
Stress	Work and Stress Stress and Health Journal of Occupational Health Psychology International Journal of Stress Management Journal of Applied Psychology Journal of Occupational Health Psychology Personnel Psychology Organizational Behavior & Human Decision Processes	
Total	26 journals	

* Journals in which the backward and forward search articles were published

Selection of journals for the initial query run: We searched for the query-keywords in titles, abstracts and keywords of all articles published since 1995, to generate an approximately 20 year (1995-2016) horizon for our search. The starting year of 1995 is prior to the uptake of pervasive, mobile, multi-device and multi-application use of IS, which are key drivers of technostress. For each discipline, we selected the set of leading journals which

allowed us to retrieve most major contributions in the starting query run (Webster and Watson, 2002). The full set of selected journals is presented in Table 2. For the IS discipline set, we selected journals based on (1) the AIS basket-of-eight journals, (2) journals previously searched for in review papers (e.g. Kappos and Rivard 2008), and (3) journals covered in the Financial Times (International), UT Dallas (US) and Association of Business Schools (UK) ranking lists. For the OB and stress disciplines set, we selected journals based on (1) journals previously searched for in previous theory and review papers (e.g. Berry et al. 2007; Leidner and Kayworth 2006) and (2) journals present in the Financial Times (International), UT Dallas (US) and Association of Business Schools (UK) lists. We ran the queries on the EBSCO engine using the databases *Academic Search Complete, PsycInfo, and Business Source Premier*. 107 results were returned for the IS journals, 15 for the OB journals, and 47 for the stress journals. All the articles were retrieved, stored and managed through reference management software. Email alerts and RSS feeds were then created so that articles published after the search were automatically retrieved and considered for inclusion.

Article selection from initial query run: We rejected articles that were not about technology-related stress, strain, coping or appraisal. For IS journals, 96 articles were rejected out of the 107 retrieved, leaving 11 valid articles. For OB journals, only one out of the 15 articles retrieved was kept. For stress journals, 40 articles were rejected out of the 47 retrieved, leaving 7 valid articles. A total of 19 articles were kept out of the 169 initially retrieved. The reasons for rejecting the articles are presented in Appendix B.

Backward and forward search on articles selected: Backward and forward search was used to retrieve a further set of relevant articles, based on the originally retained set from all the three. The backward search (i.e. articles having been cited) was conducted by analyzing the references of the articles initially selected. This resulted in 2 additional articles. The forward search (i.e. articles having cited the initially retrieved articles) was conducted using the Web of Science search engine. The forward search returned 3 additional articles. The backward and forward searches were not confined to the journals previously selected. However the articles retrieved from them were published largely in the initial set of journals, with two additional journals, as shown in Table 2. In total, the review therefore contains 24 articles.

Classification of articles: The final list of articles is presented in Appendices B and C. We find that the articles covered the following aspects of the phenomenon of stress: **Technology environmental conditions, Techno-stressors, Coping Behaviors, and Outcomes.** Some of the articles covered additional aspects such as the moderators of the stressor-outcome relationship. We recorded all the contributions for each paper under

appropriate labels. At the end of this step we produced two tables – Appendix C and Table 1 of the paper. The first tabulates each paper and identifies/checks the concept(s) that it covers. The second tabulates and describes each concept, as it emerged collectively from the papers in our corpus that covered it.

Appendix B: Methods for Literature Review: Papers Removed After Initial Screening

Reasons for removal	Articles removed	Articles* removed
Articles containing a keyword used in a different meaning (E.g., verb "to stress", "electronic survey"…)	IS: (Abrahamsson, Conboy, & Xiaofeng Wang, 2009), (Almklov, Østerlie, & Haavik, 2014), (Anderson, 2002), (Baskerville, 2009), (Baskerville, 2012), (Bergman, Lyytinen, & Mark, 2007), (Besanko, Dranove, & Shanley, 2001), (Ceccagnoli, Forman, Huang, & Wu, 2012), (D. G. Wastell, 1999) (D. Wastell & White, 2010), (Daning Hu, Zhao, Zhimin Hua, & Wong, 2012), (Desouza, 2003) (El Sawy, Malhotra, YoungKi Park, & Pavlou, 2010), (Elitzur & Wensley, 1997), (Elliot, 2011), (Garcia, Renault, & Tsafack, 2007), (Glasserman & Wang, 2011), (Gupta & Srinivasan, 1998) (Hong & Pavlou, 2014), (Hsu, Chu, Lin, & Lo, 2014), (Hutton, Danling, & Kumar, 2015), (Karim, 2009) (Kettinger & Yuan Li, 2010), (Kuntz, Mennicken, & Scholtes, 2015), (Ma, 2010), (Mamani, Chick, & Simchi-Levi, 2013), (Marlei MP Pozzebon & Eric Ev van Heck, 2006), (Matook, Cummings, & Bala, 2015), (Moynihan, 2002), (Mumford, 2006a), (Mumford, 2006b), (Otim, Dow, Grover, & Wong, 2012) (Paul, 2007), (Pavlou & Fygenson, 2006), (Puri, 2007) (Riemer & Johnston, 2014), (Scherer, Wünderlich, & von Wangenheim, 2015), (Schipper, 2015) (Schultze, 2012), (Sias, Turtle, & Zykaj, 2016), (Sterman & Repenning, 1997), (Straub, 2008), (Theodora Ngosi & Ashley Braganza, 2009), (Thiesse, 2007), (Tractinsky & Jarvenpaa, 1995), (Von Hippel & Katz, 2002), (Weber, 2004), (Westrup, 2012), (Xiao-Bai Li & Sarkar, 2014), (Yamin & Gavious, 2013), (Yang, Birge, & Parker, 2015), (Younghwa Lee & Larsen, 2009)	IS: 52
	OB: (Huff, 2001), (Mantovani, 1995), (Marino, Aversa, Mesquita, & Anand, 2015), (Mutch, 2010), (Peters & Heusinkveld, 2010), (Toh & Kim, 2013), (Rosenkopf & Padula, 2008)	OB: 7
	Stress: (Kotsou, Nelis, Grégoire, & Mikolajczak, 2011), (Rodríguez-Sánchez, Schaufeli, Salanova, Cifre, & Sonnenschein, 2011), (Saxberg, 2003), (Sonnenschein, Sorbi, van Doornen, Schaufeli, & Maas, 2007)	Stress: 4
		Total: 63

Editorials	IS: (Anonymous, 2011), (Anonymous, 2009), (Gorman, 2011), (Gorman, 2012), (Gorman, 2015), (Straub & Welke, 1998), (Tarafdar, Gupta, & Turel, 2013), (Tarafdar, Gupta, & Turel, 2015)	IS: 8
	OB: (Anonymous, 1999)	OB: 1
	Stress: (DeLeon, Brown, & Kupchella, 2003), (Levy-Leboyer, 2003)	Stress: 2
		Total: 11
Articles researching stress experienced by professionals but not due to use of IS (E.g., stress due to difficult working hours and schedules)	IS: (Ahuja, Chudoba, Kacmar, McKnight, & George, 2007), (Benamati & Lederer, 2001), (Chilton, Hardgrave, & Armstrong, 2005), (King & Sethi, 1997), (Moore, 2000), (Allen, Armstrong, Reid, & Riemenschneider, 2008), (Armstrong, Riemenschneider, Allen, & Reid, 2007), (Benamati & Lederer, 1997), (LeRouge, Nelson, & Blanton, 2006)	IS: 9
		OB: 0
	Stress: (Morimoto & Shimada, 2015), (Innstrand, Langballe, & Falkum, 2010), (Innstrand, Langballe, & Falkum, 2012), (Innstrand, Langballe, Espnes, Falkum, & Aasland, 2008), (Mantler, Matejicek, Matheson, & Anisman, 2005), (Mauno, Kinnunen, & Ruokolainen, 2006), (Morimoto & Shimada, 2015), (Stewart & Barling, 1996), (Syrek, Apostel, & Antoni, 2013), (Van de Ven, van den Tooren, & Vlerick, 2013)	Stress: 10
		Total: 19
Articles without organizational contexts (E.g., use of personal social networks by teenagers)	IS: (Chesney, Coyne, Logan, & Madden, 2009), (Jones, Ravid, & Rafaeli, 2004), (Maier, Laumer, Weinert, & Weitzel, 2015), (Majchrzak, 2009), (Moody & Galletta, 2015), (Ridings & Wasko, 2010), (Zahedi, Abbasi, & Yan Chen, 2015), (H. Lin, Fan, & Chau, 2014), (T.-C. Lin, Hsu, Cheng, & Chiu, 2015), (Tu, Turel, Yuan, & Archer, 2015)	IS: 10
		OB: 0
	Stress: (Giuseffi et al., 2011), (Markman & Medin, 1995), (Villani, Riva, & Riva, 2007)	Stress: 3
		Total: 13
Articles that were not about technology and thus not about technostress (E.g., telework stress unrelated to technology)	IS: (Dahl, 2011), (Goh, Pfeffer, & Zenios, 2016), (Kocher, Lenz, & Sutter, 2012)	IS: 3
	OB: (Elsbach & Hargadon, 2006), (Ilies, Wilson, & Wagner, 2009), (Leslie, Park, Mehng, & Manchester, 2012), (Purser & Park, 1995), (Tietze & Musson, 2005)	OB: 5
	Stress: (Biggs, Brough, & Barbour, 2014), (Gajendran & Harrison, 2007), (Gan, Gan, Chen, Miao, & Zhang, 2015), (Greenberg, Ashton-James, & Ashkanasy, 2007), (Hammer, Kossek, Bodner, & Crain, 2013), (Hornung, Rousseau, & Glaser, 2008), (Kristensen, 1996), (Lapierre & Allen, 2006), (Lundberg & Lindfors, 2002), (Peeters, de Jonge, Janssen, & van der Linden, 2004), (Sonnentag, Binnewies, & Mojza, 2008), (Zeitlin, 1995)	Stress: 12

		Total: 20
Articles that were not about technostress despite the use of keywords (E.g., technology impact on sleep quality)	IS: (Atkinson, Guetz, & Wein, 2009), (Compeau, Higgins, & Huff, 1999), (Elie-Dit-Cosaque & Straub, 2011), (George, 1996), (Herath et al., 2014), (Kautz, Madsen, & Nørbjerg, 2007), (Liang & Xue, 2009), (Nunamaker Jr., Derrick, Elkins, Burgoon, & Patton, 2011), (Ortiz de Guinea & Webster, 2013), (Ren, Kiesler, & Fussell, 2008), (Stein, Newell, Wagner, & Galliers, 2015), (Street & Meister, 2004), (Sykes, Venkatesh, & Gosain, 2009), (Xiang Fang, Benamati, & Lederer, 2011)	IS: 14
	OB: (Collin-Jacques & Smith, 2005)	OB: 1
	Stress: (Alpass et al., 2004), (Barber & Jenkins, 2014), (Dalbokova, Tzenova, & Ognjanova, 1995), (Dollard, Skinner, Tuckey, & Bailey, 2007), (Giumetti et al., 2013), (Greiner, Ragland, Krause, Syme, & Fisher, 1997), (Griffiths, 2002), (Lundberg, 2015), (Paškvan, Kubicek, Prem, & Korunka, 2015)	Stress: 9
		Total: 24
	96 IS articles rejected out of 107, leaving **11 IS articles** 14 OB articles rejected out of 15, leaving **1 OB article** 40 Stress articles rejected out of 47, leaving **7 Stress articles** **In total, 150 articles rejected out of 169, leaving 19 articles**	

*Note: The full list of references of removed articles is available from the authors.

Appendix C: Corpus of Papers Reviewed

Authors	Technology Environmental conditions	Techno-Stressors	Coping Behaviors	Outcomes	Moderators of the of the techno-stressor-outcome relationship
Aiello and Kolb, 1995				X	
Ayyagari et al., 2011	X			X	
Barber & Santuzzi, 2015		X		X	
Barley et al., 2011		X		X	
Beaudry & Pinsonneault, 2005			X		
Brown et al., 2014				X	
Chen et al., 2009		X		X	
D'Arcy et al., 2014		X	X	X	
Day et al., 2012		X		X	
Fuglseth and Sørebø, 2014				X	
Galluch et al., 2015	X	X		X	X
Korunka & Vitouch, 1999		X		X	
Maier et al., 2014		X		X	
Ragu-Nathan et al., 2008				X	
Reinke and Chamorro-Premuzic, 2014		X		X	
Soucek & Moser, 2010				X	X
Sprigg & Jackson, 2006		X		X	
Srivastava et al., 2015				X	X
Sykes, 2015				X	
Tams et al., 2014				X	
Tarafdar et al., 2007		X		X	
Tarafdar et al., 2010		X		X	
Tarafdar et al., 2015					X
Yan et al 2013				X	

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