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Affective Responses to Technology Use: Examining the Dark Side, Exploring the Bright Side

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AFFECTIVE RESPONSES TO TECHNOLOGY USE:

EXAMINING THE DARK SIDE, EXPLORING THE BRIGHT SIDE

A Dissertation Presented

by

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DEDICATION

To the memory of my father, I.D Agogo the first. You believed in the value of faith in God, integrity, and hard work. You inspire me, even from the other side of heaven.

To my wife, Andrea. You have been a phenomenal friend and life partner. You are my secret weapon, my *-mancy* and my *philia*. There is only a bright side with you.

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ABSTRACT

AFFECTIVE RESPONSES TO TECHNOLOGY USE:

EXAMINING THE DARK SIDE, EXPLORING THE BRIGHT SIDE

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The study of individual, affect-related consequences from technology adoption and use is gaining traction in the information systems (IS) discipline. Efforts to explore affective reactions to technology have considered various positive, affective constructs (e.g., enjoyment, computer playfulness, and flow), with a more recent focus on the dark side of technology use and constructs such as technostress, technophobia, and computer anxiety. While some research has examined these negative affective responses to technology, construct definitions and relationships are not well-defined or theoretically grounded. A recent theoretical advance in IS, the Affective Response Model (ARM) categorizes affective responses to technology based on five dimensions. This three-paper dissertation explores negative affective responses to technology by (1) synthesizing the IS literature through the application of ARM, (2) proposing new affective concepts, and (3) theorizing about and testing the relationships between relevant antecedents and outcomes of these affective responses.

In paper one, an integrative literature review is conducted on computer anxiety, technophobia and technostress, the main negative affective concepts in the IS literature. The known antecedents, dimensions, and outcomes of each concept are organized into nomological networks. These nomological networks are then combined to identify inconsistencies and omissions in the literature. Further, the ARM taxonomy is applied to differentiate the three constructs and to introduce technology-induced state anxiety (TISA), a new temporal (state-like) negative response to a specific instance of technology. Two empirical studies are conducted using existing and newly developed scales, and demonstrate that computer anxiety, technophobia, technostress and TISA are conceptually and empirically distinct, laying a foundation for further exploration of how these constructs are related.

In paper two, much of the integrated nomological network from paper one is tested in the context of a laboratory experiment with a spreadsheet application. The relationship between computer anxiety, technostress and TISA is explored in more depth with the mediating influence of technostress on TISA proposed and confirmed. ARM is further extended in two ways (1) by demonstrating the impact of the characteristics of the task/organizational context, a new category of antecedents identified from paper one, and (2) connecting affective responses to computing performance outcomes (e.g. satisfaction with performance, expected future performance, and an objective measure of task accuracy). Finally, this paper concludes by evaluating how the relationship between antecedents, affective responses and performance outcomes may change with system experience. The laboratory experiment is repeated after six weeks of regular system usage to test whether the strong influence of TISA observed at time 1 diminishes as expected.

In paper 3, the research model from paper 2 is expanded by integrating positive affective concepts. It is known that positive and negative concepts are distinct and individuals can experience high levels of both positive and negative affect at the same time. Therefore, ARM is

further extended by demonstrating the practical and theoretical importance of considering both positive and negative affective responses. This paper explores the domain of a less structured creative task, employing a laboratory experiment in which participants design a flyer. Computer anxiety, technostress and TISA are measured alongside enjoyment, and two newly proposed concepts, technomancy and computer enthusiasm. The unique impact of these positive and negative affective responses on performance outcomes is demonstrated. Lastly, the intervention effect of a positive mood is evaluated experimentally. Participants in a positive mood prior to working on the design task experienced more enjoyment. Those assigned a more difficult task and a less usable technology also experienced less TISA due to being in positive mood state. Positive mood also had a helpful indirect effect on performance outcomes.

The findings from the three dissertation papers have important theoretical and practical implications. A major IS theoretical framework is meaningfully applied to negative affective concepts and extended. Second, this work offers more detailed explanation of what antecedents influence certain affective concepts more, building on the omnibus and reciprocal propositions in ARM. Third, this work formally connects affective responses to computing performance outcomes. Lastly, the added benefit of considering positive concepts side-by-side with negative concepts is demonstrated. Focusing on the dark side alone is both theoretically incomplete and practically misleading.

There are also important implications for practitioners. It is shown that minimizing TISA is especially critical in the early stages of using a system, as TISA is the affective concept driving performance outcomes the most at that time. This idea holds true for both structured computing tasks and less structured, creative tasks. Also, establishing a positive mood prior to engaging with the system heightens the enjoyment experienced and reduces TISA under very challenging situations, for instance when the technology is less usable and task requirements are high. This

finding confirms that a positive mood can be a positive balancing force to negative affect,

indirectly preserving performance outcomes. Finally, the concluding chapter of this dissertation

discusses several future research directions that build on this work.

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CHAPTER 1

INTRODUCTION

The Importance of Affect in IS Research

As individuals find themselves using various types of information technologies (IT) at work and at home regularly, there is increasing evidence of strong emotional reactions to these systems. While positive responses to technology, such as enjoyment and satisfaction, are well-documented in the literature, (e.g., Bhattacherjee, 2001; Bhattacherjee & Premkumar, 2004; Van der Heijden, 2004; Venkatesh & Bala, 2008), more people report experiencing undesirable, unintended effects on emotions, productivity/performance and even mental health, than ever before (Danziger & Dunkle, 2005; Rosen & Weil, 1997; Tarafdar, Gupta, & Turel, 2013). IS research is now beginning to focus on negative emotional impacts of IT use on individuals, such as computer anxiety, technophobia and technostress (D'Arcy, Gupta, Tarafdar, & Turel, 2014; Tarafdar et al., 2013). This is necessary because emotions are strong determinants of a wide range of outcomes studied in many disciplines, including information systems (IS) research (Zhang, 2013). Yet, little is known about how such emotions, which are forms of *affect*, arise in response to technology and how they shape important technology-related outcomes. This dissertation seeks to address this area of research.

The study of affect, better described as short-lived or drawn out feelings that arise in response to an external stimulus (McCrae & Costa, 1994; Russell, 2003; Scherer, 2005; Zhang, 2013), is a major theoretical division of modern psychology, referred to as the 'A' in the ABCs of psychology (Kassin, Fein, & Markus, 2007). While the field of psychology has accumulated

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extensive understanding about the role and importance of affect, this theory base has not been applied in IS with a few exceptions (e.g., Beaudry & Pinsonneault, 2010; Loiacono & Djamasbi, 2010; Zhang, 2013). For this stream of research to be advanced within IS, appropriate theories relating to affect need to be applied to define important affective responses, identify their antecedents and outcomes, and design interventions where necessary.

Three broad gaps exist in the research on affective concepts and technology use. The first fundamental gap is the absence of conceptual clarity between technostress, technophobia and computer anxiety, three main negative affective concepts in the IS literature. These concepts have neither been theoretically distinguished nor empirically tested side-by-side, and have even been said to be interchangeable in the literature (Chua, Chen, & Wong, 1999; Rosen & Maguire, 1990; Tu, Wang, & Shu, 2005; Weil, Rosen, & Sears, 1987). Researchers have also expressed concerns with how these concepts are measured (Fuglseth & Sørebø, 2014; Riedl, 2012; Zhang, 2013). A second critical gap addressed by this dissertation is the absence of theory and empirical work that connects affective responses to important performance outcomes. While individual, technology-related performance outcomes are important to organizations, this area of research has received relatively little attention in comparison to research on technology adoption (Burton-Jones, 2005; Orlikowski, 2000). Further, there is little research connecting affect to important and interesting aspects of performance (e.g. objective measures of performance, generally competent IS performance, creative performance with technology, etc.). Finally, little or no attention has been directed at deriving and testing interventions to preserve or boost technology-based performance. Therefore, this work uses theories and concepts from the affective domain to address these gaps.

Following from this motivation, the following broad research questions drive this dissertation.

1. How are computer anxiety, technophobia and technostress conceptually distinct? How are they related to each other?

2. What are the similarities and differences in the studied antecedents and outcomes of these concepts based on existing IS (and related) literature? What gaps exist?

3. Which of these affective responses are more likely to influence different computing performance outcomes, and why?

4. Can inducing a positive mood be an effective intervention for boosting technology-based performance outcomes?

One recent seminal paper on affective concepts in IS provides a theoretical foundation for much of this dissertation. The Affective Response Model (ARM; Zhang, 2013) is a theoretical framework for the study of affect that takes on the significant task of condensing decades of psychology research on affect into an integrated framework. ARM posits a taxonomy of five dimensions along which computer anxiety, technophobia and technostress can be defined and differentiated. ARM also specifies relationships between different categories of affective concepts based on emerging consensus in the psychology literature, making it possible to explain how these three affective concepts are related. However, because ARM does not link affective concepts to cognitions, intentions, or behavior (Zhang, 2013), theoretical support from the Reflective-Impulsive Model (RIM; Strack & Deutsch, 2004) is applied to explain these relationships. ARM will be used to differentiate affective concepts and propose new ones while both ARM and RIM will provide theoretical justification for how and why certain affective concepts influence outcomes of interest.

In this dissertation, inducing a positive mood is chosen as the intervention (R4) to be evaluated for several reasons. First, prior work in IS has identified the importance of mood to various aspects of technology use (Ang, Cummings, Straub, & Earley, 1993; Loiacono & Djamasbi, 2010, 2010; Venkatesh & Speier, 1999; Zhang, 2013) so this work continues in that tradition. Further, being an emotional state, mood is more fickle (Russell, 2003; Scherer, 2005; Zhang, 2013) and lends itself more easily to manipulation in the laboratory compared to other individual characteristics. More importantly, demonstrating the impact of a positive mood on performance outcomes lays a foundation for future research into more interventions based on other categories of antecedents.

Organization of Dissertation

This dissertation consists of a sequence of three papers. Each paper includes an introduction, a review of important literature, a discussion of findings and suggestions for future research. The first paper is a literature review paper which applies theory to organize the research domain of affective responses to IT. New scales are also developed and validated. The second and third papers are empirical research papers which report experimental studies conducted to evaluate specific hypotheses. The research model and hypotheses for these papers are based on the theoretical foundation provided in paper one. This dissertation then concludes with a chapter that summarizes some of the major contributions from each paper and discusses future research opportunities and questions raised from the three papers.

Paper One (Chapter Two)

In paper one, a literature review of computer anxiety, technophobia, and technostress was conducted to understand how these constructs were similar or distinct and to identify their antecedents and outcomes from past research. Over 1,500 research publications from high quality IS journals and reverse cited papers which mentioned computer anxiety, technophobia, or technostress were identified. Of these, 179 were found to include relevant content and were reviewed. Commonalities in the antecedents and outcomes of these concepts were evaluated.

Computer anxiety is commonly defined as the tendency of individuals to be uneasy, apprehensive, or fearful about current or future use of computers (Simonson, Maurer, Montag-Torardi, & Whitaker, 1987; Parasuraman & Igbaria, 1990; Venkatesh, 2000), and has garnered the most empirical treatment in IS research. The most common category of antecedents to computer anxiety studied were individual characteristics. In addition, the most common outcomes of computer anxiety were cognitive evaluations with no work evaluating the impact of computer anxiety on actual performance. Technophobia refers to an extreme fear of computers marked by resistance to talking or even thinking about computers, or hostile and aggressive thoughts about computers (Brosnan, 2002; Jay, 1981). Technophobia was found bereft of appropriate measurement and empirical work connecting it to antecedents and outcomes. Technostress is an inability to cope with the use of a specific computer technology in a healthy manner (Ayyagari, Grover, & Purvis, 2011; Brod, 1984; Ragu-Nathan, Tarafdar, Ragu-Nathan, & Tu, 2008; Riedl, 2012). This concept was the last negative affective concept to emerge and is commonly studied in the context of work technologies. The prime antecedents of technostress in the

literature are (perceptions of) technology characteristics and organizational characteristics. However, there are issues with how technostress is currently measured and this constitutes a potential barrier to more systematic study of the concept. The most common outcomes of technostress have been role-based outcomes and this concept is also yet to be connected to objective performance outcomes of interest to managers. Individual nomological networks for these three affective constructs are first developed, followed by an integrated nomological network including all three constructs.

After completing the literature review and observing some level of consensus in the definitions of computer anxiety, technophobia and technostress, the dimensions specified in the ARM taxonomy were used to distinguish these concepts. According to ARM, affective concepts can be defined along five dimensions – *residing* (within person, within stimulus, or between person and stimulus)*, temporal nature* (temporally constrained or temporally unconstrained)*, stimulus specificity* (particular or general stimulus)*, whether the stimulus is an *object or behavior,* and whether it is a *process-based or outcome based* evaluation. Consistent with ARM, computer anxiety retains its classification as a response *residing* between a person and a stimulus, being *temporally unconstrained* (i.e. drawn out), caused by a *general* stimulus (i.e. computers in general), and related to *behavior* (i.e. using a computer). Technophobia, on the other hand, while similar to computer anxiety in the first three dimensions above (*residing* between a person and a stimulus, *temporally unconstrained*, and caused by a *general* stimulus) is typically related to an *object* (i.e. the physical computer itself). This is consistent with the suggested treatment of technophobia as a 'specific phobia' such as claustrophobia (fear of small spaces) or arachnophobia (fear of spiders). Finally, technostress is specified as *residing* between the person

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and stimulus, being *temporally unconstrained* (i.e. drawn out), and being tied to *outcomes-based* evaluations that result from *using* (i.e. behavior) a *particular* technology (e.g. word-processing software). This categorization of technostress as temporally unconstrained is consistent with the treatment of technostress as an affective evaluation that persists over time and presents an ongoing challenge in the workplace, a notion reflected in the common definitions of technostress used by IS researchers. Further, research on technostress tends to reference specific software applications and researchers commonly prime survey participants with specific technologies that are then referenced within the survey measures used.

Another benefit of applying ARM is that it helps identify new affective concepts to fill important gaps in the current nomological network. For instance, there is no existing concept to represent the *temporally constrained* (i.e. short-lived) affective response that occurs during episodes of technology use. ARM refers to this category of affective concepts as *induced affective states.* This work proposes technology induced state anxiety (TISA) to fill this gap. The concept of TISA also helps clarify the common misrepresentation of computer anxiety as a state variable, and is shown to be the negative matching concept to enjoyment, a known positive affective state that occurs during technology use. Other newly proposed affective concepts include technomancy, technophilia and computer enthusiasm. In addition, the concept of affective fit (Avital & Te'eni, 2006, 2009; Zhang & Galletta, 2006)is classified within ARM.

Finally, this paper addresses noted challenges with the measurement of these affective concepts. A scale development and validation exercise is undertaken with two different studies, (1) a survey of a working population, and (2) a laboratory experiment with student participants. New measures

are shown to be appropriately discriminant and a foundation is laid for using these scales to test

empirical relationships in the two subsequent papers.

Paper Two (Chapter Three)

In the second paper, our current understanding of these affective concepts is explored in more

detail. First, the relationship between affective constructs is considered more closely. Second, the

question of which antecedents are more likely to influence each affective construct is also

considered. Third, the link between affective responses to technology and performance outcomes

is addressed. Fourth, the moderating effect of system experience on the relationships between

antecedents, affective concepts, and outcomes is studied.

ARM proposes omnibus and reciprocal relationships between all affective constructs, however,

this is of limited practical value. Two dimensions of ARM are used to focus the study of the

relationships between affective concepts. The temporal nature of the affective response to

technology (temporally constrained or unconstrained) and specificity of the stimulus (specific or

general stimulus) are therefore applied to identify an appropriate focal point. The temporally

constrained use of a specific technology, also referred to as the IT performance episode (Zhang,

2013; Beal et al, 2005), is selected as the unit of analysis based on which directed relationships

between affective concepts are proposed. Finally, additional theory is integrated to describe the

two-systems involved in the processing of different categories of affect and how they lead to

behavior and performance outcomes. The Reflective-Impulsive Model (RIM; Strack & Deutsch,

2004) postulates that two general processing systems, a cognitions-governed *reflective* system

and an automatic *impulsive* system, are accountable for processing different affective responses. This theory also explains how additional system experience might moderate important relationships. Based on these theoretical foundations, testable hypotheses are proposed.

A 2 x 2 laboratory experiment is conducted to test the research hypotheses in this chapter. Two task characteristics are manipulated. They are task complexity (low and high) and task time pressure (low and high). Other important antecedents are measured. Participants were randomly assigned to treatments and were asked to complete a computing task using SimNet, a simulation of Microsoft's spreadsheet application, and the effect of the manipulations and measured antecedents on TISA and performance outcomes were assessed. The resulting impact on both perceptual and objective outcomes were tested. Perceptual outcomes included the individual's satisfaction with their performance and future performance expectations of performing well with that technology. The objective outcome evaluated was task accuracy which was recorded by SimNet. The laboratory experiment is repeated after six weeks to test hypotheses about the moderating influence of added system experience.

Two important issues this paper does not address pertain to the influence of positive affective concepts and the question of possible interventions to limit the adverse influence of negative affective responses to technology. The third and final paper of this dissertation seeks to do that by taking a balanced view, testing positive and negative affective responses to technology side-by-side and manipulating mood state prior to the performance episode as an intervention.

Paper Three (Chapter Four)

The third paper of this dissertation serves to test several of the principal ideas from paper two in a different computing context – that of an less structured, creative design task. In addition, this paper broadens the nomological network of affective responses to technology by testing both negative and positive affective concepts which are complementary to each other, at the same time. It is well known that positive and negative affective concepts are relatively independent dimensions and individuals can experience high levels of both positive and negative affect at the same time (Huppert & Whittington, 2003; Warr, Barter, & Brownbridge, 1983; Watson, Clark, & Tellegen, 1988). Yet, only a handful of IS papers have considered both positive and negative concepts together (Beaudry & Pinsonneault, 2010), and none of these have considered complementary concepts of both valences at the same time. Computer enthusiasm, technomancy and enjoyment, the complementary positive affective concepts comparable to computer anxiety, technostress and TISA, are measured and evaluated in an expansion of the research model from paper 2.

To test the research hypotheses, a 2 x 2 x 2 laboratory experiment is conducted in which participants are asked to design a flyer, a less structured and more creative task than the one conducted in paper 2. Experimental manipulations included the technology assigned (low vs high usability), the task requirements (high vs low), and the mood state of participants prior to completing the task (neutral vs happy mood state). The manipulation of mood serves to test whether a positive mood serves as a simple intervention to limit the influence of negative affective responses to technology.

Both perceptual performance outcomes from paper 2 are measured again in this paper (i.e. satisfaction with performance and future expected performance).

Concluding Chapter

In the final chapter of this dissertation, there is a discussion of the findings from all three chapters and a presentation of the complete range of theoretical and practical contributions of this dissertation. Also, future directions in which this research program may be extended are proposed.

CHAPTER 2

"HOW DOES TECH MAKE YOU FEEL?" A REVIEW AND EXAMINATION OF

NEGATIVE AFFECTIVE RESPONSES TO TECHNOLOGY USE

<u>Introduction</u>

The study of affective concepts has recently become mainstream in the Information Systems (IS) discipline, with a growing number of journal articles and special issues examining affective responses to technology (e.g., Djamasbi, 2007; Djamasbi & Strong, 2008; Djamasbi, Strong, & Dishaw, 2010; Loiacono & Djamasbi, 2010; Tarafdar, Gupta, & Turel, 2013). This interest in feelings towards IT artifacts is welcome given that feelings are now considered important factors in many research areas such as behavioral economics (Kahneman, 2003), financial decision-making (Lucey & Dowling, 2005), organizational studies (McGrath, 2006) and human resource management (Ashkanasy & Daus, 2002). For decades, IS researchers focused primarily on the efficiency and effectiveness evaluations of technology (e.g. perceived ease of use, perceived usefulness) and individual characteristics (e.g. innovativeness, computer self-efficacy) as drivers of adoption. But as technology pervades both our work and personal lives, an understanding of the role of affect is critical. Affective responses to technology, such as enjoyment, satisfaction and computer playfulness have been studied (e.g., Agarwal & Prasad, 1998; Beaudry & Pinsonneault, 2010; Van der Heijden, 2004), and more recently, negative affective constructs or "dark side" variables are being examined (Tarafdar et al., 2013). Research on the "dark side" of technology use has focused on technostress (e.g., Ayyagari, Grover, & Purvis, 2011; Ragu-

Nathan, Tarafdar, Ragu-Nathan, & Tu, 2008; Riedl, 2012), computer anxiety (e.g., Compeau & Higgins, 1995b; Igbaria & Parasuraman, 1989; Thatcher & Perrewe, 2002), technophobia (e.g., Brosnan, 1999, 2002; Weil & Rosen, 1995), and even technology-related addiction (e.g., Turel, Serenko, & Giles, 2011). However, much remains to be learned about negative responses to technology and the effect on technology-related evaluations and performance (Riedl, 2012; Tams, 2015; Tarafdar et al., 2013).

Despite the growing interest in these negative affective responses to technology, there is a lack of conceptual clarity amongst the negative affective concepts that exist in the literature. Early research on these concepts acknowledges this ambiguity, stating that "*whether we call it 'computer anxiety,' 'technostress,' or 'computerphobia,' all estimates indicate that as many as one out of three adults suffers from aversive reactions to computers and computer-related technology*" (Weil, Rosen, & Sears, 1987, p. 180). IS research on these concepts is also being advanced from different perspectives, including social cognitive theory (Compeau & Higgins, 1995a, 1995b; Marakas, Yi, & Johnson, 1998), transaction-based models of stress (Ragu-Nathan et al., 2008; Tarafdar, Tu, & Ragu-Nathan, 2010), person-environment models of work strain (Ayyagari et al., 2011), and physiological responses (Fischer & Riedl, 2015; Riedl, Kindermann, Auinger, & Javor, 2012), with recent work describing the current state as atheoretical and lacking integration (Tams, 2015). Theoretical grounding and integration of the existing literature is essential to the progress of research (Gregor, 2006; Rivard, 2014). Further, insufficient understanding of the concepts becomes a barrier to developing interventions that may reduce negative affect toward technology – an area largely ignored in IS research (Pirkkalainen & Salo, 2016). No known study has examined more than one of these negative affective responses to

technology, and there is limited research on the process through which these negative responses may affect IS outcomes, such as IS use, resistance, and performance.

The following research questions guide this examination of negative affective responses to technology:

1. How are computer anxiety, technophobia and technostress conceptually distinct?
2. What are the similarities and differences in the studied antecedents and outcomes of these concepts based on existing IS (and related) literature? What gaps exist?
3. How are computer anxiety, technophobia and technostress related to one another and to other affective concepts?

In this chapter, a review of the literature on computer anxiety, technophobia, and technostress is conducted, including the antecedents and outcomes related to these negative affective responses to technology. Nomological networks are developed for each construct based on the existing literature, and then integrated to create a combined nomological network. A recently developed IS framework, the Affective Response Model (ARM) (Zhang, 2013), provides timely theoretical grounding for studying these affective responses to IS. ARM, based on the psychology literature, was advanced to foster consensus on the meanings and structures of IS affect-related phenomena. ARM provides a taxonomy based on five dimensions: *residing, temporal nature, particular vs. general stimulus, object vs. behavior stimulus, and process-based vs. outcome based evaluations* (Zhang, 2013). In this paper, the ARM framework is applied to the three 'dark side' variables to better define and describe how these constructs are related. Further, gaps and inconsistencies in the integrated nomological network are identified, including a new affective response to

technology, the technology-induced state anxiety construct (TISA), which may better explain the process through which affect influences technology-related outcomes.

Two empirical studies are conducted to assess construct validity and the relationships among these constructs. Existing scales are used and new scales developed (i.e., technophobia, TISA, and a reflective measure of technostress) to better measure and validate these negative affective constructs. The first empirical study surveys users of office productivity tools, enterprise systems, and other systems. A second study employs an experimental context with different software and two levels of task requirements to further assess the discriminant validity of computer anxiety, technostress, technophobia, and the proposed construct TISA.

In the following sections, the literature review is first described and nomological networks for the three existing constructs are presented. The ARM framework is then introduced and applied to differentiate these constructs, generate research propositions, and to suggest a new negative affective construct, TISA. Next, the research design and results of the empirical studies are reported. Finally, theoretical and practical implications are described and future research opportunities are presented.

Literature Review

Because the modern workplace is flooded with technology, people have little choice whether or not to use it (Venkatesh, 2000). Whereas several decades ago individuals could opt to avoid technology when they felt apprehensive about it, that option barely exists today. This mandatory use of technology underscores why it is so important to better understand the negative emotional

experiences associated with frequent, on-going use of technology. This objective is addressed by reviewing the literature on the three, primary negative affective concepts in the IS literature – computer anxiety, technophobia and technostress.

Methodology

The methodology for conducting this literature review was informed by guidelines suggested by Levy & Ellis (2006). The primary source of articles was high quality, peer-reviewed IS research journals as identified through the AIS Senior Scholars Consortium (2011) and ranking studies of IS journals (e.g., Lowry, Romans, & Curtis, 2004). A total of 14 journals, listed in Table 1, were searched for all articles[1] that contained the words 'stress', 'anxiety' and 'phobia' anywhere within the article. Given the somewhat common usage of the first two terms, the initial search resulted in 1,542 research publications. This breadth was deemed appropriate given that the objective was to identify as many unique definitions, antecedents, outcomes and source theories for these concepts as possible. Subsequently, by reviewing the titles and abstracts of the 1,542 papers, a subset of 190 were deemed to be potentially relevant and selected for closer review. Within this subset, papers in which either computer anxiety, technostress, or technophobia were conceptualized or measured as part of the research model were reviewed in detail. Reverse citations were used to find additional articles from other IS journals that addressed these concepts. Technophobia was

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[1] Published before July, 2014

not as commonly mentioned in the IS literature as the other two constructs, thus reverse citations were carried out to find articles and books outside of the IS discipline that referenced this concept. Relevant research emerged mostly from the psychology literature.

Table 1: List of Journals Searched and Publications retrieved

Years Searched	Journal Title	Search Results	Potentially Relevant
1969 - 2014	ACM SIGMIS Database	20	6
1992 - 2014	Decision Support Systems	351	22
1972 - 2014	Decisions Sciences	62	11
1991 - 2014	European Journal of Information Systems	161	7
1963 - 2014	IEEE Transactions on Engineering Management	37	5
1989 – 2014	Information & Management	30	11
1991 - 2014	Information & Organization *	114	22
1997 - 2014	Information Systems Journal	167	16
1990 - 2014	Information Systems Research	125	29
1986 - 2014	Journal of Information Technology	161	8
1984 - 2014	Journal of Management Information Systems	12	10
1995 - 2014	Journal of Strategic Information Systems	108	9
2000 - 2014	Journal of the Association for Information Systems	80	7
1977 - 2014	MIS Quarterly	114	27
1963 - 2014	Total	1542	190

* Titled Accounting, Management and Information Technologies from 1991-2000.

The Computer Anxiety, Technophobia and Technostress Overlap

Nearly twenty years after the United States Census Bureau ordered the first commercial computer produced in the US, a wide range of attitudes toward computers was documented in a national survey (R. S. Lee, 1970). Dominant attitudes toward computers were found to reflect one of two perspectives: the computer as a helpful instrument of man's purposes, or the computer as a relatively autonomous entity (i.e., invoking awe and a sense of inferiority). Despite researchers of

that period resisting the temptation to label these attitudes as positive and negative, there emerged a class of 'negative concepts' to describe the experience of interacting with computers. These concepts extend beyond attitudes to describe negative feelings associated with technology use. The main ones, in chronological order of first appearance in the literature, are computer anxiety (Masters, 1967), technophobia (Paschen & Gresser, 1974) and technostress (Brod, 1982). Other negative, affective constructs referenced in the IS literature (e.g., technology addiction, computer-mediated communication anxiety) are excluded from this review as those constructs are viewed as a mode of usage behavior rather than an affective evaluation, or are a specific form of computer anxiety.

The popularization of these terms can be partially ascribed to books by psychologists Brod (1984), Rosen and Weil (1997), and Brosnan (2002) which have laid the foundation for many IS research studies in this area. In breaking new ground, these authors and others commonly describe the spectrum of responses to technology using various terms interchangeably, without clearly distinguishing them or explaining how they are related (Chua, Chen, & Wong, 1999; Rosen & Maguire, 1990; Tu, Wang, & Shu, 2005). Brod states that *"(computer) anxiety is a symptom of ambivalence, fear or reluctance towards computers*" and "*technostress manifests as a struggle to accept computers*", but does not conceptually connect both phenomena (1984, p. 16). Rosen and Weil acknowledge that "*technophobia … is used to describe a variety of negative reactions to technology*" and then state that the experience of these negative reactions is technostress (1997, p.13). Further, Brosnan unequivocally posits that technophobia is comprised of both computer anxiety and negative computer attitudes (2002). Despite the lack of conceptual clarity, the psychology field is consistent in recognizing the significance of these negative

responses to technology, suggesting that over thirty percent of users have major, aversive

reactions to technology (Weil, Rosen & Sears, 1987. 180). The following sections examine

computer anxiety, technophobia and technostress, in turn, defining them, reviewing the literature

and theory on these constructs, and pointing out areas of agreement and discrepancy in the source

literature.

A. Computer Anxiety

Computer anxiety (CA) is the oldest construct used to capture negative reactions to technology

implementation or use. The earliest recorded use of this term was in the *Journal of Occupational*

and Environmental Medicine where it was suggested as a new diagnosis that captured the

prolonged trauma that employees of a company undergoing computerization tended to experience

(Masters, 1967). In a world without computers there would not be computer anxiety – making the

emergence of this concept correlate strongly with the massive explosion in the number of end

user computing devices. The root word anxiety is an emotion, characterized by feelings of

tension, worried thoughts and physical changes, like increased blood pressure, which may result

in response to a situation or object perceived as threatening (Kazdin, 2000; Weiner & Craighead,

2010). Computers can stimulate CA in the same way social situations stimulate social anxiety and

math problems stimulate math anxiety. Two common definitions of CA are: "*the tendency of*

individuals to be uneasy, apprehensive, or fearful about current or future use of computers"

(Igbaria & Parasuraman, 1989; Simonson, Maurer, Montag-Torardi, & Whitaker, 1987;

Venkatesh, 2000) and "*fears about the implications of computer use such as the loss of important data or fear of other possible mistakes*" (Sievert & Others, 1988; Thatcher & Perrewe, 2002).

Two categories of theories, psychological and sociological, have been used as the foundation for the study of CA, providing slightly different contexts for understanding this concept. The psychological theory commonly applied is social cognitive theory (SCT), or social learning theory (Compeau & Higgins, 1995a, 1995b; Compeau, Higgins, & Huff, 1999; Marakas et al., 1998). SCT views the different behavior of individuals in similar situations as determined by their different appraisals of the environment (see Bandura, 1977 for a review). On the other hand, sociological theories focus on the changing role of the individual within a broader context in which the individual, technology, and the environment are intrinsically woven and interdependent. These sociological theories include Kurt Lewin's field theory (Elie-Dit-Cosaque, Pallud, & Kalika, 2011) and Gidden's social theory of transformation (Barrett & Walsham, 1999). Sociological theories look at CA as a result of technology implementations changing the work environment, while psychological theories view CA as the individual reacting directly to technology use.

Multidimensionality and Measurement

CA was initially conceptualized as a multidimensional construct with dimensions including self-efficacy, computer literacy, arousal, positive beliefs, and negative beliefs (e.g., Beckers & Schmidt, 2001; Chua et al., 1999; Heinssen Jr., Glass, & Knight, 1987). As several dimensions emerged as distinct constructs (e.g., Beckers & Schmidt, 2001), CA was increasingly

conceptualized as unidimensional (e.g., Brown, Fuller, & Vician, 2004; Elie-Dit-Cosaque et al., 2011; Thatcher & Perrewe, 2002; Venkatesh, 2000), and commonly measured with Likert-type scales using items such as *working with IT makes me feel nervous, uncomfortable, uneasy or scared* (e.g., Brown et al., 2004; Elie-Dit-Cosaque et al., 2011; Thatcher & Perrewe, 2002). Physiologic methods have also been used to measure CA, given that anxiety responses are associated with physiological changes. For instance, systolic and diastolic blood pressure, heart rate, and electro dermal response (EDR) have been linked with CA (Powers, 1973), but are not commonly used.

Antecedents and Outcomes

In this section, the antecedents and consequences of CA documented in the literature are described, with summaries provided in Table 2 and in the nomological network shown in Figure 1. Within Table 2, support for the relationships that have not been empirically is noted as "C" for conceptual, or "E" if the relationship has been empirically tested based on the studies reviewed. The relationships that have been tested were examined in a piece meal manner rather than within a single study or paper. Antecedents are first discussed and are organized by the general categories of (1) individual characteristics, (2) organizational/environment characteristics, and (3) technology characteristics. Outcomes are organized by the categories of (1) behavior, (2) evaluations & perceptions, and (3) other affective concepts.

Individual characteristics (antecedent): From a psychological perspective, CA is

conceptualized as a dynamic, IT-specific individual difference (Thatcher & Perrewe, 2002),

which can be influenced by other individual differences often referred to as internal forces (Elie-

Dit-Cosaqu, Pallud, Kalika (2011). CA is positively related to other forms of negative affect,

including stable traits and dynamic attributes such as *trait anxiety* (Thatcher & Perrewe, 2002)

and *negative affectivity* (Thatcher & Perrewe, 2002). Forms of positive affect have negative

relationships with CA, including *computer playfulness* (Webster & Martocchio, 1992) and

personal innovativeness with technology (Elie-Dit-Cosaque et al., 2011; Thatcher & Perrewe,

2002). Cognitive-processing attributes such as *cognitive style* (Igbaria & Parasuraman, 1989) and

computer self-efficacy (Compeau & Higgins, 1995b; Compeau et al., 1999; Thatcher, Zimmer,

Gundlach, & McKnight, 2008) are known to negatively influence CA. Demographic variables

such as *gender and age* may also influence CA with females and older users reporting greater CA

(Chua et al., 1999; Elie-Dit-Cosaque et al., 2011; Igbaria & Chakrabarti, 1990; Igbaria &

Parasuraman, 1989). Other individual characteristics tested as antecedents of CA include

education level (Igbaria & Parasuraman, 1989), experience (Hackbarth, Grover, & Yi, 2003;

Igbaria & Parasuraman, 1989), locus of control (Igbaria & Parasuraman, 1989), math anxiety

(Howard & Mendelow, 1991; Igbaria & Parasuraman, 1989), and use (Igbaria, Pavri, & Huff,

1989).

Table 2: Computer Anxiety: Published Antecedents and Outcomes

	D	S	Papers
Antecedent: Individual Characteristics			
Trait anxiety	↑	E	Thatcher & Perrewe, 2002
Negative affectivity	↑	E	Thatcher & Perrewe, 2002
Computer Playfulness	↓	E	Webster & Martocchio, 1992
Personal innovativeness w/IT	↓	E	Elie-Dit-Cosaque et al., 2011; Thatcher & Perrewe, 2002
Education	↓	E	Igbaria & Parasuraman, 1989
Math Anxiety	↑	E	Howard & Mendelow, 1991; Igbaria & Parasuraman, 1989
External locus of control	↑	E	Igbaria & Parasuraman, 1989
Computer Self-Efficacy	↓	C E	Marakas et al., 1998; Compeau & Higgins, 1995b; Compeau et al., 1999; Thatcher et al., 2008; Torkzadeh et al., 2006
Cognitive style		E	Igbaria & Parasuraman, 1989
Use	↑	E	Igbaria, Pavri, & Huff, 1989
User experience (organization level), User training	↓	E	Chua et al., 1999; Hackbarth, Grover, & Yi, 2003; Igbaria & Parasuraman, 1989; Igbaria, 1990; Igbaria et al., 1989
Age	↑	E	Chua et al., 1999
Gender (Females)	↑	E	Igbaria & Parasuraman, 1989; Chua et al., 1999; Igbaria & Chakrabarti, 1990
Antecedent: Organizational/Environment Characteristics			
Perceived managerial support	↓	E	Elie-Dit-Cosaque et al., 2011
Autonomy	↓	E	
Information center support	↓	E	Igbaria, 1990
Organizational services	↓	E	McKenna, Tuunanen, & Gardner, 2013
Overload	↑	E	Elie-Dit-Cosaque et al., 2011
Work-life experiences	↑	E	Igbaria, 1990
Implementation gap	↑	C	Chau, 1996
Antecedent: Technology Characteristics & Perceptions			
Perceived web quality	↓	E	Hwang and Kim 2007
Interface/interaction with system	↓	E	Igbaria & Chakrabarti, 1990
Perceived risk	↑	C	Blili, Raymond, & Rivard, 1998; G. Howard, 1986
Interface with too many options	↑	C	Hoffman & Novak, 1996; Krasonikolakis, Vrechopoulos, & Pouloudi, 2014
Outcomes: Behavior			
Computer Avoidance	↑	C	Brosnan, 2002, Rosen & Maguire, 1990, Marakas et al., 1998
Behavior Intentions	↓	E	McKenna et al., 2013
Discretionary computer use	↓	E	G. S. Howard & Mendelow, 1999
Neurophysiological responses	↑	E	Powers, 1973
Outcomes: Evaluations & Perceptions			
Computer Self-efficacy	↓	C E	Marakas et al., 1998; Thatcher & Perrewe, 2002; Torkzadeh et al., 2006; Harrison & Rainer Jr., 1992
End User Satisfaction GSS Satisfaction	↓	E	Igbaria & Nachman, 1990; Srite, Galvin, Ahuja, & Karahanna, 2007
Perceived Behavioral Control	↓	E	Elie-Dit-Cosaque et al., 2011
Perceived Ease of Use	↓	E	Chee Wei Phang et al., 2006, Venkatesh 2000
Relative advantage of an IT	↓	E	Karahanna, Ahuja, Srite, & Galvin, 2002
E-Trust	↓	E	Hwang & Kim, 2007
Attitudes	↓	E	Schwaig, Segars, Grover, & Fiedler, 2013; Igbaria & Parasuraman, 1989; Igbaria 1990
Outcomes: Other Affective Concepts			
Technophobia	↑	C	Brosnan 2002, Thorpe & Brosnan, 2007, Brosnan & Thorpe, 2006; Weil et al., 1987

Technology Characteristics
- Perceived Web Quality
- Interface & Interaction with System
- Perceived Risk

Individual Characteristics
- Computer Self Efficacy
- Trait Anxiety
- Negative Affectivity
- Computer Playfulness
- PIIT
- Education
- Math Anxiety
- Locus of Control
- User Experience / Training
- Age
- Gender
- Cognitive Style

Organizational Characteristics
- Managerial Support
- Autonomy
- Information Center Support
- Organizational Services
- Overload
- Work-life experiences
- Implementation Gap

Computer Anxiety

Behavior
- Computer Avoidance
- Behavior Intentions
- Discretionary Computer Use
- Neurophysiological Responses

Evaluations & Perceptions
- Computer Self Efficacy
- Satisfaction
- Perceived Behavioral Control
- Ease of Use
- Usefulness
- E-Trust
- Attitudes

Technophobia
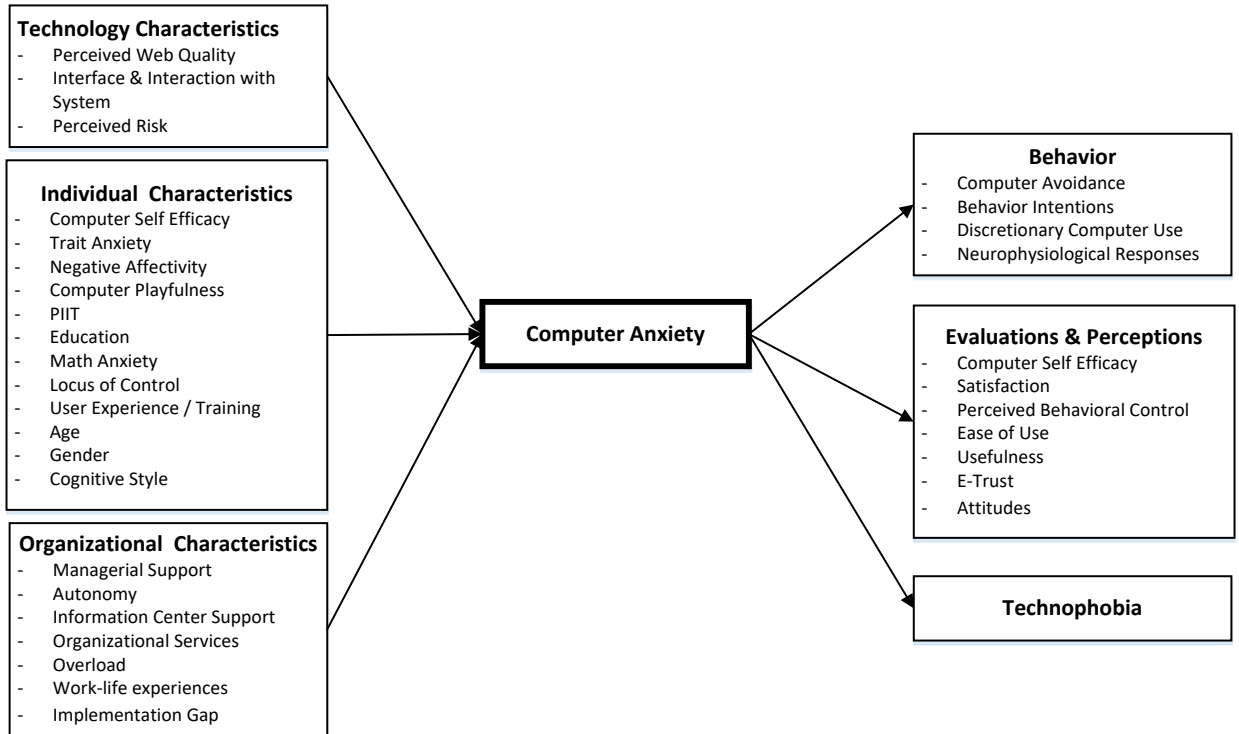
Figure 1: Nomological Network for Computer Anxiety

Technology characteristics (antecedent): Characteristics of the technologies regularly used by an individual may also influence the CA felt by that individual. For example, interface or website quality has been examined as a determinant of CA (Hoffman & Novak, 1996; Hwang & Kim, 2007; Krasonikolakis, Vrechopoulos, & Pouloudi, 2014). While the relationship between technology attributes and CA may seem intuitive, there has been little research on the topic. The limited research may be attributed to CA being commonly viewed as anxiety toward computer

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use in general, rather than perceptions of a specific technology or technology characteristics such as interface quality, usability, security, etc.

Organizational/environment conditions (antecedent): From a sociological perspective, CA can be influenced by the organizational environment in which an individual works, often referred to as external forces (Elie-Dit-Cosaque et al., 2011) or macro stressors (Saleh & Desai, 1986). These external stressors include an individual's role, assigned work tasks, managerial support, autonomy, and perceptions of overload (Elie-Dit-Cosaque et al., 2011), and can contribute to, or diminish, the general tendency of an individual to be anxious or fearful of using technology.

Use or use-related behavior (outcome): Computer aversion, an extreme form of non-usage also referred to as computer avoidance (Rosen & Maguire, 1990), is the earliest and most commonly mentioned outcome of CA in IS and the related literature. Early research cites aversive behavior, such as avoidance of computers and the general areas where computers are located, and attempts to reduce the necessary use of computers, as sure signs of CA (Brosnan, 2002). Similarly, CA is conceptualized as having a negative effect on computer-based performance, however, no papers that experimentally test this relationship were found in the CA literature.

Cognitive evaluations or expectancies (outcome): Another category of CA outcomes is cognitive evaluations or expectancies such as computer self-efficacy (CSE) (Thatcher & Perrewe, 2002) and the broader related concept, perceived behavioral control (Elie-Dit-Cosaque et al., 2011). A reciprocal relationship exists between CA and computer self-efficacy, in line with the source psychological theory (Bandura, 1977). A priori CSE, an individual characteristic, influences CA (Compeau & Higgins, 1995a; Compeau et al., 1999; Marakas et al., 1998), while the experience of CA may then impact future CSE (Marakas et al., 1998). Perceived behavioral

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control (Trafimow, Sheeran, Conner, & Finlay, 2002) reflects perceptions of both internal and external constraints on behavior, encompassing controllability and self-efficacy (Elie-Dit-Cosaque et al., 2011; Venkatesh, Morris, Davis, & Davis, 2003). As a result, it has a similar conceptual relationship with CA, although this has not been tested in the IS literature.

B. Technophobia

Technophobia is described as a more severe form of anxiety towards computers, and a composite of behavioral, emotional and attitudinal responses to computers i.e., *a resistance to talking about computers or even thinking about computers, fear or anxiety towards computers, or hostile or aggressive thoughts about computers* (Brosnan, 2002; Jay, 1981). It is also called computerphobia, to refer specifically to computers, rather than all technologies. Technophobia has been minimally studied in the IS literature (only 10 articles out of 1512 retrieved mentioned the term), and only a handful of psychologists have written about the construct, conceptualizing it as a composite of computer anxiety and negative computer attitudes (Brosnan, 2002).

Technophobia is considered to be a *specific phobia*, a psychological disorder characterized by an excessive, irrational fear of a specific object or situation, and avoided at all cost or endured with great distress. Specific phobia is one of the most common psychiatric disorders in the U.S. with one in five cases considered to be severe (Kessler, Chiu, Demler, & Walters, 2005). There are four subtypes of specific phobias: animal (e.g., spiders), natural environment (e.g., heights), situational (e.g., closed spaces), blood-injection-injury (e.g., dentist), and an "other" category for phobias that do not fit into the designated subtypes (Choy, Fyer, & Lipsitz, 2007; Thorpe &

Brosnan, 2007). Technophobia falls under the 'other' subtype. Although there is limited empirical

work ascribing clinical-disorder status to technophobia, technophobia reduction programs have

been designed with reductions in negative feelings observed (Brosnan & Thorpe, 2006; Weil et

al., 1987).

Multidimensionality and Measurement

Technophobia has been conceptualized as a composite of several factors including (1) computer

anxiety, (2) negative attitudes to computers, (3) style of thought (or cognitive styles) (Brosnan,

2002), and individual factors which influence the incidence of other specific phobias such as (4)

cultural/environmental factors, and (5) genetic factors (Maj, Akiskal, López-Ibor, & Okasha,

2004). One study investigated whether technophobia might reach clinical levels similar to other

specific phobias (such as spider phobia or arachnophobia), and found tentative support, but

measured technophobia with a computer anxiety scale (Thorpe & Brosnan, 2007). Researchers

have suggested that technophobia could be measured directly, or indirectly by the severity of

outcomes (extent of computer avoidance) or as a composite of other constructs, (e.g., computer

anxiety, negative computer attitudes) (Brosnan, 2002), but there are no known direct measures,

and no real validation efforts with indirect measures.

Antecedents & Outcomes

The documented antecedents and outcomes of technophobia are included in Table 3, and are

depicted within a nomological network in Figure 2. Given the paucity of literature studying

technophobia as a construct, there are no empirically tested antecedents and outcomes. However,

observations from the available literature suggest that antecedents of CA may be antecedents of

technophobia, with the primary outcome discussed being computer aversion or avoidance.

Physiological reactions (e.g. sweaty palms, heart palpitations, high blood pressure) and

psychosomatic responses (e.g. headaches, nausea, dizziness) are also likely outcomes from

technophobia (Brod, 1984; Brosnan, 2002), but have not been empirically tested.

Table 3: Technophobia: Published Antecedents and Outcomes

	D	S	Papers
Antecedents: Individual Characteristics			
Cognitive style	↑↓	C	
Cultural/environment factors	↑↓	C	*Brosnan 2002*
Computer attitudes	↑↓	C	
Antecedents: Other Affective Responses			
Computer anxiety	↑	E C	*Brosnan 2002, Thorpe & Brosnan, 2007, Brosnan & Thorpe, 2006; Weil et al., 1987*
Outcomes: Behavior			
Computer avoidance	↑	C	
Discretionary use	↓	C	*Brod, 1984; Brosnan, 2002*
Neurophysiological responses	↑	C	

Note: D = direction of relationship with ↑ indicating positive and ↓ indicating negative; S =
Support for relation with C indicating conceptual support only and E indicating empirical support.

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Computer Anxiety  ──────────────┐
                                 ↓
                            ┌──────────────┐              Behavior
Individual                  │ Technophobia │──────→   -  Computer Avoidance
Characteristics  ──────────→└──────────────┘          -  Behavior Intentions
-  Cognitive Style,                                    -  Discretionary Use
-  Computer Attitudes                                  -  Neurophysiological
-  Cultural/Environmental                                 Responses
   Factors
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Figure 2: Nomological Network for Technophobia

C. Technostress

Technostress is commonly defined as "*a modern disease of adaptation caused by an inability to cope with new computer technologies in a healthy manner which may manifest as a struggle to accept computer technology, or by over-identification with computer technology*" (Ayyagari et al., 2011; Brod, 1984; Ragu-Nathan et al., 2008; Riedl et al., 2012). It has also been defined more generally as "*any negative impact on attitudes, thoughts, behaviors, or body physiology that is caused either directly or indirectly by technology*" (Rosen & Weil, 1997; Tarafdar et al., 2007). Despite these broad definitions, research in this area tends to focus on business users of technology, and particularly mandatory use of technology. Technostress was first written about by psychologist Craig Brod who viewed technostress as emerging from work environments changed out of recognition by the technological revolution of the eighties (Brod, 1984; Knowles & Elliott, 1998). In his book, observations and interviews were used to explore how work and daily life were irreversibly changed by the proliferation of computer technology.

Technostress is based on the root concept of stress, which has several different definitions, including (1) the internal state of the organism (or strain); (2) an external event (or stressor); or (3) an experience that arises from an ongoing transaction between a person and the environment (Mason, 1975). It is further derived from general stress in the workplace, which is defined as the harmful physical and emotional responses that occur when job requirements do not match the worker's capabilities, resources, and needs (National Institute for Occupational Safety and Health, 1999). Technostress is commonly described in association with the role an individual occupies in the workplace and the tasks the individual is assigned to perform with the technology as part of that role (Tu, Tarafdar, Ragu-Nathan, & Ragu-Nathan, 2007). Specifically, technostress occurs when an individual has a negative evaluation of their experience carrying out tasks using technology in any job or field, which is distinct from studies of general work stress among IS workers in particular (e.g., Ahuja, Chudoba, Kacmar, McKnight, & George, 2007; Duxbury, Higgins, & Mills, 1992; Guimaraes & Igbaria, 1992; Lee, 2000; Moore, 2000; Rutner, Riemenschneider, O'Leary-Kelly, & Hardgrave, 2011).

In the IS field, there are two sub-streams of research investigating the phenomenon of technostress. The earlier stream is the series of papers by Tarafdar and collaborators (Ragu-Nathan et al., 2008; Tarafdar et al., 2015; Tarafdar et al., 2007; Tarafdar et al., 2010) which employs sociotechnical theory (Trist & Bamforth, 2000) and role theory (Gross, McEachern, & Mason, 1996) as well as transaction-based models of stress (McGrath, 1976). Their work takes the perspective that the implementation of technology within organizations has an influence on the individual's role and technology-related work tasks, and thus this stream focuses on *technostress creators* as antecedents in the work environment. The later stream (Ayyagari et al.,

2011) adopts the person-environment fit model of stress (Edwards & Cooper, 1990), a popular

model of work stress (Jones & Bright, 2001). The person-environment fit model takes the

perspective that work stress occurs because a misfit exists between the abilities of the employee

and the demands of the job. This substream of technostress research focuses on a subset of

established *work stressors* which have a significant technology component as a means for

operationalizing technostress.

Multidimensionality and Measurement

In both sub-streams of technostress research, technostress is measured as the external events or

stressors that lead to an internal state of stress, and the resulting internal state is not measured

directly. Tarafdar and collaborators (Ragu-Nathan et al., 2008; Tarafdar et al., 2007; Tarafdar et

al., 2010) developed scales to measure five *technostress creators* which serve as a proxy for

technostress. These technostress creators have been operationalized as reflective sub-dimensions

of a second-order construct, although only four of the five dimensions are often used (Tarafdar et

al., 2015). Alternatively, Ayyagari et al. (2011) adapted and developed new scales to measure

five *work stressors* as a proxy for technostress, but modeled the stressors independently of each

other (i.e., not as a part of a second-order construct). In both sub-streams, the lack of a direct

measure of technostress, conceptualized as the internal state of the individual and operationalized

as a unidimensional construct, has limited the validation of the stressors (i.e., antecedents), which

serve as a proxy for technostress. Ayyagari et al. (2011) comes closest by measuring strain using

an adapted scale of work exhaustion or burnout (Moore, 2000), however, the items describe end-

stage exhaustion[2] rather than technostress. Riedl echoes this measurement concern, noting that the literature has examined antecedent, moderating and outcome variables, but has yet to look at direct measures of ICT-related stress, or the activation of relevant biological stress systems (2012).

Antecedents and Outcomes

The antecedents and outcomes for technostress documented in the literature are listed in Table 4 and are depicted in a nomological network in Figure 3. Antecedents are first discussed and are organized by the general categories of (1) technology characteristics, (2) organizational/environment characteristics, and (3) individual characteristics, which are largely treated as control variables in the technostress literature. Outcomes are organized by the categories of (1) behavior, and (2) evaluations & performance.

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[2] It is possible to experience strain or technostress without reaching the end-stage state of burnout (Schaufeli & Maslach, 1993), as burnout is marked by exhaustion and cynicism (King & Sethi, 1997), and is a condition of severe strain resulting from prolonged exposure to stressors (Pawlowski, Kaganer, & Cater III, 2007). Ayyagari et al. (2011) measure strain using the items: "I feel drained from activities that require me to use ICTs; I feel tired from my ICT activities; working all day with ICTs is a strain for me; and I feel burned out from my ICT activities."

Table 4: Technostress: Published Antecedents and Outcomes

	D	S	Papers
Antecedent: Individual Characteristics			
Negative Affectivity	↑	E	*Ayyagari et al., 2011*
Antecedent: Technology Characteristics			
System breakdown, Error	↑	E	*Riedl et al. 2012*
Usefulness	↓	E	
Complexity, Ease of Use	↑	E	
Reliability	↓	E	*Ayyagari et al., 2011*
Presenteeism	↑	E	
Anonymity	↓	E	
Pace of change	↑	E	
Antecedent: Organizational/ Environment Characteristics			
Technical Support Provision (TI)	↓	E	*Ragu-Nathan et al., 2008*
Literacy Facilitation (TI)	↓	E	
Involvement Facilitation (TI)	↓	E	*Ragu-Nathan et al., 2008, Tarafdar et al. 2010*
Stressors			
Techno-complexity (TC)	↑	E	*Ragu-Nathan et al., 2008, Tarafdar et al., 2007*
Techno-uncertainty (TC)	↑	E	
Overload (WS), Techno-overload (TC)	↑	E	*Ayyagari et al., 2011; Ragu-Nathan et al., 2008, Tarafdar et al., 2007*
Job insecurity (WS), Techno-insecurity (TC)	↑	E	
Privacy invasion (WS)	↑	E	*Ayyagari et al., 2011*
Role ambiguity (WS)	↑	E	
Work-home conflict (WS). Techno-invasion(TC)	↑	E	*Ragu-Nathan et al., 2008, Tarafdar et al., 2007*
Outcomes: Behavior			
Neurophysiological responses	↑	E	*Galluch, 2009; Riedl et al., 2012; Tams, 2011*
Outcomes: Evaluations & Perceptions			
Role Stress - Conflict Role Stress - Overload	↑ ↑	*E*	*Tarafdar et al., 2007*
Job Satisfaction	↓	*E*	*Ragu-Nathan et al., 2008*
Organizational Commitment	↓	*E*	
Organizational Continuance	↓	*E*	
End User Performance	↓	*E*	*Tarafdar et al. 2010*
End User Satisfaction	↓	*E*	
Productivity	↓	*E*	*Tarafdar et al., 2007*
Strain (Burnout Scale)	↑	*E*	*Ayyagari et al., 2011*

TC: Technostress creators; TI: Technostress inhibitors (*Ragu-Nathan et al., 2008)*
WS: Work Stressors (Ayyagari et al., 2011)
Note: D = direction of relationship with ↑ indicating positive and ↓ indicating negative; S = Support for relation with C indicating conceptual support only and E indicating empirical support.
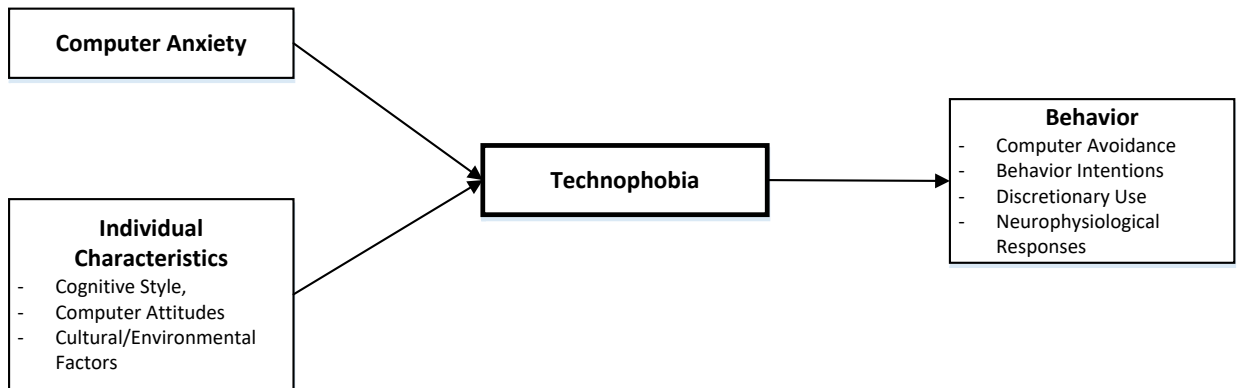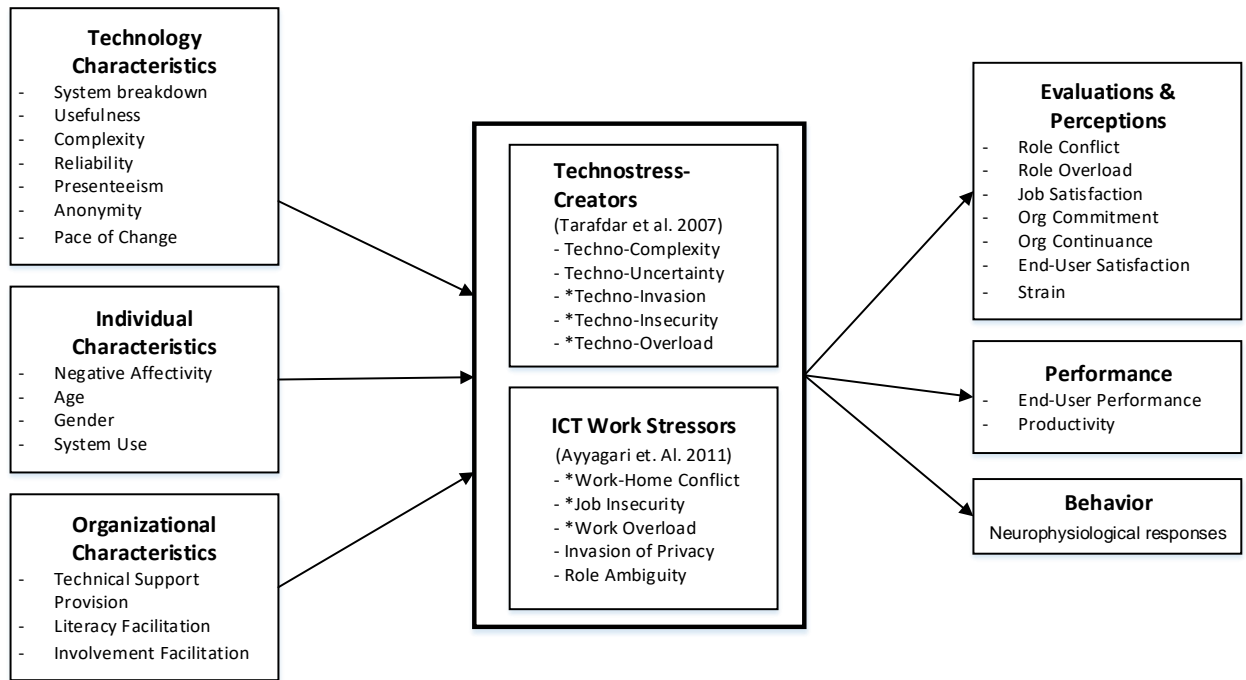
* denotes overlap between technostress creators and stressors

Figure 3: Nomological Network for Technostress

Technology characteristics (antecedent): Ayyagari et al. (2011) identified a range of

technology-related antecedents to technostress based on the existing literature on work stress.

These antecedents include usefulness, complexity (or ease of use), reliability, pace of change,

presenteeism, and perceived anonymity, and are all operationalized as perceptions of technology

features. System breakdown has also been examined (Riedl et al., 2012).

Organizational/Environment Characteristics (antecedent): Two groups of organizational

(environment) characteristics have been identified in the literature as being antecedents, or

components, of technostress: 1) *technostress* creators by Tarafdar et al. (2007), and *stressors* by

Ayyagari et al. (2011). Tarafdar et al. (2007) identified five technology-related stressors based on the organizational stress and IS literature, including techno-complexity, techno-overload, techno-insecurity, techno-uncertainty, and techno-invasion. Ayyagari et al. (2011) also identified five work stressors based on Moore (2000) that were relevant to IT workers, and proposed overload, job insecurity, privacy invasion, role ambiguity, and work-home conflict as technology-specific stressors that increase technostress (Ayyagari et al., 2011; Tarafdar et al., 2007). Three stressors overlap significantly between the two research streams – techno-overload/overload, techno-insecurity/job insecurity, and techno-invasion/privacy invasion, as shown in Figure 3. Some organizational conditions have been identified as inhibiting technostress, including technical support provision, literacy facilitation and involvement facilitation (Ragu-Nathan et al., 2008).

Individual characteristics (antecedent): Several individual characteristics were documented as control variables in the technostress literature, including age, gender and negative affectivity (Ayyagari et al., 2011). While formal relationships were not proposed, prior literature suggests that older users, female users, and users with greater negative affectivity are more likely to experience technostress.

Behaviors and physiological reactions (outcomes): Given that psychologists Brod (1984) and Rosen and Weil (1997) conceptualize technostress as a psychological disorder with direct and psychosomatic health responses, technostress could be associated with reactions and behavior such as irritability, headaches, nightmares, resistance to or avoidance of computers, or outright refusal to use the technology (Brod, 1984). However, these relationships have not been empirically tested. Research on the physiological changes associated with technostress have measured levels of neuro-endocrine markers such as salivary cortisol and alpha-amylase as a

proxy for technostress (Galluch, 2009; Galluch, Grover, & Thatcher, 2015; Riedl et al., 2012; Tams, 2011).

Evaluations and perceptions (outcomes): While there has been limited study of direct behaviors in response to technostress, outcomes such as user evaluations and perceptions have been studied. Stress from the use of technology is believed to influence work-related conflict and overload (Tarafdar et al., 2007). When technology-related stress persists, users may approach an extreme end point of burnout or exhaustion (Ayyagari et al., 2011) as well as a loss of job satisfaction, performance (Ragu-Nathan et al., 2008; Tarafdar et al., 2015) and productivity (Tarafdar et al., 2007). These forms of strain are undesirable because they are also known drivers of negative organizational outcomes such as turnover intentions (Maier, Laumer, Eckhardt, & Weitzel, 2013; Moore, 2000) and individual conditions such as poor mental health (Faragher, Cass, & Cooper, 2005), although IS research is yet to explore these longer-term effects of technostress.

D. Research Gaps & Integrated Nomological Network

Based on the literature described above, an integrated nomological net of computer anxiety, technophobia, and technostress is proposed, as shown in Figure 4, and gaps in this literature are identified. Despite the commonalities among these constructs, Figures 1-4 show that there is little overlap in the studied antecedents and outcomes of these concepts, and there is also a large number of proposed but untested relationships. Other gaps identified in the literature include definitional problems, measurement issues, and different streams of research that need to be merged and synthesized, as further described below.
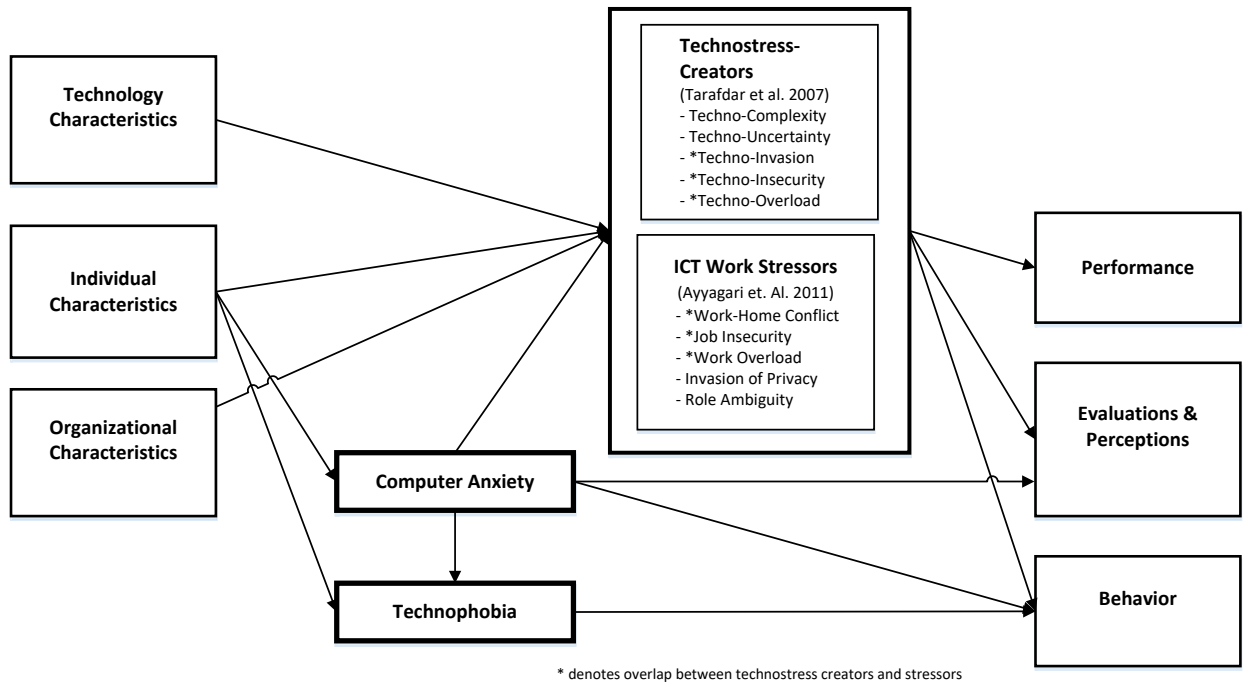
Figure 4: Combined Nomological Network (Current State of the Literature)

CA and technophobia are described as different constructs, yet technophobia is commonly

operationalized as the combination of CA and negative attitudes toward technology. The

literature has described computer anxiety as "nervousness and agitation when interacting with

computers" while technophobia or computerphobia is described as "fear of using them" (Tarafdar

et al., 2010, p. 308). In line with this perspective, CA is described as having normal levels of

anxiety toward computers (Chua et al., 1999), with technophobia associated with a more neurotic

reaction to computers. Thus, CA and technophobia would benefit from more precise definitions

and differentiation, and separate measurement scales.

Technostress also suffers from definitional and measurement problems given the two separate

streams of research on technostress with different dimensions/antecedents of technostress, and the

lack of a direct measure for the construct. The creation of a unidimensional measure would make

it easier to explore relationships with other relevant phenomena (Segars, 1997), and would

provide an opportunity to validate the proposed stressors as independent antecedents or formative

first-order dimensions[3] of technostress. Thus, this paper suggests that stressors be treated as

antecedents (or formative dimensions) of technostress, and a direct, reflective measure of

technostress be developed.

The potential relationships between the three negative affective constructs have also not been

well-documented. Not surprisingly, these concepts have largely been explored independently, and

thus the antecedents and outcomes studied with each construct are also largely different. Further,

no common theoretical base or framework has been applied to help improve our understanding of

these concepts and the connections between them. Last, there has been limited exploration of

objective outcomes from the presence of these negative affective responses, including

physiological responses, and performance measures such as task accuracy and time spent using

the technology.

In summary, a theoretical framework is needed to better define and operationalize these concepts,

and relate them to one another, and to other affective responses to technology. New measures are

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[3] Based on the reflective/formative measurement guidelines in (Petter, Straub, & Rai, 2007), the technostress creators (Tarafdar et al., 2007) and the work stressors (Ayyagari et al., 2011), would be best represented as independent antecedents or formative dimensions of a second order construct.

needed for some of the concepts, and validation efforts are needed for all three constructs within

the same empirical study. In the next section, the Affective Response Model, (ARM; Zhang,

2013) is described and applied to these three concepts to address some of these research gaps.

Applying the ARM Taxonomy

A sound understanding of the role of affect-related phenomena in the IS discipline cannot be

achieved without a solid theoretical framework. In response to this need, Zhang (2013) produced

the Affective Response Model (ARM), based on recent literature from the field of psychology,

which provides consensus on the meanings and structures of affect-related phenomena (Barrett &

Russell, 1999; Rosenberg, 1998; Russell, 2003, 2009; Watson & Clark, 1984; Watson, Wiese,

Vaidya, & Tellegen, 1999; Weiss & Cropanzano, 1996). ARM is a comprehensive model of

affective concepts that can further explain how computer anxiety, technophobia and technostress

are different from each other and related to other important concepts. The choice of ARM as the

suitable theoretical framework for understanding the negative, affective IS constructs in this

literature review is based on three reasons.

1. ARM provides a helpful taxonomy that differentiates affective concepts along five

    dimensions: residing, temporal nature, particular vs. general stimulus, object vs. behavior

    stimulus, and process-based vs. outcome based evaluations.

2. ARM applies to situations where direct experience with an ICT is the stimulus, which aligns

    with the focus of this research, excluding cases where the stimulus was the announcement of

    an ICT implementation.

3. ARM provides propositions to support the relationships among affective constructs based on the dimensions or characteristics of the constructs.

Affective Response Model (ARM)

The five affective dimensions of ARM (residing, temporal nature, particular vs. general stimulus, object vs. behavior stimulus, and process-based vs. outcome based evaluations) (Zhang, 2013), serve as a taxonomy for categorizing and comparing affective responses to technology. In the sections below, these five affective dimensions are described and then are applied to better define and differentiate CA, technophobia, and technostress. Appendix A1, Table A1.1, adapted from Zhang 2013, provides more detailed descriptions and examples of the five dimensions of ARM.

The *residing dimension* describes the referent object of an affective response, with the options being a person (e.g., the mood of person), a technology stimulus (affective attribute of technology), or the intersection of person and technology stimulus (an affective evaluation of technology). The *temporal dimension* describes whether the affective response is more permanent or fleeting (trait vs. state), while the *object/behavior stimulus* describes whether the response is directed toward the technology or toward a specific behavior with the technology. The *general vs. specific dimension* describes whether the affective response is applicable to a specific technology or a general class of technologies, and the *process vs. outcome based dimension* differentiates whether the response occurs during use of a technology or represents an overall outcome and extended exposure to a technology.

Classifying Negative Affective Responses

Given the rich taxonomy of affect-related concepts provided by ARM, this paper now describes how the three negative, affective concepts reviewed in this paper (i.e., computer anxiety, technophobia, and technostress) can be differentiated based on the categorizations provided by ARM. In Zhang (2013), CA was categorized within the taxonomy, but technophobia and technostress were not. In the sections below, all three negative affective responses are categorized and compared by the five ARM dimensions. Table 5 depicts the ARM categories based on the five dimensions, and places CA, technophobia, and technostress within their respective categories along with other known and potential, negative affective responses to technology. Appendix A1, Table A1.2 provides definitions of several other concepts classified in the different boxes of ARM.

Table 5: Classifications of Negative, Affect-Related Concepts (adapted from and extending Zhang 2013)

Residing within a person		Residing within stimulus	Residing Between Person and Stimulus				
Temporally Constrained	Temporally Unconstrained		Temporally Constrained (state)	Temporally Unconstrained (Evaluation / Disposition)			
					Particular Stimulus		General Stimulus
					Process-Based	Outcome-based	
1. Mood	2. Trait Anxiety	3. ICT Physical Attributes	**Technology induced state anxiety*	Object Stimulus	5.1 Perceived Aesthetic Factors	5.2 **+ Affective Fit**	7. **+Techno-phobia**
		ICT System Attributes		Behavior Stimulus	6.1 Use-Session Experience Factors	6.2 **+ Technostress**	8. Computer Anxiety

+ New proposed classification for existing construct
* New proposed classification for new construct

1. **Residing Nature:** All three negative, affective responses are categorized as residing between an individual and an object, as CA, technophobia and technostress each represent an emotional response or evaluation by a user of technology. These three responses are not isolated to the individual (e.g., mood), and are not objective attributes of the technology itself (e.g., an hedonic interface). Thus, all three constructs are found on the right side of the ARM classification table (Table 5), under the heading "residing between person and stimulus."

2. **Temporal Dimension (state or trait):** The temporal dimension describes whether an affective response is state-like (e.g., temporary, transient), or trait-like (e.g., persistent, permanent). All three constructs can be classified similarly as trait-like, as these negative affective responses tend to persist over time, and can be found on the right side of the ARM classification table (Table 5), under the heading "temporally unconstrained". For example, an individual who is technophobic will likely continue to be fearful and neurotic about computers. Users who exhibit technostress, have accumulated negative feelings about a technology over repeated use of the technology, and are likely to continue feeling and exhibiting signs of technostress.

   CA, on the other hand, has been classified as both state-like and trait-like in the literature. It has been conceptualized as an on-going feeling towards what might happen when one uses computers (Chua et al., 1999; Heinssen Jr. et al., 1987; Rosen & Maguire, 1990; Zhang, 2013), but also referred to as state-like (Bostrom, Olfman, & Sein, 1990; Brosnan, 2002; Chua et al., 1999; Zhang, 2013), based on evidence that CA levels may change in response to an anxiety reduction program (Weil et al., 1987). However, explicit tests of whether CA is state or trait by Beckers, Wicherts, and Schmidt (2007) conclude that CA appears to harbor

components of trait anxiety, and such affective feelings about computers are considered as cumulative over time (Beckers & Schmidt, 2001). Thus, this literature review takes the perspective that CA is temporally unconstrained, i.e., trait-like, a position consistent with the original classification of CA in ARM. Further, both technophobia and technostress are also temporally unconstrained, suggesting the need to propose a temporally constrained concept that can further our understanding of affective responses to technology.

3. **Object or Behavior Stimulus:** The object vs. stimulus dimension helps to differentiate CA and technostress from technophobia, as CA and technostress appear in the "Behavior Stimulus" row, while technophobia appears in the "Object Stimulus" row of Table 5. The IS literature commonly treats CA as an anxiety associated with *using* ICTs (i.e., behavior stimulus) (Compeau & Higgins, 1995b; Compeau et al., 1999; Thatcher & Perrewe, 2002), or *the prospect of using* ICTs (Beaudry & Pinsonneault, 2005). Technostress is similar, in that the experience of actually using a technology is necessary for technostress to occur (Ayyagari et al., 2011). Thus both CA and technostress are responses to a behavior stimulus (using an ICT). However, the literature on technophobia suggests that the extremely reactive behavior of individuals who often qualify as being 'phobic' appears to be directed at the object itself, without requiring use or interaction with the object. This may be key to understanding why technophobia is much more extreme and less common than CA. Consider a policeman who "*developed such a complex about the computer console in his police car that he shot it*" (Howard, 1986, p. 17) as an example of ridiculous and extreme behavior that may result from technophobia. Thus, this literature review takes the perspective that technophobia best represents an extreme response to an object stimulus.

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4. **General or Specific Stimulus:** The general vs. specific dimension provides further differentiation, with CA and technophobia referring to computers in general (and classified in the General Stimulus column of Table 5), and technostress referring to a specific technology (and thus classified in the Particular Stimulus column). CA is regarded as a response to the prospect of general computer use (Compeau & Higgins, 1995b; Compeau et al., 1999), and is most often measured as an affective response to using technology in general (Agarwal & Venkatesh, 2002; Brosnan, 1999; Elie-Dit-Cosaque et al., 2011). Similarly, technophobia is regarded as a more extreme or phobic response to computers in general. On the other hand, technostress is an accumulated affective response to a specific technology. For example, Ayyagari et al. (2011) surveyed users on a list of work specific IT such as enterprise systems, while Tarafdar and collaborators referenced specific computer applications, or categories of applications used in the respondents' jobs (Tarafdar et al., 2010, p. 323).

5. **Process vs. Outcome based Affective Evaluation**: Finally, CA and technophobia are affective responses to general stimuli and thus cannot be assessed for whether the response occurs during the process of using a specific technology or as an outcome of cumulative responses to a specific technology, according to ARM. Therefore, the process vs. outcome-based affective evaluation dimension applies only to technostress. Outcome-based affective evaluations are more in-depth, based on "goals, relevance, consequences, or overall take-away messages" (Zhang, 2013). Therefore, this literature review categorizes technostress as an outcome-based response derived from accumulated experiences with a specific technology.

Based on the five dimensions of ARM, CA, technophobia and technostress were categorized into different cells of Table 5, highlighting the differences and similarities among these constructs. Contributions of this categorization include classifying technophobia and technostress within the taxonomy (Zhang, 2013), which were not previously defined from this perspective. The comparison of the three constructs through ARM enables us to better understand how these constructs are different, and should be measured differently. For example, the items measuring affective responses to the use of general technology should reference general technology, such as computers rather than specific software like spreadsheets, and should including wording about actual use of the technology.

Further, classifying these constructs and other negative affective responses within the ARM taxonomy illuminated cells in the taxonomy that were empty. Theoretically, there should be a negative affective response within each cell of the taxonomy and an empty cell suggests that a negative affective response may have been overlooked in IS research. Two such cells were identified during this classification process, cell 5.2 (outcome-based evaluations of a specific technology object) and cell 4.0 (temporally constrained episodic affective evaluation of a technology). These gaps which are noted in Table 5, are addressed below.

Affective Fit – ARM cell 5.2

As shown in Table 5, cell 5.2 references a temporally-unconstrained outcome-based evaluation towards a specific ICT object, which had previously not been identified in the IS literature. However, during this literature review, an applicable affective concept emerged. *Affective fit* is

the feeling associated with the individual's evaluation of the fit between the features of a specific

ICT and the goals of using it (Avital & Te'Eni, 2009). This affective state occurs when interface

design considerations support or promote the user's attainment of a desired goal (Avital & Te'Eni,

2009). For example, for a user wishing to carry out a wide range of mathematical operations on

tabulated data, affective fit might be achieved from an interface designed to look like a

spreadsheet or a similar application, e.g., as found in Microsoft Excel. Achieving affective fit

requirements is a positive result, while failing to meet the requirements is negative.

Distinguishing between evaluating an object, and behavior using the object, is also useful. For

instance, an individual's evaluation of Microsoft Excel as an ICT object (e.g. interface quality) is

related to, but separate from how they evaluate the act of using Microsoft Excel (e.g.

intuitiveness, ease of use, etc). The IS literature has distinctly captured the evaluation of an ICT

object using satisfaction scales such as satisfaction with an object (Wixom & Todd, 2005) and

satisfaction with a decision aid (Hess, Fuller, & Mathew, 2006). Affective fit, measured as

emotional evaluation of visual complexity and other design features of a website, has been shown

to influence subsequent behavior towards the ICT object (Deng & Poole, 2010).

Technology Induced State Anxiety (TISA) – ARM cell 4

As shown in Table 5, cell 4.0 references a temporary, state-like negative affective response

residing between a person and a technology-related stimulus, and was previously empty with no

applicable affective concepts identified during the literature review. We propose that a new IS

construct, *technology-induced state-based anxiety* (TISA), is needed to fill this gap and represent

state-like feelings of uneasiness and anxiety during exposure to technology, which subsequently disappears when the technology is no longer present. CA, technophobia and technostress are trait-like and persistent and thus distinct from the proposed construct, TISA. TISA characterizes a negative episode or encounter with technology and could be described as episodic stress or strain, providing a complement to positive state-like concepts in the IS literature, such as enjoyment. The proposed construct would also be correlated with neuro-physiological measures of anxiety that occur during a negative encounter or episode with technology.

An emotional episode like TISA occurs when (1) an event stimulates a response from an individual; (2) the event is appraised or evaluated by the individual; and (3) emotions result based on the appraisal and relevance of the event (Russell, 2003; Scherer, 2005; Weiss & Cropanzano, 1996). From an ICT perspective, an ICT serves as the event that stimulates an initial response and then is appraised by the individual based on relevance, and results in experienced emotion (Zhang, 2013). TISA provides a means to capture the temporary, felt emotion during a negative episode with technology.

Relationships Among Negative Affective Responses

The classification of negative affective antecedents and responses to technology shown in Table 5 also suggests relationships among these constructs. While the ARM taxonomy (Zhang, 2013) describes how the various categories of affective constructs may be related, most of these relationships have not been empirically tested. This paper now proposes how the three principal concepts of interest (computer anxiety, technophobia and technostress) and the new concept,

technology induced state anxiety (TISA) are related based on emotional episode models (Russell, 2003; Scherer, 2005; Weiss & Cropanzano, 1996) and the ARM dimensions (Zhang, 2013).

Emotional episode models take a process or circular perspective, as the emotions that result from an evaluation of multiple emotional episodes can become outcome-based evaluations and learned dispositions, which may in turn affect the affective response of an individual to another event (Russell, 2003; Scherer, 2005; Weiss & Cropanzano, 1996). As learned dispositions (trait-like responses to ICT), CA and technophobia may influence an individual's initial response to an ICT stimulus. These trait-like negative dispositions toward ICT in general, may also influence the level of TISA that an individual experiences while using an ICT. In addition, the affective attributes of that ICT may influence the TISA experienced by that user. In other words, if an individual experiences CA whenever they use technology (or worse, is technophobic), then the individual is more likely to experience anxiety while using a specific ICT (i.e., TISA). Thus, an individual may experience TISA, a state-like negative response to using a specific ICT, based on learned predispositions, the affective attributes of an ICT, and other affect-related antecedents such as mood. Repeated episodes of TISA with an ICT, can result in a more trait-like affective response to the specific ICT, in the form of technostress. From a process perspective (and circling back to CA and technophobia), the technostress felt toward a specific ICT could over time become a learned disposition toward all ICT in general, resulting in the trait-like conditions of CA, and possibly a more extreme emotional response, technophobia. Based on ARM and emotional episode models, we suggest that TISA, CA, technophobia, and technostress are unique constructs but will be correlated with one another. Formal propositions, which are instantiations of the high level propositions in ARM, are provided below:

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P1a: An individual's degree of apprehension towards ICT objects (*technophobia*) and apprehension towards using ICTs (*computer anxiety*) influences the *technology induced state anxiety (TISA)* they feel when using a particular ICT.

P1b: The degree to which an individual experiences *technology induced state anxiety (TISA)* while using ICTs increases their apprehension towards ICT objects (*technophobia*) and apprehension towards using ICTs (*computer anxiety*).

P2a: The degree to which an individual experiences *technology induced state anxiety (TISA)* while using a particular ICT increases the degree to which the ICT is an ongoing source of discomfort and pressure to the individual (*technostress*).

P2b: The degree to which an ICT is an ongoing source of discomfort and pressure to the individual (*technostress*) increases *technology induced state anxiety (TISA)* experienced by the individual while using that particular ICT.

P3a: An individual's degree of apprehension towards ICT objects (*technophobia*) and apprehension towards using ICTs *(computer anxiety*) influences the degree to which they feel an on-going sense of discomfort and pressure with particular ICTs (*technostress*)

P3b: The degree to which an individual feels an on-going sense of discomfort, pressure or inadequacy with a particular technology (*technostress*) influences his/her degree of apprehension towards ICT objects in general (*technophobia*) and apprehension towards using ICTs in general (*computer anxiety*).

P4a: People who are apprehensive towards exploring and trying out ICTs (*computer anxiety*) are more likely to have a high aversion for ICT objects (*technophobia*).

P4b: People with a high aversion for ICT objects (t*echnophobia*) are also apprehensive towards exploring and trying out ICTs (computer anxiety).

Classifying Positive Affective Responses

In an effort to gain more insight into negative affective responses to technology, a set of matching positive concepts is also described. Table 6 depicts the ARM classification with positive affective

responses, providing a more balanced understanding of affective responses to ICT stimuli by calling attention to the bright side of technology. Positive and negative concepts that were easily matched include trait anxiety and trait playfulness, TISA and enjoyment, and computer anxiety and computer playfulness. Based on Zhang (2013) and existing IS research on positive, affective responses, gaps in the literature were identified, and technophilia and technomancy were proposed as matching positive concepts to technophobia and technostress.

Table 6: Classifications of Positive, Affect-Related Concepts
(adapted from and extending Zhang 2013)

Residing within a person		Residing within stimulus	Residing Between Person and Stimulus				
Temporally Constrained	Temporally Unconstrained		Temporally Constrained (state)	Temporally Unconstrained (Evaluation / Disposition)			
					Particular Stimulus		General Stimulus
					Process-Based	Outcome-based	
1. Mood	2. Trait Playfulness	3. ICT Physical Attributes	Enjoyment	Object Stimulus	5.1 Perceived Aesthetic Factors	5.2 + **Affective Fit**	7. *__Techno-philia__
		ICT System Attributes		Behavior Stimulus	6.1 Use-Session Experience Factors	6.2 * **Technomancy**	8. Computer Playfulness

+ New proposed classification for existing construct
* New proposed classification for new construct

Technophilia represents the degree of affinity an individual has towards ICT objects in general, as compared to the negative feelings of repulsion experienced with technophobia. When Apple computers uses the tag line "The notebook people love" to advertise the MacBook Air computer (Nudd, 2014), they are appealing to a widespread acceptance of the anthropomorphic nature of technology objects. While ICT objects are inanimate, they also have the ability to seem as if they act and think for themselves by clever design and through the addition and subtraction of capabilities (in form of new software, upgrades, etc.). This dynamic property, common to other

"epistemic consumption objects", results in an "on-going cycle of revelation and discovery" which can cause users to become attached to the object in intimate and quasi-social ways (Zwick & Dholakia, 2006).

Technomancy is defined as the on-going feeling of achieving remarkable things through the use of an ICT, as compared to the on-going negative feelings with technostress. The suffix of the word technomancy, adapted from the Greek word *manteia* which means divination, was chosen to reflect the almost magical outcomes of technology use, as "any sufficiently advanced technology is indistinguishable from magic" (Clarke, 1962). Other terms such as technoease or technocalm, created by using antonyms to stress, are also comparable labels for the complement to technostress, reflecting the positive emotions associated with being able to successfully wield technology to one's needs, goals and intentions. Technomancy is different from mastery, because an individual can experience technomancy without necessarily understanding how a technology works or knowing how to use the full range of capabilities or features of a particular technology. In the same way, an individual who experiences technomancy using one technology, e.g., word processors, can experience technostress while using a different one, e.g., spreadsheets.

It is meaningful to point out, based on ARM, that technostress and technomancy are formed through an individual's perception of physical and system attributes of specific technologies. Negative antecedents which give rise to technostress include concepts that have been studied under the label of perceived stressors such as uncertainty, overload, (usage) complexity, presenteeism and unreliability. On the positive side, antecedents of technomancy may include user perceptions of system intuitiveness, intelligence, dexterousness and purposiveness. This

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paper categorizes such concepts as *use-session experience factors* which are antecedents of both technostress and technomancy based on ARM (cell 6.1 within ARM, Tables 5 and 6).

Research Method

Given the above propositions, a fundamental goal to advancing this area of research is assessing the discriminant validity of the four negative affective constructs and the relationships between them. A preliminary task was therefore to identify or develop scale items to measure each construct as called for by Zhang (2013). Further, the review of the literature documented the lack of direct measures for technostress and technophobia. As a result, new scales were developed for technophobia, technostress, and the new construct TISA. Two studies were conducted to validate the scales, establish the discriminant validity of these constructs, and to better understand the relationships between the constructs. A cross sectional survey was first conducted to establish the validity of technostress, technophobia and computer anxiety. Known dimensions of technostress and antecedents for all three constructs were included to provide a more comprehensive validation. A second study was conducted in an experimental context to further validate the measures for technostress, technophobia and CA, and to validate and test the measure for TISA. The following sections describe the scale development process and both empirical studies.

Scale Development

The scales used to measure the four negative affective responses to ICT are shown in Table 7. In creating the new scales for technostress, technophobia, and TISA, care was taken to clearly state the referent object and to ensure that the items were valid to the definitions of the constructs previously described based on the dimensions of ARM. A new five-item, direct measure of technostress was created by adapting the perceived stress scale (Cohen, Kamarck, & Mermelstein, 1983), a reflective general measure of an individual's perceived stress, to stressful situations which involved the use of ICT. The general version of the scale has been extensively used in stress research, and the version developed for an ICT context follows the same format. A new measure of technophobia was created by adapting existing specific phobia scales such as the fear of spiders questionnaire (Szymanski & O'Donohue, 1995) and the phobic beliefs scale (Chambless, Craig, Bright, & Gallagher, 1984; Thorpe & Brosnan, 2007), such that the referent object was general ICT. The measurement scale for technology induced state anxiety (TISA) was adapted from the state sub-scale of the State-Trait Anxiety Inventory (STAI) (Marteau & Bekker, 1992; Spielberger, Gorsuch, & Lushene, 1970), a commonly used measure of state anxiety. This scale prompts the respondent to focus attention on a recent ICT episode and report how strongly they experienced certain feelings. Finally, CA was measured using the existing, short form of the Computer Anxiety Rating Scale (Heinssen Jr. et al., 1987) commonly used in IS research (Hardin, Looney, & Fuller, 2014; Marakas, Johnson, & Clay, 2007; Thatcher & Perrewe, 2002; Webster & Martocchio, 1992).

A multi-staged approach was taken to refine and validate the new measurement scales (Boudreau, Gefen, & Straub, 2001; Straub, Boudreau, & Gefen, 2004). The initial pool of items was

reviewed by several researchers in IS and psychology. Following this, two pre-tests were conducted with an undergraduate sample and the results were used to refine the wording of the measurement scales, after which a pilot was conducted with a sample of workers. Due to space constraints, these pre-tests and pilot tests are not reported. Through this process, the scales were refined and shortened to the form listed above in Table 7. A summary of the research design for each study is provided in Table 8, and is further described below.

Table 7. Scale Items for Studies 1 and 2

Measurement Items		Source
Computer Anxiety (CA): *Indicate how well the statement below describes your feelings towards using computers in general:*		
canx1	I feel apprehensive about using computers	Heinssen et al. 1987
canx2	It scares me to think that I could cause the computer to destroy a large amount of information by hitting the wrong key	
canx3	I hesitate to use computers for fear of making mistakes that I cannot correct	
canx4	Computers are somewhat intimidating to me	
Technophobia: *Do the following statements describe how you feel about computers?*		
tphob1	If I saw a computer system now I would probably break out in a sweat and my heart would beat faster.	Adapted from Szymanski & O'Donohue 1995; Chambless et al. 1984; Thorpe & Brosnan 2007
tphob2	If I saw a computer system now, I would feel very panicky.	
tphob3	Computer systems are one of my worst fears.	
tphob4	If I came across a computer system, I would be afraid of it	
Technostress: *Please answer by selecting how well the statement describes feelings you have felt towards using _____ in recent times. Think about the past month of active use of these technologies when answering the questions that follow.*		
tstress1	You have felt that the application was stopping things from going your way	Adapted from Cohen et al. 1983
tstress2	You have found that you could not cope with all the things that you had to do using the application	
tstress3	You have lost the ability to control irritations resulting from using the application	
tstress4	You have felt that you were NOT on top of things because of the application	
tstress5	You have lost the ability to control the way you spend your time when using the application	
Technology Induced State Anxiety (TISA): *While working on the task you just completed using this technology, how did you feel?*		
tisa1	Tense	Adapted fromMarteau and Bekker 1992; Spielberger et al. 1970; Spielberger, 2010
tisa2	Strained	
tisa3	Nervous	
tisa4	Worried	
tisa5	Anxious	

Table 8: Research Design for Studies 1 and 2

	Study 1	Study 2
Computer Anxiety	✓	✓
Technophobia	✓	✓
Technostress	✓	✓
TISA		✓
Technostress-Creators	✓	
Participant Type	Workers	Students
Research Design	Survey	Lab Experiment
Sample size	191	351

Study 1 – Cross Sectional Survey

The purpose of the first study was to validate measures for the three negative affective responses which were the original focus of this research – CA, technophobia, and technostress. An online survey was conducted which included the scales for these three constructs, and for the technostress creators which have been used as multidimensional, indirect measures of technostress in past research (see Appendix A2, Table A2.1). In addition, demographic questions were included, as was a marker variable scale for assessing the possible effects of common method bias.

Given the need to survey individuals who had experience using computers and thus were more likely to have experienced technostress (i.e., technostress is an outcome-based evaluation of using an ICT), a general sample of working adults were invited to take the survey through Amazon Mechanical Turk, an increasingly popular source of data for social science and behavioral research (Buhrmester, Kwang, & Gosling, 2011; Goodman, Cryder, & Cheema, 2012; Steelman, Hammer, & Limayem, 2014). Participants were asked early in the survey about their use of computers at work. While all participants were compensated for their participation, only those

individuals who reported using some ICT, 191 participants, were included in the data set for analysis. This filter was necessary, as otherwise some participants would not be able to realistically respond to questions about technostress. Participants were asked to specify which category of ICT they used most frequently (i.e., Office productivity, Enterprise and database systems, and other ICTs), and then respond to survey questions referencing this ICT.

Study 2 - 2x2 Experiment

A second study was conducted in a controlled experimental context to further validate the affective constructs measured in the first study and the measure for the proposed construct, TISA. A controlled experiment was needed as TISA is a negative, affective response that is temporally constrained to an episode of using technology. In order to assess participants' affective response to a specific, recent use of technology, an experiment was conducted in which participants used an ICT immediately prior to completing a survey. A 2x2 between subjects experiment was conducted with ICT familiarity and task requirements. These treatments were designed to create variation in TISA, by having participants use a less (more) familiar ICT to complete a task with greater (lesser) requirements. Using a less familiar ICT to complete greater task requirements is presumed to result in more TISA, and could thus demonstrate the distinction between TISA and technostress. Both TISA and technostress were measured in reference to the ICT assigned to the participant. The sample used in this second study was a cohort of 351 undergraduates enrolled in an introductory IT course at a large public university in the US.

Experimental Procedure

Participants were first asked to complete a pre-task survey in which CA, technophobia and technostress towards an assigned technology (the more familiar Microsoft PowerPoint or less familiar Paint) were measured. After completing the pre-task survey, participants completed a design task in which they were asked to create a flyer. Depending upon their assigned treatments, participants were instructed to either design a flyer of their choosing (lower requirements) or to design a flyer that met specific requirements (higher requirements). Right after completing the design task, participants responded to a post-task survey in which TISA towards the assigned technology (Microsoft PowerPoint or Paint) was measured.

Results and Findings

In this section, results are presented for both studies. SPSS 23.0 was used to calculate reliability with Cronbach alpha, conduct exploratory factor analysis (with varimax rotation), and to run analysis of variance (ANOVA). MPlus 7.0, a covariance-based SEM application, was used to provide a more comprehensive assessment of construct validity with confirmatory factor analysis (CFA) and overall model fit.

Study 1 Validation

Descriptive statistics, Cronbach's alpha, and correlations for the three negative affective responses examined in Study 1 are shown in Table 9. Technophobia had the lowest mean, the

smallest range, and smallest standard deviation of all three constructs, as expected, given that this

more extreme negative affective response is a type of phobia and found less frequently in the

population than other negative affective responses. The correlations shown were all significant

and confirm that the concepts are related, but were also less than the square root of the average

variance extracted (AVE) for each construct, suggesting that these constructs are also distinct.

Table 9: Study 1 Workers Sample - Descriptive Statistics and Correlations

	Mean	StDev	Min	Max	Alpha	CR	AVE	CA	Tphobia	Tstress
Computer Anxiety (CA)	1.71	0.99	1.00	6.00	.82	.83	.55	**0.740**		
Technophobia	1.18	0.56	1.00	4.60	.93	.94	.80	0.561	**0.893**	
Technostress	1.80	1.03	1.00	6.38	.92	.92	.69	0.471	0.336	**0.820**

Note: Square root of the AVE is shown on the diagonal in bold. CR = composite reliability

Exploratory factor analysis was first performed as shown in Table 10, and all loadings were high,

ranging from .67 to .91, and all cross-loadings were at least .35 lower than the loadings, providing

evidence of convergent and discriminant validity. Confirmatory factor analysis was then

conducted and similar validation results were obtained, with loadings ranging from .65 to .95, and

all model fit statistics were within acceptable ranges with CFI = .954, TLI = .944, RMSEA = .08,

SRMR = .058, and Chi-Square/df = 163.65/74 (Gefen, Straub, & Rigdon, 2011; Hu & Bentler,

1999; Steiger, 2007). The goodness-of-fit indices and factor loadings show that the three-factor

model constraining CA, technophobia and technostress to be distinct constructs fits the data well.

Table 10: Study 1 Workers Sample - EFA Factor Structure and CFA Loadings

| | EFA Loadings/Crossloadings | | | CFA |
	CompAnx	TPhobia	TStress	Loadings
canx1	**0.70**	0.20	0.09	0.65
canx2	**0.72**	0.07	0.12	0.65
canx3	**0.70**	0.34	0.25	0.85
canx4	**0.67**	0.30	0.26	0.79
tphob1	0.19	**0.86**	0.12	0.88
tphob2	0.19	**0.91**	0.15	0.92
tphob3	0.23	**0.90**	0.17	0.95
tphob4	0.31	**0.76**	0.24	0.81
tstress1	0.12	0.09	**0.80**	0.81
tstress2	0.22	0.23	**0.76**	0.80
tstress3	0.20	0.11	**0.88**	0.90
tstress4	0.16	0.09	**0.86**	0.87
tstress5	0.09	0.23	**0.74**	0.77

Additional assessments of validity were also conducted including a check for common method bias (CMB), and more stringent assessments of convergent and discriminant validity in the presence of related constructs. As technostress had been previously measured indirectly by technostress creators (Tarafdar et al., 2007), further validation of the new direct, reflective measure of technostress was conducted, as shown in Appendix A2, Table A2.2. Given the high correlation (.73) between the second-order formative construct, composed of the technostress creators, and the new reflective measure of technostress, it was concluded that the new scale was an appropriate representation of technostress, aligning with prior formative measures in the literature. Appendix A3 reports the assessment of the discriminant validity between these affective responses and two important psychological covariates (trait anxiety, negative affectivity). Finally, the marker variable test for common method bias was conducted. The

results, reported in Appendix A4, suggest that common method bias did not have a significant effect on the study results.

Study 1 Results

In Study 1, participants were asked to respond to survey questions referencing the category of ICT they used most frequently (i.e., Office productivity, Enterprise and database systems, and other ICTs). Technostress was expected to vary based on the ICT category, as technostress is a negative affective response to a specific technology with greater technostress expected with ICTs that are more complex or result in greater overload or uncertainty. On the other hand, CA and technophobia are negative responses to technology in general and are not expected to vary based on an evaluation of a specific technology. Table 11 provides the mean levels of technostress by ICT category, and the test of significant differences in levels of technostress. Further analysis of pair-wise contrasts show that users experience greater technostress with enterprise & database software than the other two categories, and the technostress reported with office productivity software and the "other work software" category were not significantly different.

Table 11: Study 1 Workers Sample - Comparison of
Technostress across Technology Category

	Enterprise & Database	Office Productivity	Other Work Software	F-Ratio	Sig (2-tailed)
Computer Anxiety	1.86 (0.92)	1.69 (1.00)	1.52 (1.07)	1.061	0.348
Technophobia	1.21 (0.46)	1.20 (0.68)	1.05 (0.25)	0.777	0.461
Technostress	2.25 (1.30)	1.59 (0.91)	1.91 (1.32)	6.640	**0.002**
Sample Size	48	117	26		

Study 2 Validation

A similar validation process was conducted with the data from study two. Descriptive statistics, Cronbach's alpha, AVEs, and correlations for the four negative affective responses examined in Study 2 are shown in Table 12. Technophobia again had the lowest mean, as expected, given that this more extreme negative affective response is a type of phobia and found less frequently in the population than other negative affective responses. The correlations shown were all significant and confirm that the concepts are related, but all correlations were less than the square root of the average variance extracted (AVE) for each construct suggesting that these constructs are also distinct.

Table 12: Study 2 Student Sample - Descriptive Statistics and Correlations

	Mean	StDev	Min	Max	Alpha	CR	AVE	CA	Tphobia	Tstress	TISA
Computer Anxiety (CA)	2.56	1.13	1.00	6.00	.84	.85	.58	**0.762**			
Technophobia	2.15	1.10	1.00	7.00	.94	.93	.77	0.522	**0.877**		
Technostress	2.63	1.15	1.00	6.00	.96	.95	.80	0.409	0.348	**0.894**	
TISA	3.35	1.41	1.00	7.00	.93	.94	.74	0.306	0.332	0.250	**0.860**

Note: Square root of the AVE is shown on the diagonal in bold. CR = composite reliability

Exploratory factor analysis was performed as shown in Table 13, and all loadings were found to be high, ranging from .63 to .92, and all cross-loadings were at least .35 lower than the loadings, providing evidence of convergent and discriminant validity. Confirmatory factor analysis was also conducted with similar validation results, and all model fit statistics were within acceptable ranges with CFI =0.963, TLI =0.956, RMSEA=0.066, SRMR=0.033, and Chi-Square/df =325.98/129.954 (Gefen et al., 2011; Hu & Bentler, 1999; Steiger, 2007). In summary, these results confirm the discriminant validity of the four negative affective responses and show that these constructs can each be measured with parsimonious, reflective measurement scales.

Table 13: Study 2 Student Sample - EFA Factor Structure and CFA Loadings

	EFA Loadings/Crossloadings				CFA
	CompAnx	TPhobia	TStress	TISA	Loadings
canx1	**0.71**	0.13	0.18	0.11	0.75
canx2	**0.63**	0.17	0.06	0.08	0.65
canx3	**0.76**	0.27	0.14	0.09	0.82
canx4	**0.75**	0.19	0.24	0.14	0.82
tphob1	0.30	**0.72**	0.10	0.14	0.79
tphob2	0.29	**0.84**	0.15	0.18	0.91
tphob3	0.15	**0.89**	0.17	0.14	0.91
tphob4	0.16	**0.85**	0.15	0.11	0.89
tstress1	0.11	0.13	**0.84**	0.10	0.87
tstress2	0.15	0.11	**0.89**	0.10	0.92
tstress3	0.12	0.13	**0.92**	0.11	0.94
tstress4	0.21	0.05	**0.88**	0.10	0.89
tstress5	0.13	0.20	**0.82**	0.09	0.86
tisa1	0.11	0.12	0.07	**0.85**	0.87
tisa2	0.02	0.10	0.14	**0.79**	0.80
tisa3	0.09	0.10	0.07	**0.84**	0.86
tisa4	0.13	0.15	0.11	**0.89**	0.92
tisa5	0.14	0.08	0.09	**0.84**	0.85

Study 2 Results

In Study two, a controlled experiment was used to manipulate the familiarity and the perceived complexity of a computing task (episode) to demonstrate the differing effects on TISA and technostress. Participants were randomly assigned to use one of two ICTs (PowerPoint-more familiar vs. Paint-less familiar) and were also assigned to a more/less complex computing task (no requirements-design any type of flyer, vs. requirements-design a flyer to meet specific requirements). Thus participants had varying experiences during their episode of technology use and were expected to report different levels of TISA depending upon the ICT task requirements.

Technostress toward the same computing application was measured in a pre-task survey, and thus was expected to be affected by the assigned application, but not by the computing task requirements, which had not yet been presented to the participants. Table 14 shows the construct means by treatment.

Table 14: Study 2 Student Sample - Means of Technostress and
TISA across Treatments

	Paint			PowerPoint			Total	
	Requirements			Requirements			Requirements	
	Low	High	Total	Low	High	Total	Low	High
Technostress	2.98 (1.17)	2.85 (1.20)	2.92 (1.18)	2.34 (1.03)	2.40 (1.08)	2.37 (1.05)	2.64 (1.14)	2.62 (1.16)
TISA	3.14 (1.28)	3.84 (1.49)	3.47 (1.42)	2.77 (1.10)	3.83 (1.50)	3.25 (1.40)	2.95 (1.20)	3.84 (1.49)

A MANOVA test was run to examine the effects of the experimental treatments on TISA and technostress. CA and technophobia were included as control variables given the possible effects of these general, trait-based affective responses on affective evaluations of specific ICTs. Gender was also included as a control variable based on research chronicling gender differences in anxiety responses (Feingold, 1994; Whitley, 1997). The results showed that the Wilks Lamba effects were significant for all control variables and for the main effects of familiarity and ICT task requirements (p-value < .000), but the interaction of these two treatments was not significant. Thus, individual ANOVAs were conducted for TISA and technostress as shown in Table 15.

Table 15: Study 2 Student Sample – MANOVA Results

	TISA		Technostress	
	F	Sig.	F	Sig.
Gender	3.350	.068	**11.482**	**.001**
Computer Anxiety	**5.966**	**.015**	**30.123**	**.000**
Technophobia	**11.346**	**.001**	**13.154**	**.000**
ICT Familiarity	1.425	.233	**21.792**	**.000**
ICT Task Requirements	**31.586**	**.000**	1.494	.222
ICT Familiarity x Task Requirements	2.066	.152	.288	.592

TISA R-Squared = .198
Technostress R-Squared = .240

The control variables had the expected effects, with both CA and technophobia having significant positive effects on TISA and technostress. Gender also had a significant effect on technostress and a marginal effect on TISA (p-value <.07), with females reporting higher levels of TISA and technostress than males. The results for ICT familiarity and task requirements support the differentiation of TISA and technostress, with ICT familiarity having a negative effect on technostress, but no effect on TISA. In other words, when participants were assigned to use a less familiar ICT (i.e., MS Paint), they reported higher levels of technostress. Further, ICT task requirements had a significant, positive effect on TISA, such that when participants were asked to create a flyer with specific design requirements, they reported significantly higher levels of TISA during the task. An additional ANOVA was run for TISA with technostress included as a covariate (i.e., technostress is an outcome based evaluation-based on past experiences with an ICT and was assessed on the pre-task survey), and ICT task requirements continued to have a positive, significant effect on TISA, even when considering the effects of existing technostress toward the ICT.

Discussion

Dark side variables, and affective constructs in general, have become increasingly important in IS research, just as the importance of affect and feelings has been recognized in other disciplines. ARM provides the theoretical foundation needed to better understand and integrate affective responses to technology. As documented in the literature, the three negative affective constructs of computer anxiety, technophobia, and technostress have overlapping qualities with some similar antecedents and outcomes, yet ARM enables us to differentiate among these related concepts, and to propose a new affective response to technology, TISA. Our review of the existing research on these constructs identified gaps in the literature related to the operationalization and measurement of the constructs, and relationships among them. These gaps require both conceptual and empirical examination, as they limit thorough understanding of the potential outcomes from these negative affective responses to technology. In the following sections, theoretical and practical implications, future research opportunities and the limitations of this paper are described.

Theoretical Implications

In the light of recent guidelines on theoretical contributions in IS (e.g. Rivard, 2014), this paper has a number of contributions. First, it applies an IS framework to differentiate affective concepts that seemingly overlap. As a result, this paper clarifies existing constructs, documents the differences in how they have been conceptually and empirically studied and provides clear pathways for future research in this area. Our examination highlights the need to better understand the nature of computer anxiety, technophobia and technostress in accordance with the

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five dimensions of ARM, and to appropriately operationalize and measure these constructs. For example, research on technostress has identified the stressors and the resulting strain or burnout that results from technostress (Ayyagari et al., 2011), often conceptualizing technostress as a second order construct with first order dimensions (Tarafdar et al., 2007), or even a formative first order construct (Tarafdar et al., 2015). However, existing research did not measure the higher order factor reflectively or formally model this multi-level construct. This oversight is problematic, as it confounds the internal state of technostress with the stressors that create technostress. In this paper, this overlap is resolved first conceptually and then empirically as formative measures of technostress creators are shown to be strongly related to a measure of technostress as an internal state.

Second, a new construct, technology induced state anxiety (TISA), was proposed to address a noted gap in the ARM taxonomy of affect-related responses to technology. This construct represents episodic affective responses to technology use that are temporary and do not persist over time. Yet, several similar emotional responses to multiple episodes of technology use can accumulate and become a persistent, outcome-based affective evaluation of that same technology. As an individual experiences TISA repeatedly, technostress can develop. Similarly, repeated TISA experiences can become learned responses, resulting in increased CA, or perhaps even technophobia related to technology in general. The relationships between these categories of affective responses is supported by ARM, but had not been advanced in the literature. Further, the absence of an appropriate concept to instantiate these patterns of effects (i.e., TISA) was a gap in this re-search area. Thus, the introduction of TISA provides a strong theoretical contribution, as this construct explains how state-like emotional responses to technology can evolve into more

permanent negative dispositions that may hinder performance outcomes with technology and future interactions to technology. Further, TISA may be critical to connecting research on affective responses to existing streams. For example, consider that recent research on ICT-enabled interruption in the workplace appropriately focuses on episodic stress rather than lasting or chronic stress (e.g., Galluch et al., 2015). Also, the growth of neuroIS methods, which focus on episodic measurements, makes it critical for such a state/transient affective concept to be proposed. Future research in this area can benefit from including perceptual measures of TISA in studies that examine the operational level of using technology, and then further connect TISA to lasting affective dispositions and use outcomes.

Third, in response to calls in ARM (Zhang, 2013) and to address gaps identified in the literature review, this paper develops several new scales. A reflective, direct measure of technostress as an internal state was developed. This presents a parsimonious and psychometrically valid alternative to the current use of stressors, as formative factors of technostress, to represent an internal state. A measure of technophobia was developed, as previously a composite of two or more existing affective concepts was used to measure this construct. Further, a measure of the new construct, TISA, was developed. The development of these new scales and the use of existing scales for CA and technostress creators, enabled a comprehensive construct validation exercise through two empirical studies. The results suggest that these constructs are distinct, yet related, and clear up potential for confusion in the literature, laying the groundwork for future empirical studies on negative affective responses to technology.

Fourth, this paper presents an integrated nomological network which provides a pathway to understanding the associations between sociological and psychological approaches to studying

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computer anxiety, technophobia and technostress. Sociological theory and psychological theory typically operate on different levels, as such, this kind of convergence is desirable for the advancement of our understanding of important concepts (Levinson, 1964). For example, studies that focus on how individual characteristics relate to organization level outcomes such as job satisfaction or job performance (i.e., psychological perspective) will do well to consider how organizational conditions (i.e., sociological perspective) or task characteristics can influence those outcomes, or take them into account as control variables at the least. This integration of additional categories of affective antecedences contributes by extending ARM beyond the two affective antecedences it considers (individuals and technology).

This research also provides an extended foundation for the increased study of cyberpathologies and disorders such as computer and internet addiction, computer rage and other obsessive compulsive technology use behaviors. In the nomological network, these behaviors would be represented as outcomes of these affective concepts. For example, research on technology addiction can integrate affective evaluations to better understand what triggers overly high levels of engagement with technology that becomes compulsive and interferes with daily life (Turel et al., 2011). Addictions are motivated both from pleasure-seeking motivations and the desire to avoid the aversive symptoms of withdrawal (Robinson & Berridge, 2000), therefore these concepts may have interesting relationships with problematic patterns of technology use.

Practical Implications

This paper also delivers strong practical implications for the design of technology interfaces and the related training and ongoing support within organizations. A comprehensive structure for the antecedents of the three dark side variables provides increased insight into the factors that could be modified to minimize the negative affective experience on three levels – individual, technology, and organizational/environmental. These can be combined in innovative ways to curb technostress in organizations. For example, managerial support could be enhanced and the interface could be modified to reduce TISA, which should in turn reduce technostress. Further, individual characteristics associated with these negative affective responses could also be assessed to determine which users might benefit from individual management or intervention with these dark side variables.

Similarly, a better understanding of the outcomes that may result from these negative affective responses can assist organizations in being more aware that such responses are occurring and in understanding the seriousness or intensity of these responses. For example, routine assessments could help organizations in diagnosing when negative affective responses have crossed the threshold from the more benign computer anxiety to a more extreme technophobia. Such measures could also enable organizations to monitor how the downstream effects of technology-related stress and anxieties threaten employee retention and organizational performance.

Third, a distinction between generalized and non-generalized (specific) negative evaluations of technology has not been commonly applied in the IS literature and might be more appropriate going forward. This differentiation, empirically shown in this paper, points out that the context

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appropriate construct and measure should be used in empirical studies to provide more

appropriate operationalization and increased explanatory power.

Limitations

This paper describes a literature review and conceptual discussion of negative, affective

responses to technology, with two empirical studies conducted to validate and differentiate four

negative affective responses to technology. While several positive, affective responses to

technology were highlighted, an empirical examination of positive affective responses to

technology was not conducted. Further, cognitive responses to technology were excluded from

the review and empirical studies. An integration of negative and positive affective responses and

cognitive responses is needed to fully understand the impact of affective responses to technology

on important outcomes.

Conclusion & Future Research

This paper set out to identify the range of antecedents and outcomes for the concepts of

technostress, computer anxiety and technophobia, and to differentiate among the three constructs.

An extensive literature search was carried out to identify research from which individual

nomological networks and an integrated nomological network of antecedents and outcomes was

created. ARM was then applied to explain the relationship between these focal constructs and

other affective constructs, a process which led to the identification of a new construct with

foundations in the existing literature (technology induced state anxiety; TISA), and shed more

light on the range of affective responses to ICT stimulus. Brod (1984), a pioneer of technostress research, opined that stakeholders needed to carefully reevaluate many elements of computer technology integration into our daily lives in order to make technology less machine-centered and more human-centered. Understanding exactly how humans react to technology is essential to this undertaking. This work represents an attempt to integrate forty years of research on negative emotional responses to technology and recent theoretical advances (ARM) into a clear path for future research on how to better understand and predict the responses of individuals to technology.

For future research, the range of relationships which were hitherto established in the wider nomological network (Figure 4) may be tested to confirm our understanding of this area and clear up any areas of confusion. Similarly, propositions from ARM are yet to be empirically tested in the IS literature and such work is clearly needed for us to gain a more nuanced understanding of how these negative affective concepts relate to each other over time, and impact technology-related performance outcomes.

Another important direction for future research is the consideration of positive, affective concepts that result from interaction with IT objects or from using IT. It has been widely documented that positive and negative concepts are distinct (Huppert & Whittington, 2003; Warr, Barter, & Brownbridge, 1983; Watson, Clark, & Tellegen, 1988) and there is need for positive, affective concepts to be afforded a similar focused review and validation. Further, a comprehensive empirical study of both positive and negative affective responses to technology is needed to understand this distinction and the effects on performance outcomes. By proposing a number of

positive affective concepts, this work seeks to lay a foundation for future research in this direction.

In addition, a better understanding of the process by which IT attributes (both physical and system attributes) might lead to TISA can help designers think of dynamic ways of reducing technology induced state anxiety using design. For instance, it is known that more beautiful interfaces are considered easier to use (Tractinsky, Katz, & Ikar, 2000), thus perhaps the adoption of smart and dynamic use-session experiences can be used to improve the degree to which the individual feels positive affect. This is not completely futuristic as present day video game design is known to utilize dynamic difficulty adjustment (DDA) to change parameters of the game environment based on the player's abilities to prevent them either becoming too bored or too frustrated.

Further, research is needed to theoretically and empirically connect affective responses to technology with behavior and performance outcomes. IS research now acknowledges that emotions can play a critical role in system use, and models like ARM need to be connected to post-adoptive behavior (Zhang, 2013). An important next step in IS research on affect is to examine which affective responses to technology most influence performance during episodes of system use, and which responses to technology are most influential on long-term behavior such as continued use or avoidance.

CHAPTER 3

FROM FEELINGS TO FAILING? HOW AFFECTIVE RESPONSES TO TECHNOLOGY INFLUENCE PERFORMANCE OUTCOMES

<u>Introduction</u>

In the previous chapter, the Affective Response Model (ARM; Zhang, 2013) was applied to classify and differentiate the major known negative affective responses to technology (computer anxiety, technophobia and technostress). A new concept, Technology Induced State Anxiety (TISA), was also introduced based on ARM. New measurement scales were created and preliminary evidence of the convergent and discriminant validity of these concepts was provided. This work lays the foundation for further research in this area. For instance, there is need to (a) understand how these concepts relate to each other, (b) clarify which antecedents in the nomological network most strongly influence each affective concept, and (c) evaluate the impact of affective responses on computing performance outcomes, an ignored category of outcomes that managers and businesses care about. Further, there is need to explore how these relationships might change with added experience with a given system.

Prior literature suggests omnibus reciprocal relationships between all four of these negative affective concepts (Zhang, 2013). However, no single study has measured more than one of these affective concepts at the same time, despite the maturity of three of the concepts. This absence of research that explores and tests the relationships between affective concepts is a gap that can now be addressed given the development of psychometrically and theoretically valid scales.

Related to this, there are still many untested relationships within the nomological network identified in the prior chapter. For instance, while some research has considered the influence of individual characteristics on computer anxiety, there is no detailed examination of how individual characteristics influence technostress. This work addresses this gap by considering how different types of antecedents identified in the IS literature may influence the different affective concepts. ARM describes two categories of antecedents - individual characteristics and technology characteristics. These antecedents are said to directly influence all four negative affective concepts (Zhang, 2013). For practical reasons, this interconnected set of relationships does not offer much to businesses seeking to manage affective responses to technology. There is need for more nuanced and actionable explanations of relationship patterns between antecedents and affective concepts. Such directional relationships can also be empirically tested more easily. Further, the IS literature, as described in the prior chapter, has examined task/organizational characteristics as being relevant antecedents of affective responses to technology. Thus the ARM propositions need to be extended to address the role of this additional antecedent category.

Further, existing IS research connecting affective responses to outcomes of interest is still sparse. For instance, while ARM does a lot to advance this body of research, it does not link affective concepts to performance outcomes from using technology. Given that performance outcomes are an important aspect of technology use, this is a gap that needs to be addressed. Existing IS research points out that affect can influence the nature of system use (Beaudry & Pinsonneault, 2010), attitudes and expectancies toward use (Brown, Fuller, & Vician, 2004; Igbaria & Parasuraman, 1989), and effectiveness of decision aid use (Djamasbi, 2007). However, this work pre-dates the clarity instituted by the ARM theoretical framework. There is need to integrate what

is now known about different affective concepts into our understanding of various computing outcomes. There is also need to evaluate which of several affective concepts are more likely to impact performance outcomes.

Lastly, it is known that affective concepts are not static (Zhang, 2013), and the repeated interaction of users with a technology may change their perspective. Existing IS research has shown such changing effects with the acquisition of greater system experience (Venkatesh, 2000). Recent work points out that affect might have an influence on technology usage under some conditions but not under others (Ortiz de Guinea & Webster, 2013). Therefore, this paper considers how user experience with a given technology may moderate the relationships between antecedents, affective responses to technology, and resulting performance outcomes.

This paper seeks to address the gaps identified above by answering the following research questions:

1. How do the different affective concepts studied in the prior chapter, computer anxiety, technophobia, technostress and TISA, influence each other?
2. Which antecedents are more likely to influence the different affective concepts?
3. How do the different affective responses come to influence performance outcomes on computing tasks? And which of them are more likely to influence different performance outcomes?
4. How do these relationships change with added system experience?

To address these questions and offer a clearer, alternative explanation of existing relationships, this work relies on a theoretical foundation in the existing IS literature and integrates some new

ideas from the reference discipline of psychology. First, two dimensions of ARM are considered in closer detail – whether an affective concept is (1) temporally constrained or temporally unconstrained, and (2) directed towards a specific technology or towards technology in general. Based on these dimensions, the IT interaction episode or performance episode (temporally constrained and specific technology) is considered as a unit of analysis.

The idea of a "performance episode", a time-bound period during which an individual is using a specific technology to complete a given task" (Beal, Weiss, Barros, & MacDermid, 2005), also makes it possible to evaluate possible changes in relationships with greater experience. IS researchers have considered this idea as the intersection between the user, system and task (Burton-Jones & Grange, 2012; Burton-Jones & Straub, 2006), and have labeled it as the episode (J. Kim & Lerch, 1997; Newell, Simon, & others, 1972), the ICT interaction episode (Zhang, 2013), the task episode (Eason, 1984; Jeffries, 1997), an individual "employing an IT to accomplish a work-related task" (Ortiz de Guinea & Webster, 2013) , and "the time (an individual) works with a system" (Loiacono & Djamasbi, 2010). Existing psychology literature makes it clear that affective states and performance outcomes are directly related to what occurs in such task-focused performance episodes. Thus, taking a single episode of system use prior to building experience with the system as an initial focal point, this paper explores how existing affective evaluations and other antecedent characteristics come to influence the performance outcomes from the episode. The changes to these relationships after users acquire more system experience is also evaluated.

This paper seeks to make several contributions to our understanding of negative affective responses to technology, building on IS research that identifies emotions as playing a critical role

in patterns of systems use and other outcomes (De Guinea & Markus, 2009; Djamasbi, 2007; Ortiz de Guinea & Webster, 2013), and answering the call for research to better connect the affective response model to post-adoptive behavior (Zhang, 2013). First, the nature of the relationships between key affective concepts is discussed and then tested experimentally. Different categories of antecedents are assessed for their influence on affective responses. The influence of affective responses on various performance outcomes is also assessed. Lastly, a longitudinal view is taken making it possible to explain and test relationships that may strengthen or attenuate with added experience using a given system.

In the following section, the theoretical foundation for this work is introduced in more detail. First, the propositions from ARM are reviewed then antecedents and outcomes of affective responses to technology are discussed. Two dimensions of ARM are then focused on to further explain how affective concepts relate with each other and why certain antecedents match up better with particular affective responses. There is also a discussion of anticipated changes in some key relationships as added experience is gained, after which several research hypotheses are proposed. The laboratory experiment used to test the hypotheses is then described and the findings are presented. The paper ends with a discussion of findings, implications for theory and practice, and future research directions.

Theoretical Background

In this section, propositions from ARM which explain the relationships between affective concepts are reviewed and applied to the research context of negative affective responses to

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technology. Antecedents to affective concepts are reviewed, including two categories of

antecedents from ARM, and a proposed third category of antecedents based on a review of the IS

literature on affect. Following this, ARM is extended by connecting these affective concepts to

performance outcomes. Two dimensions of ARM, temporal and general/specific referent objects

are used to provide justification for why certain antecedents and outcomes are more strongly

related to different affective responses. Finally, these two dimensions of ARM, along with the

psychology and IS literature are integrated to develop the concept of technology performance

episode which helps explain how user experience with a system may change the relationships

between antecedents, affective concepts and outcomes.

ARM Propositions

ARM is a theoretical framework that supports defining affective concepts based on five

dimensions (*residing, temporal nature, particular vs. general stimulus, object vs. behavior*

stimulus, and process-based vs. outcome based evaluations). These dimensions are used to create

the taxonomy of affective concepts, with the relationships between categories specified by

theoretical propositions in ARM. Because ARM is a process model, these propositions include

circular flows (i.e., bidirectional relationships), and all categories of affective states and responses

are related to one another. It then follows that computer anxiety, technophobia, technostress and

TISA, the concepts studied in the prior chapter, are all reciprocally related to each other. While

this omnibus collection of relationships may be theoretically grounded, it is of limited practical

relevance. This paper seeks to address this gap in the literature. A first step in this process is to

review the ARM propositions and apply the propositions to the specific constructs examined in this research.

Three super-categories of affective concepts are identified from ARM. These categories include *general learned affective evaluations/dispositions*, *particular affective evaluations* and *induced affective states*. The negative affective concepts considered in this paper fall into each of these three categories. Both computer anxiety and technophobia are general learned affective evaluations/dispositions, with computer anxiety directed towards the *behavior* of using computers, while the more severe response of technophobia arises from the mere thought of the system as an *object*. Given the severity of the concept, technophobia is not expected to be a major driver of behavior within the populations studied in this paper (workers and students) and so is not included in the propositions or hypotheses. Technostress is a particular affective evaluation directed towards a specific system (i.e. a particular instance of the general category). TISA, the newly proposed concept, is an affective state which occurs during the episode of use (which can only be the use of a specific system).

General, Learned Affective Evaluations/Dispositions

Learned affective dispositions are more general, lasting and enduring. They result from higher-level reflections and are stored in memory, making them an ongoing determinant of behavior and attitudes. ARM offers that learned affective dispositions can shape future affective responses towards specific stimuli, activating feelings when the right stimulus is present. (Zhang, 2013). Computer anxiety, being such a learned affective disposition is thus expected to trigger feelings of TISA during a user's interaction with an IT. To paraphrase proposition 1 from Zhang (2013),

"*learned affective dispositions towards IT in general influence the induced affective states experienced during interaction with any particular IT object*". This leads to the following proposed relationship:

> P1: An individual's degree of apprehension towards using IT in general (computer anxiety) influences the induced affective states they experience while using a particular IT (TISA).

An individual's induced affective state during the interaction with a particular IT becomes a source of information that is additionally considered, thereby updating one's learned affective evaluations/dispositions (Schwarz 2001; Schwarz and Clore 1983 in Zhang, 2013). A user's experience of an anxious state during the episode (i.e. TISA), leads to an even more apprehensive disposition towards IT in general. In other words, to paraphrase proposition 2 from Zhang (2013): "*Induced affective states experienced during the interaction with particular IT influences an individual's learned affective evaluations/disposition towards IT in general*". This leads to the following proposed relationship:

> P2: The degree to which an individual experiences technology induced state anxiety while using IT increases their apprehension towards using IT (computer anxiety).

Induced Affective States

As hinted in P2 above, affective states during episodes of interaction with an IT lead to the formulation of lasting affective dispositions. While the proposition above refers to learned affective evaluations/dispositions towards in IT in general, there also exist particular affective

evaluations towards the specific technology that was being used in the episode. According to proposition 3 in Zhang (2013), "*induced affective states experienced during the interaction with particular IT objects influence an individual's affective evaluation of the interaction experience with the ICT"*. Affective evaluations of the interaction experience have been shown by Zhang (2013) to be multi-faceted. In fact, the more detailed nomological net of ARM (Zhang, 2013) proposes an extensive set of relationships among process-based affective evaluations and outcome-based affective evaluations, as well as between evaluations towards objects and towards behavior. Based on the classification of technostress offered in the prior chapter, it is an outcome-based affective evaluation towards using a specific technology. Experiencing TISA during episodes of use will influence expectations about future outcomes with a particular system, possibly leading the individual to feel that they are incapable of coping with that system i.e. technostress. This leads to the following proposed relationship:

> P3: The degree to which an individual experiences technology induced state anxiety while using a particular IT increases the degree to which they feel that particular IT is an ongoing source of discomfort and they will be unable to cope with it (technostress).

The relationship between induced affective states and particular affective evaluations also holds in the opposite direction as explained by Zhang (2013). Just as learned affective evaluations/dispositions towards IT in general can produce affective states, particular affective evaluations can produce induced affective states during interaction with that system. In fact, induced affective states during an interaction episode using a particular IT (i.e. TISA) should be even more closely linked to existing particular affective evaluations towards that IT (i.e. technostress) than towards the general class of all IT (i.e. computer anxiety). To paraphrase,

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proposition 4 from Zhang (2013), "*an individual's affective disposition towards a particular IT influences the induced affective state experienced during the interaction with that particular IT*". Zhang (2013) points out that this link is yet to be tested in the IS literature. This leads to the following proposed relationship:

> P4: The degree to which an individual feels a particular IT is an ongoing source of discomfort with which they are unable to cope (technostress) increases technology induced state anxiety experienced by the individual during an interaction episode with that that particular ICT.

Particular Affective Evaluations

ARM points out that although they can be easily confounded, affective responses towards a general category of stimuli are different from affective responses towards a particular stimulus within that general category. According to Zhang (2013), the statement "I enjoy using **this** decision support **tool**" means something very different from "I enjoy using decision support **tools**". Nevertheless, these categories bear a relationship with each other. Prior evaluations of a type of object category tend to 'guide' the formation of new, learned evaluations towards particular objects of the same category in the future. Therefore, "*an individual's affective disposition towards IT in general influences their affective evaluations of particular IT*". This leads to the following proposed relationship:

> P5: An individual's degree of apprehension towards using IT (computer anxiety) influences the degree to which they feel an on-going sense of discomfort and pressure with a particular IT (technostress)

According to Zhang (2013), because general affective dispositions are also capable of changing with time (albeit very gradually), particular affective evaluations may serve to reinforce and strengthen such general dispositions. With each negative particular affective evaluation acquired (i.e. technostress), it is internally consistent with a learned disposition of computer anxiety towards the entire category of IT, therefore it should strengthen feelings of apprehension towards using computers all other things being equal. Thus, proposition 6 from Zhang (2013) can be paraphrased as follows: "*an individual's affective evaluation of interactions with particular IT influences their affective disposition towards IT in general*". This leads to the following proposed relationship:

> P6: The degree to which an individual feels an on-going sense of discomfort, pressure or inadequacy with a particular technology (technostress) influences his/her degree of apprehension towards using IT in general (computer anxiety).

The preceding six propositions, based on ARM, lay the foundation for a much closer consideration of how these affective concepts are related. The next section reviews two categories of antecedents of these affective concepts based on ARM, and suggests a third category of antecedents. Propositions are provided to describe the general relationships between antecedent categories and affective responses.

Affective and Non-Affective Antecedents

According to ARM, individual characteristics and technology characteristics are the two main categories of antecedents to affective responses. Individuals have affective traits which are relatively fixed aspects of their personality that come to influence affect, even after accounting for the context of study. Similarly, any given technology possesses many attributes and characteristics, some of which are perceived as 'affective cues' and as having 'affective quality'. These can be perceived by the individual, thereby triggering certain affective responses. In an extension to the antecedent categories of ARM, the prior chapter identifies task/organizational characteristics as being a driver of affective responses in past IS literature. While ARM focuses on affective dimensions of these antecedents alone, there is a need to consider the possible influence of non-affective dimensions of these antecedent categories, especially given the non-affective nature of the task/organizational characteristics.

Individual Characteristics

ARM proposes that individual characteristics and traits can influence how users respond to technology. The previous chapter points out a number of individual characteristics that have been considered antecedent to various affective responses to technology in past research. Of these, negative affectivity and trait anxiety are clearly negative affective traits which according to ARM, influence (all) affective responses to technology. Another individual characteristic that ARM proposes will influence affective responses to technology is the individual's free floating mood state. While some research has considered the role of mood in influencing cognitive processes

and subsequent IS usage and performance (Loiacono & Djamasbi, 2010), no IS research on computer anxiety or technostress have considered the possible influence of free floating mood on the observed results.

In addition to the affective traits discussed above, there are several non-affective individual characteristics of relevance. For instance, general computer self-efficacy, user experience, gender, etc. have been shown to influence various affective responses to technology. These non-affective characteristics need to be considered for their influence on affective responses to technology. This leads to the following proposition:

> P7: Both affective and non-affective individual characteristics influence affective responses to technology

Technology Characteristics

Affective technology characteristics are considered antecedent to the range of affective responses to technology. They include affective cues and affective quality. Affective cues are specific features of a technology such as size, visual appearance, color, etc. that manifest an affective quality (Zhang, 2013). Existing IS research has considered how loading attractive affective cues into a system design can improve user perception of utilitarian evaluations such as usability (Hassenzahl, 2004; Tractinsky, Katz, & Ikar, 2000; Van der Heijden, 2003). As such, it is not farfetched to expect that the presence of certain affective cues can lead to the activation of certain affective responses to technology in the individual.

However, there are also many non-affective system attributes that may eventually drive affective responses to technology. These have to do with more general attributes of a technology as identified during the requirements gathering process for a new system, broadly categorized into physical attributes and system attributes (Chung, Nixon, & Yu, 2000). Physical attributes of the system pertain to *what* the system does and the kind of operations that can be carried out on inputs as well as the outputs of the system. They are typically established through functional requirements gathering. While some of these attributes may possess an affective quality (e.g. use of color, overall aesthetics, etc.), the majority of them pertain to more utilitarian considerations such as the relative placement of icons, the clarity of graphics used, the logic and sequence of steps required to carry out operations, etc. System designers strive to create visually appealing systems as well as make systems that are usable and capable of doing the job they are designed to do. System attributes pertain to *how* the system performs i.e. the performance of the system and the data it produces (Chung et al., 2000). Examples of system attributes include speed, interoperability, error-handling capabilities, etc. Such characteristics are usually established via non-functional requirements. Many of these attributes cannot be ascribed a purely affective quality based on the definition in ARM (Zhang, 2013), but they can create cognitive barriers and make using the technology more anxiety-inducing overall. For instance, a slow performing system that frequently glitches, aside from making computing tasks difficult to complete, can make users unhappy and anxious. These ideas lead to the following proposition:

> P8: Both affective and non-affective technology characteristics influence affective
> responses to technology

Task/Organizational Characteristics

The prior chapter identifies a good number of task/organizational characteristics that past research has found to be antecedent to computer anxiety and technostress. Several organizational characteristics have been shown to influence computer anxiety and technostress, but none of them are affective concepts. Rather, they represent realities within an individual's immediate environment and describe the context in which the IT interaction episode is occurring. Examples of such environmental characteristics include technical support provision, literacy facilitation, involvement facilitation, perceived managerial support, autonomy, and presence of organizational services.

The influence of task characteristics on how individuals use and perform with technology has been widely documented (Dishaw & Strong, 1999; Goodhue & Thompson, 1995). However, this work tends to disproportionately focus on the cognitive burden from task characteristics (Goodhue & Thompson, 1995; Speier, Vessey, & Valacich, 2003). However, there is also evidence that task characteristics have an affective dimension, influencing feelings experienced during the task as well as the state of intense concentration referred to as optimal flow (Ghani & Deshpande, 1994). Such characteristics are clearly distinct from the technology itself and may even be determined by the broader organizational context in which the task is being completed. These characteristics can bear upon the individual, and have been noted to increase subjective perceptions of stress, heighten neurophysiological markers which objectively measure stress and influence task performance (Galluch, Grover, & Thatcher, 2015; Ortiz de Guinea & Webster, 2013; Speier et al., 2003). This warrants their inclusion along with organizational characteristics

as contextual factors likely to influence affective responses to technology. This leads to the following proposition:

P9: Task and organizational characteristics influence affective responses to technology

Three categories of antecedents to affective responses to technology have been introduced and discussed. The first two categories of antecedents are argued to influence all affective concepts i.e. computer anxiety, technostress and TISA, according to ARM (Zhang, 2013). Despite theoretical support in ARM, the idea that these two broad categories all have a similar influence on the seven categories of affective concepts is rather overwhelming and limits applicability to practice. Further, affect-related research on task and organizational characteristics is rather limited and no guidance is offered as to whether this newly added antecedent category will similarly be assumed to influence all affective responses. There is clearly a need to offer a more systematic explanation and proffer a pattern of relationships that indicates which antecedents might most influence certain affective responses more. The next section reviews the literature on the potential influence that affective responses to technology have on performance outcomes.

Affective Concepts and Performance Outcomes

Performance outcomes, broadly defined as evaluations of the output of a computing task performed by an individual (Burton-Jones & Gallivan, 2007), are of importance to individuals and businesses. These can be objective evaluations of the computing task outcomes or subjective perceptions held by the individual. The information systems field has been criticized for not

studying performance outcomes as much as topics such as technology adoption (Burton-Jones, 2005; Orlikowski, 2000). Despite the implicit assumption that people who adopt technology will go on to perform well with it, the reality is that today's workplace is marked by significant variations in the performance of technology users and there have been calls for IS researchers to better study the realities of continued IT usage (De Guinea & Markus, 2009; Zhang, 2013). In 2011, three out of four administrative professionals struggled to keep pace with technology (IAAP, 2011; Katie Bascuas, 2013), and this issue remains a top concern with this group of workers (IAAP, 2013). Even in technology-focused professions, significant variations in performance and output exist. It is estimated that as much as a ten-fold difference in productivity exists between the best and average programmers (Guzdial, 2014; Oram & Wilson, 2010). Provocatively, a VP of Engineering at Google believes that the difference is more in the order of 300 to 1 (Tam & Delaney, 2005). The reality is that people behave in different ways and use technology differently, and this translates to variations in performance that deserve the attention of IS researchers. This paper holds that affective responses to technology may play a role in shaping performance outcomes with technology.

Much research has connected affective concepts and the related underlying processes as critical for performing well. This includes cognitive performance (Eysenck & Calvo, 1992; Eysenck, Derakshan, Santos, & Calvo, 2007; Gray, 2004), memory and recall (Kensinger & Corkin, 2003; Luine, Villegas, Martinez, & McEwen, 1994; Richards & Gross, 2006; Shackman et al., 2006), overall wellbeing (Diener, Oishi, & Lucas, 2003; Fredrickson, 2001; Kitayama, Markus, & Kurokawa, 2000), even physical performance (Biddle & others, 2000). In management research,

a variety of outcomes have been shown to be consequences of affect in the workplace (Barsade & Gibson, 2007; Brief & Weiss, 2002).

While some IS research has considered the influence of affective concepts on behavior, including use-related behavior (Beaudry & Pinsonneault, 2010; Djamasbi, Strong, & Dishaw, 2010), no known work has taken on the challenge of linking affective responses to performance outcomes. Even ARM, while making significant strides to advance this area of research, "does not prescribe the consequences of affective concepts on other factors" (Zhang, 2013, p. 268), including performance outcomes. Nevertheless, there are several performance outcomes that are likely impacted directly by affective responses to technology that deserve attention. For instance, within the context of a computing task such as the use of a spreadsheet application or other enterprise system, user accuracy and efficiency are important objective performance outcomes. Also, there are practically relevant attitudes and expectancies that are formed based on objective performance, which are proxies of a successful interaction with technology. For instance, one's satisfaction with their performance using a given system, and future expectations of being able to perform well with the system are important subjective outcomes that business managers should care about.

Negative affective responses, such as those being examined in this paper, may significantly impact all such performance outcomes, as a negative state can redirect attentional focus from the task at hand to surrounding circumstances, and this tends to be detrimental to performance (Beal et al., 2005). When stimulated negatively, individuals tend to distance themselves from the perceived source of negative emotion (Avey, Luthans, & Youssef, 2010; Davidson, 1998; Harmon-Jones & Sigelman, 2001; Strack & Deutsch, 2004), and may redirect cognitive resources

towards the management of negative affect (Beal et al., 2005). This drains cognitive capacity, impairing cognitive processing efficiency (Eysenck & Calvo, 1992) and working memory (Kensinger & Corkin, 2003; Shackman et al., 2006). Therefore, this paper seeks to investigate if and how these negative affective responses to technology (i.e. computer anxiety, technostress and TISA) have an impact on computing performance outcomes. The foregoing postulates of ARM might lead us to expect an omnibus effect, i.e. that all affective concepts will influence all performance outcomes. However, given the practical importance of performance outcomes to IS research and practice, this research considers a pattern of relationships between antecedents, affective responses and performance outcomes.

Temporal and Specific/General Dimensions of ARM

Based on ARM and the IS literature, a theoretically grounded review of the relationships among the affective responses have been examined (i.e., relationships between computer anxiety, technostress and TISA). Categories of antecedents and the performance outcomes have also been discussed. While theoretically backed, the omnibus and reciprocal relationships expected between constructs based on the propositions from ARM need to be evaluated more closely. A pattern of relationships between antecedents, affective concepts, and outcomes will provide insight into the more influential relationships and direct future work in this area. Fortunately, two of the dimensions from ARM stand out as theoretical elements with which patterns of relationships can be proffered. The following section considers how the temporal nature and the technology

reference (specific or general) dimensions of ARM provide a better indication of the patterns of relationships between affective constructs.

Temporally Constrained/Unconstrained

This dimension of ARM refers to the duration of the affective condition. Affective evaluations and dispositions are temporally unconstrained because they endure for a long time. In that sense, they are very similar to attitudes – long lasting but not impossible to change (Clore and Schnall, 2005, p. 438 in Zhang, 2013). On the other hand, induced affective states are temporally constrained or state-like and last only while the triggering stimulus is present. Computer anxiety and technostress fall into the category of temporally unconstrained while TISA falls into the category of temporally constrained.

Specific/General

This dimension has to do with the specificity of the stimulus that triggers the affective condition. It also provides an indication of how aggregated and abstract that affective concept is. For a specific affective evaluation, e.g. technostress, the evaluation is directed towards a specific technology (named and known). As such, an individual may feel a different level of technostress towards a spreadsheet application than they feel towards design software. This effect was already demonstrated in the prior chapter where technostress varied significantly across different kinds of technology. On the other hand, a general affective evaluation is towards a more abstract general

category e.g. computer anxiety directed towards computers in general. This sort of affective

evaluation is therefore an aggregation of many specific affective evaluations.

Performance Episode: Temporally Constrained and Specific

Taking these two dimensions of ARM together leads to a natural unit of analysis for studying

affective responses to technology during interactions with technology. ARM addresses the

concept of an 'IT interaction episode' (Zhang, 2013), but there is need to address this concept

more formally. Other IS researchers have considered a similar unit of analysis under the labels of

episode (J. Kim & Lerch, 1997; Newell et al., 1972), "IT interaction episode" (H.-W. Kim, Chan,

& Chan, 2007; Zhang, 2013), and "task episode" (Eason, 1984; Jeffries, 1997). The *performance*

episode, a conceptualization from the field of psychology, provides a more formal description of

a time-bound collection of related actions directed towards a given goal, personal striving, or

desired state (Beal et al., 2005). In an IS context, a technology performance episode could be used

to describe a single interaction with a technology for the purpose of completing a task, and is

consistent with ARM in using a specific technology for a short time (shown in Figure 5 below).

Users will approach a given performance episode with prior levels of both technostress and

computer anxiety, which are temporally unconstrained. These affective concepts act as antecedent

factors to TISA, a temporally constrained concept emerging during a technology performance

episode. Further, the temporally unconstrained affective concepts can be thought of as aggregates

of experience over many past performance episodes.

Temporally Constrained	Temporally Unconstrained	
	Particular Stimulus	**General Stimulus**
TISA	Technostress	Computer Anxiety

EXPERIENCED WITHIN IT INTERACTION EPISODE   OVERALL EVALUATION/ DISPOSITIONS
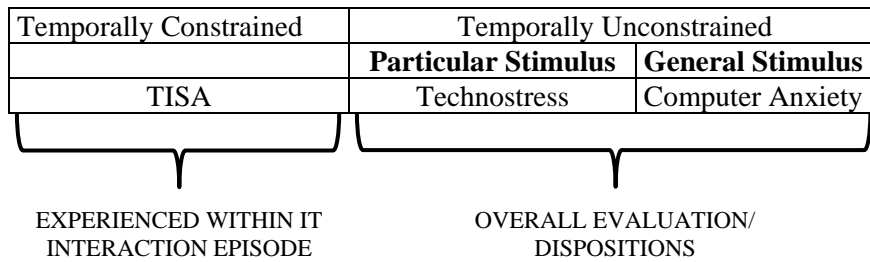
Figure 5: The Performance Episode and Affective Response Model (ARM) dimensions

The use of a technology episode as a unit of analysis lays a foundation for progressing research in this area for three reasons: (1) it is consistent with the dimensions of ARM, (2) it provides a stronger theoretical connection for both antecedents and performance outcomes, and (3) it aligns with the literature on psychological systems which explain how affect is processed during a given episode. In the last section of this literature review, the psychology literature on reflective and impulsive systems for processing emotions (the reflective-impulsive model – RIM) is discussed. This theory explains how affective states are triggered and why these states may have less impact as users gain additional system experience.

Reflective and Impulsive Processing of Affect

There are two distinct but interoperating systems for processing emotions, an impulsive and reflective system. The reflective system is a selectively-activated and more cognitive-demanding processing system while the impulsive system is always-on and responsible for more automatic processing (Strack & Deutsch, 2004). Both systems operate in parallel, but function very differently from each other. These systems have also been referred to as reflexive/reflective

systems (Soror, Hammer, Steelman, Davis, & Limayem, 2015), system 1/system 2 (Bösch, Erb, Kargl, Kopp, & Pfattheicher, 2016; Evans, 2003), and hot/cool systems (Kraft, Drozd, & Olsen, 2009; Metcalfe & Mischel, 1999). This theory has been applied widely in related contexts.

The reflective system is responsible for processing temporally unconstrained affect and long term, higher-order thinking, while the impulsive system processes immediate affective states (Strack & Deutsch, 2004). During any emotional episode, both systems are at work. However, if the perceptual input from the environment into the 'always-on' impulsive system is unfamiliar and very salient, it can impede the functioning of the 'selectively activated' reflective system (Wouda & van de Wiel, 2013). On the other hand, when the input from the environment is more familiar and thus only moderately salient, the reflective system can override the impulsive system and becomes a stronger influence on behavior.

Applications of RIM have pointed out that the impulsive system is responsible for non-rational or reactive behavior such as impulse buying. Positive feelings elicited from an immediate appeal to purchase a product will drive behavior when reflective mechanisms are disengaged (Strack, Werth, & Deutsch, 2006). Within the field of IS, this two-system distinction has been applied to explain when system design features can drive impulsive purchasing (Ning Shen & Khalifa, 2012); how cyber-harrassment can be reduced on social networking sites (Van Royen, Poels, Vandebosch, & Adam, 2017); and to explain why individuals may become addicted to mobile phones and video games (T. Hartmann, Jung, & Vorderer, 2012; Soror et al., 2015; Zwanenburg, 2013). However, despite the relevance of these two systems for understanding how affect is processed, it is yet to be applied to the study of affective responses to technology.

In the context of the current study, technostress and computer anxiety are considered trait-like and more long lasting, and thus are processed reflectively (i.e. in the reflective system). TISA is considered state-like and temporally constrained, and thus is processed differently (i.e. in the impulsive system). It is an activated state directed at a specific system that depends heavily on the perceptual input from the context. The two dimensions from ARM, temporal and general/specific, provide support for categorizing these affective concepts within RIM. Affective states arise during the use of specific technologies and persist for the duration of a performance episode, and are processed through the impulsive system. Aggregate affective dispositions are developed from the experience of multiple performance episodes with a technology and individual traits, and are processed by the reflective system. The aggregate affective evaluations are constantly updated with each additional performance episode, potentially changing the nature of relationships as more system experience is gained. This dual-systems theory of affective processing sheds light on why gaining additional system experience may fundamentally change the nature of affective responses. This foundation enables more specific explanations of the relationships between antecedents, affective concepts, and performance outcomes based on the processing system involved and user experience with the technology.

Research Model & Hypotheses

In this section, the theoretical foundations already introduced are applied to computer anxiety, technostress and TISA. Specific antecedents from the nomological network in the prior chapter are introduced and evaluated for their influence on these affective constructs. In addition,

affective concepts are connected to both objective and perceptual performance outcome variables.

The research model for this paper is pictured in Figure 6 below.
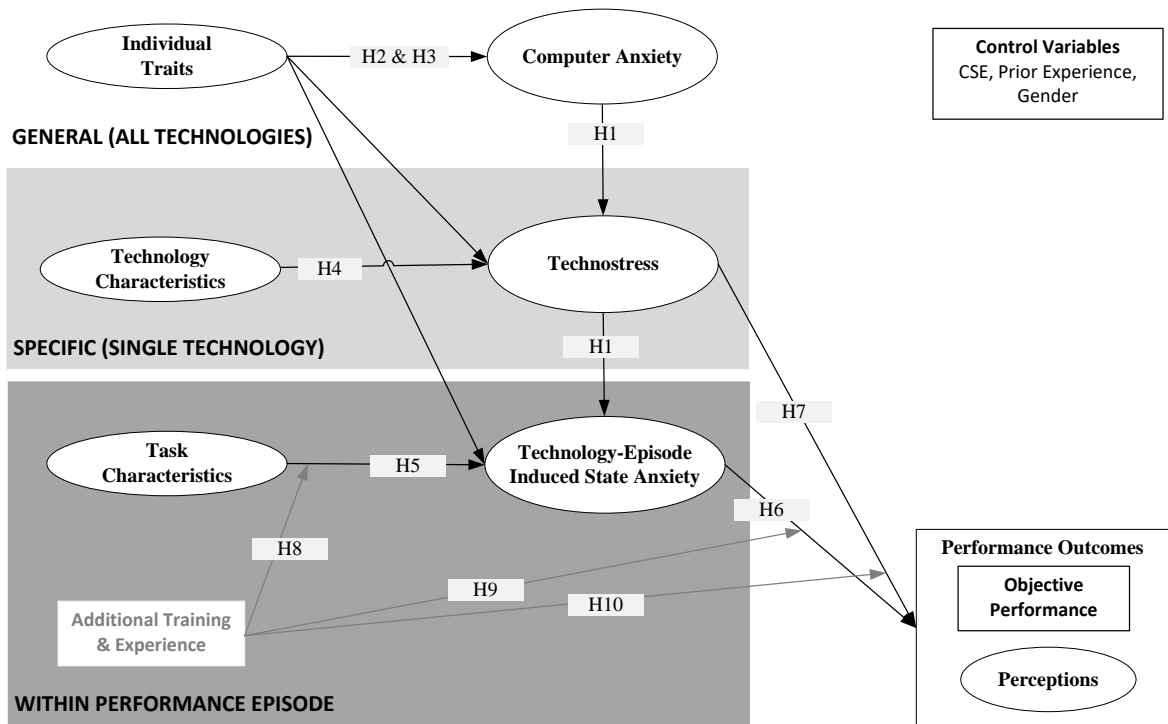
Figure 6: Research Model

Relationships between Affective Concepts: Mediating Role of Technostress

The literature establishes that computer anxiety, technostress and TISA are all related to each other. For technostress, which is specific to a particular technology, past experiences with that particular technology will be the basis for perceptions of technostress. Similarly, computer anxiety is constituted of recollections of past experiences, but with technology in general rather than a specific system. Given this, the general feeling towards all systems (e.g., CA) can be

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expected to be related to feelings towards any given particular system (e.g., technostress) (Zhang, 2013). Further, as an individual brings to a performance episode prior formed levels of technostress and computer anxiety, these are expected to influence how much TISA is felt during that episode. However, TISA during an interaction episode using a particular IT should be even more closely linked to technostress than computer anxiety, since technostress is directed towards the IT being used while computer anxiety is towards the general class of all IT. For instance, consider the possible variety of IT an individual might use regularly, from complex work applications to easy to use hedonic games and apps. It is reasonable to expect that technostress towards an ERP system will be most informative about the level of TISA during the use of that same ERP system, than computer anxiety about all different applications and technology that individual has been exposed to. This is consistent with relationships between general and specific IS constructs (e.g., Agarwal, Sambamurthy, & Stair, 2000; Marakas, Yi, & Johnson, 1998). This implies a mediating role for technostress in the relationship between general computer anxiety and the level of TISA experienced. This leads to the following hypotheses:

H1: The relationship between computer anxiety and TISA is mediated by technostress

Influence of Individual Character Traits

The expectation that differences in individual characteristic will shape technology-related behavior is fairly common (Agarwal & Prasad, 1998; Goodhue, 1995; Igbaria & Parasuraman, 1989; Webster & Martocchio, 1992). Consistent with this body of work in IS, individual characteristics are expected to influence affective responses to technology. Based on prior

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research on computer anxiety, two affect-related character traits are tested for their influence on the performance episode. They include trait anxiety and negative affectivity, and have been shown to lead to differences in the way individuals perceive and use technology (Igbaria & Parasuraman, 1989; Thatcher & Perrewe, 2002). Trait anxiety is a predisposition to respond to stimuli and experiences with feelings of apprehension, dread and tension (Spielberger, 1966). People with high trait anxiety are more likely to experience state anxiety in challenging situations (Spielberger, 1973; 1966; Mathews & MacLeod, 2002; Morgan, 1995). Similarly, negative affectivity is a tendency to experience, recall and express negative emotion and integrate same into one's self concept (Watson & Clark, 1984). People high in negative affectivity are more likely to imagine the worst or recall more negative experiences than others. In other words, trait anxious individuals are more likely to become anxious about situations they are presented with while individuals with high negative affectivity are more likely to recall more negative past experiences and then assume a more negative self-concept.

These tendencies are carried over into their interactions with technology. Prior IS research has shown these traits as being debilitating for technology use and related outcomes (e.g. Thatcher & Perrewe, 2002). Also, prior research has shown that people high in either negative affectivity or trait anxiety also feel more computer anxiety (Igbaria & Parasuraman, 1989; Thatcher & Perrewe, 2002). Given what is known about how general affective evaluations translate to specific ones, it can also be expected that computer anxiety will mediate this relationship between general character traits and specific feelings towards a given IT (i.e. technostress) as well as experiences during the performance episode (i.e. TISA). This leads to the following two hypotheses:

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H2: Computer anxiety mediates the relationship between (a) trait anxiety, and (b) negative affectivity and technostress

H3: Computer anxiety mediates the relationship between (a) trait anxiety, and (b) negative affectivity and TISA

Influence of Technology Characteristics

With respect to a specific IT, it's properties and characteristics are expected to strongly predict whether the individual feels they are incapable of coping with the system or not. As explained earlier, this should hold whether the attributes are affective or non-affective in nature. Technology characteristics exist at a level specific to a particular technology and are more likely related to feelings towards that technology (i.e. technostress) than towards all technologies in general (i.e. computer anxiety).

In this paper users' perceptions of overall system usability, a non-affective technology characteristic, is measured prior to the performance episode. IS research documents how individuals are constantly forming evaluative attitudes about systems based on their perceptions of ease of use and overall characteristics. Even with limited exposure to a system, users are able to make split judgements about how easy a system will be to use and these judgements can influence subsequent interactions and evaluations (Deng & Poole, 2010; J. Hartmann, Sutcliffe, & De Angeli, 2007; Soper, 2014). It is therefore expected that perceptions of usability will be inversely related to perceptions of technostress. This leads to the following hypothesis.

H4: Perceived usability of a system will have a negative effect on technostress

Task/Organizational Context and TISA

This paper includes task/organizational conditions as antecedent to affective responses to technology. The associated conditions of a typical performance episode can impede on the individual, inducing negative affect within the performance episode. Insights from the reflective-impulsive model also support this hypothesis. According to theory, the impulsive system is strongly activated by immediate perceptual input from the environment (Strack & Deutsch, 2004; Strack et al., 2006). Compared to individual characteristics and technology characteristics, task/organizational characteristics are more varied within the workday. Such factors then impose added and unexpected constraints on the performance episode, constituting a direct perceptual input that induces TISA during the performance episode.

While holding organizational characteristics constant, two task characteristics are experimentally manipulated in this paper to show their influence on affect during performance episodes. These characteristics include task complexity, a situation where the computing task to be completed is complicated and difficult, and time pressure, a situation where inadequate time is made available for completing the computing task. These two characteristics were chosen because they complement each other to provide a more complete understanding of common task/organizational conditions. Task complexity is intrinsically related to the nature of the task for which technology is being used, while time pressure is related to the conditions under which the task is being completed.

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Both contextual factors are temporally constrained and specific to the episode. As such, they are more likely to influence induced affective states. As such, when task complexity and time pressure are unfavorably high, they are likely to contribute to feelings of TISA. Task complexity has been documented to hinder effective system use (Speier et al., 2003) and time pressure has been documented to induce anxiety and impact performance both during episodes of system use and over the software development lifecycle. (Ahituv, Igbaria, & Sella, 1998; Austin, 2001; Hwang, 1994). Therefore, the presence of these task conditions will have a strong and direct influence on the affective states during the performance episode. This leads to the following hypotheses:

H5: TISA experienced will increase with greater (a) time pressure, and (b) task complexity

Affect and Performance Outcomes

The link from affective responses to performance outcomes is one that has not been systematically addressed or tested in existing IS literature. The experience of negative affective states has been widely documented to constitute a cognitive burden to be overcome in order for an individual to perform well (Beal et al., 2005). Negative affective responses harm cognitive processing efficiency (Eysenck & Calvo, 1992) and working memory (Kensinger & Corkin, 2003; Shackman et al., 2006) and impose a barrier to focused attention during performance episodes.

Both objective performance (task accuracy) and subjective performance measures (user's satisfaction with their performance and future expectations of performance) are considered in this paper. TISA is expected to have a direct negative impact on cognitive functioning within the performance episode. Further, based on the affect-as-information paradigm (Clore, Gasper, Garvin, & Forgas, 2001; Clore & Storbeck, 2006; Zhang, 2013), TISA will likely inform the individual's subjective self-evaluations, diminishing their level of satisfaction with their performance and discouraging them from expecting to perform well in the future. The implicit conclusion drawn would be something akin to "I felt anxious and nervous during this task so I must have not performed very well and I must be terrible at this". This is expected to occur even without participants receiving feedback on how they performed. This leads to the following hypotheses on the impact of TISA on subjective and objective performance outcomes:

H6: TISA will have a negative effect on performance, including (a) reduced task accuracy, (b) decreased user satisfaction, and (c) decreased future expectations of performing well.

While computer anxiety is likely too general to have such a direct effect on the episode, technostress is expected to have a negative influence on performance outcomes. It has already been suggested that technostress is a strong determinant of TISA and mediates the influence of other antecedents on TISA. Therefore, it is expected that technostress will also have a net negative effect on the different outcomes associated with the performance episode.

H7: Technostress will have a negative effect on performance outcomes, including (a) reduced task accuracy, (b) decreased user satisfaction with performance, and (c) decreased future expectations of performing well.

The Influence of Experience

Changes due to additional system experience have been observed in other IS research streams. For instance, research into the drivers of technology adoption have pointed out that perceived ease of use is more critical in the early stages of using a system, but tends to decline in importance after sufficient experience is built (Venkatesh, 2000). Venkatesh (2000) explains that direct experience with a system is new information integrated into the user's perception of ease of use. The operation of the reflective and impulsive systems helps shed light on what happens as more system experience is gained.

Early in the use of a system, under more chaotic and unfamiliar contexts and when individuals are yet to form stable affective dispositions towards the technology, the impulsive system will play a greater role. However, once experience from episodes of use is accumulated, familiar contexts have less of an activation effect on the impulsive system and the considerations from the reflective system will then play a greater role in shaping outcomes (Strack & Deutsch, 2004; Strack et al., 2006; Wouda & van de Wiel, 2013).

At the same time, TISA during performance episodes leads to changes in existing levels of temporally unconstrained affective evaluations (i.e. technostress and computer anxiety). These temporally unconstrained affective concepts, which represent aggregated judgements, represent an aggregate of affective states experienced across many different performance episodes. Given this, it is expected that both the level of induced affective states within a performance episode and the related outcomes should differ after additional system experience is gained. Three hypotheses related to the effects of system experience are presented below.

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Experience and Task Characteristics

After performance episodes in which high pressure and complexity are encountered, the subsequent influence of these characteristics on TISA is expected to diminish. Because perceptions of a technology are inseparable from perceptions of the tasks that technology must be used for (Burton-Jones & Straub, 2006), the task characteristics become integrated into aggregate affective dispositions. Users may become accustomed to high levels of pressure and complexity associated with a task and subsequently anticipate a high level of cognitive demand with that task. Therefore, in a future identical situation, a lower level of TISA might be experienced under the same task conditions that previously caused a stronger response. As such, the influence of task characteristics on TISA is expected to attenuate such that future identical experiences lead to lower TISA. This leads to the following hypotheses:

H8: The influence of task characteristics on TISA will attenuate with greater experience such that those initially assigned to the (a) high time pressure condition, (b) high task complexity condition, will experience less TISA under an identical situation in the future

Experience and Affect

As users gain experience with a technology, antecedents in the impulsive system have a lesser influence on TISA as compared to reflective constructs such as technostress. Similarly, it is expected that the influence of TISA on the outcomes of the performance episode will attenuate with experience. Humans are highly adaptable and so this sort of homeostatic regulation can be

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expected between the impulsive and reflective systems (Strack et al., 2006). Therefore, the expectation is that TISA will become less important to explaining performance outcomes as more system experience is acquired. This leads to the following hypotheses:

H9. The influence of TISA on the performance outcomes of (a) task accuracy, (b) user satisfaction, and (c) future expectations of performing well, will attenuate with greater experience.

At the same time that the impulsive system becomes a weaker influence, the reflective system kicks in and becomes a stronger determinant of outcomes. Technostress is expected to increase in importance given that the aggregate experience of the individual has been updated to better reflect the challenges that they have become accustomed to. This latter measure of technostress will then be a better and more stable measure with a stronger relationship with the individual's performance outcomes. This leads to the following hypothesis:

H10: The influence of technostress on the performance outcomes of (a) task accuracy, (b) user satisfaction, and (c) future expectations of performing well, will strengthen with greater experience.

There are a few noteworthy relationships that have not been hypothesized above. A major one is the relationship between technology characteristics and TISA. In this paper, while task characteristics are manipulated experimentally, a single technology with relatively stable characteristics is used. This limits the variability in technology characteristics. Under typical technology conditions, individuals tend to act automatically (Ortiz de Guinea & Webster, 2013).

As such, since no unexpected technology event is billed to occur and all users are experience the same technology (and same level of usability), the potential influence of technology characteristics on TISA is not hypothesized in this paper, and is addressed in the following dissertation chapter. Similarly, the influence of other non-affective individual characteristics will be treated as control variables, including computer self-efficacy, sex, age and other measures of general technology experience.

Research Design

To test the research model and hypotheses discussed above, a laboratory experiment was conducted in which participants were asked to carry out several spreadsheet operations in a simulated Microsoft Excel environment called SimNet. During the experiment, task characteristics were manipulated in a 2 x 2 factorial design with task complexity (low and high) and time pressure (low and high) varied. Those in the high complexity condition were given a more complex set of spreadsheet operations to complete[4]. Those in the high time pressure condition were advised to complete the entire task within four minutes and a countdown clock was added to the system window to provide the additional pressure of constant visual feedback while they worked on the task.

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[4] The existing classification of difficulty within the SimNet application was used to determine which operations were assigned to the high complexity and low complexity task conditions. Details of the operations participants were asked to complete are provided in Appendix A.

<u>**Experimental Procedure**</u>

The experiment commenced with a pre-test during which negative affectivity, trait anxiety, computer anxiety, technostress and some control variables were measured. Participants were then randomly assigned to different conditions to commence the task. Last, a post-test was administered in which TISA and subjective performance outcomes (performance satisfaction and future expected performance) were measured. The objective performance outcome, task accuracy, was collected from SimNet. Participants were not informed about the accuracy of their tasks in SimNet to avoid confounding their post-test survey responses.

To assess the potential strengthening (attenuating) effects of system experience (H8 – H10), the study was first conducted at T1 when participants were only in their second week of learning to use SimNet. The study was then repeated with the same participants after six weeks of regular weekly training and usage of the SimNet application and Microsoft Excel. At T2, time pressure was manipulated in a fully crossed manner but only the high complexity task was assigned to all participants. In a similar fashion to T1, technostress was measured during the pre-test and the remaining variables were collected from SimNet and the post-test.

Measures

Both objective and perceptual dependent variables were collected in this study. The objective performance outcome, task accuracy, was collected directly from the SimNet application. The two remaining dependent variables, future expected performance and satisfaction with

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performance were measured using newly created multi-item measures designed to tap directly into those concepts. Technostress and TISA were measured with scales created and validated in the previous chapter. Existing scales were used to measure computer anxiety (Heinssen, Glass, & Knight, 1987; Thatcher & Perrewe, 2002) , usability (Barnes & Vidgen, 2002), negative affectivity (Thatcher & Perrewe, 2002), trait anxiety (Thatcher & Perrewe, 2002) and other control variables (e.g. computer self-efficacy (Compeau & Higgins, 1995b). Finally, new measures of time pressure and task complexity were created for use as manipulation checks for these two treatments. More details of the scales and the items used are provided in Appendix B.

Participants

This study was administered to business undergraduate students enrolled in a large section of an introductory IS class in a public university in the USA. A total of three hundred and forty participants took the study at time 1, but thirty-nine of those participants did not take the study at the time 2, leaving a total sample of three hundred and one participants. Over half of the sample were male (62%), and both the mean and median age was twenty years of age, with almost all participants (95%) falling between eighteen and twenty-two years. Lastly, almost all (96%) of the participants reported having used computers and technology for over five years. The number of participants assigned to each condition was reasonably balanced at both time periods as shown in Tables 16a and 16b below.

Table 16a: Distribution of Sample across Experimental Conditions at T1

Time 1 Only	Low Complexity	High Complexity	Total
No Pressure	70	67	137
High Pressure	78	86	164
Total	148	153	301

Tables 16b: Distribution of Sample across Experimental Conditions at T2

		Time 2 Pressure Condition		Total
		No Pressure	**High Pressure**	
Time 1 Pressure Condition	**No Pressure**	74	63	137
	High Pressure	78	86	164
Total		152	149	301

Analysis & Results

A range of analytic methods were employed in a sequential order to assess construct validity and
to test the hypotheses using SPSS 22.0 and Mplus 7.0. First, descriptive statistics are presented,
and manipulation checks were performed to ensure that all experimental manipulations were
successful, using MANOVA and ANOVA tests. In addition, control variables, individual
differences, and some affective concepts were examined across treatments to ensure that these
variables did not vary across treatment condition (e.g., age, gender, computer self-efficacy) using
MANOVA. Next, the measurement validity of all latent variables was assessed, first using an
exploratory factor analysis (EFA), and then using a confirmatory factor analysis (CFA). At this
time, common method bias was assessed using the Harmon Single Factor Test (Podsakoff,
MacKenzie, Lee, & Podsakoff, 2003). Thereafter, multiple MANOVA models were run to test
different hypotheses and then the overall structural model was tested for T1 and T2 separately

using a covariance based SEM model. The use of SEM made it possible to assess the overall model simultaneously and support the veracity of conclusions made from analyses performed on subsets of the data.

Descriptive Statistics and Manipulation Checks

Descriptive statistics are presented in Table 17 by treatment for all measured constructs. A series of MANOVAs and ANOVAs were used to confirm that the experimental manipulations successfully differed across conditions and had no significant confounding effects. The guidelines for doing this from Perdue & Summers (1986) were followed. A MANOVA showed there was no significant interaction of the manipulations. While one way ANOVAs showed that perceptions of complexity significantly varied across the low and high pressure conditions, splitting the dataset by complexity and repeating the analysis confirmed that time pressure was successfully manipulated at each level of task complexity (also reflected in the cell means in Table 17). Such an observation is not surprising as it seems reasonable that decreasing the time allocated for a task would increase perceptions of complexity. Further details about the manipulation check, including the MANOVA, one-way ANOVA results, and raw means of the manipulation check variables are provided below in Table 18a and 18b. For T2, a one-way ANOVA was run to confirm that perceptions of time pressure significantly differed between the high and low pressure conditions (shown in Table 18c).

Table 17: Descriptive Statistics for Measured Variables at both T1 and T2

Time 1

	High Task Complexity		Low Task Complexity	
	High Time Press	**Low Time Press**	**High Time Press**	**Low Time Press**
TISA	4.655 (0.146)	3.886 (0.166)	4.226 (0.153)	3.727 (0.165)
Technostress	2.633 (0.138)	2.431 (0.157)	2.542 (0.146)	2.688 (0.156)
Computer Anxiety	2.485 (0.132)	2.358 (0.150)	2.444 (0.138)	2.390 (0.148)
Exp Future Performance	4.183 (0.129)	4.297 (0.147)	4.658 (0.136)	4.818 (0.146)
Perf Satisfaction	2.266 (0.155)	2.492 (0.176)	3.395 (0.163)	3.904 (0.175)
Task Accuracy (%)	31.655 (2.100)	32.554 (2.387)	60.816 (2.207)	68.227 (2.369)

Time 2

	High Time Press	**Low Time Press**
TISA	4.085 (0.102)	3.916 (0.101)
Technostress	3.004 (0.104)	2.875 (0.103)
Computer Anxiety	2.710 (0.100)	2.686 (0.099)
Exp Future Performance	4.101 (0.094)	4.223 (0.093)
Perf Satisfaction	2.538 (0.108)	2.887 (0.107)
Task Accuracy (%)	30.662 (1.259)	33.000 (1.256)

Table 18a: MANOVA and One-Way ANOVA Results of Manipulation Check at T1

	Multivariate Test (F)	Univariate Tests (F)	
		MC_Complex	MC_Pressure
Complexity	***19.152	***37.703	0.146
Pressure	***118.91	*5.735	***238.157
Complexity * Pressure	0.787	0.429	0.848
R-Square		12.2%	44.2%

*** <0.001, ** <0.01, *<0.05, ^<0.10

Table 18b: Means of Manipulation Check across conditions at T1

Time 1	Low Task Complexity		High Task Complexity	
	Low Time Press N=70	**High Time Press** N=78	**Low Time Press** N=67	**High Time Press** N=86
Complexity MC	3.721 (1.364)	4.212 (1.278)	4.813 (1.569)	5.093 (1.352)
Time Pressure MC	2.750 (1.209)	5.263 (1.619)	2.657 (1.412)	5.489 (1.643)

Table 18c: Means of Manipulation Check and Significance at T2

Time 2	Low Time Pressure	High Time Pressure	F
Time Pressure MC	3.069 (1.509)	4.490 (1.854)	***53.261

Further analysis was conducted to provide assurance that individual differences, perceptions of usability and control variables did not differ across treatments. ANOVA results showed that age, gender, trait anxiety, negative affectivity, computer self-efficacy, experience, and perceptions of usability did not differ across treatments at either T1 or T2. Further, because technostress was measured prior to the task, no differences in technostress were expected due to the manipulations. ANOVA results showed that there were no differences in technostress across the treatments in T1 or T2.

Measurement Model

Prior to testing the research model, an exploratory factor analysis (EFA) was conducted to assess the factor structure of the items used at both time periods. At T1, all constructs loaded on their respective factors, with no loadings less than 0.531 and there were no cross-loadings above 0.30. For T2, the results were similar with no loading less than 0.541 and only one cross-loading above 0.30 (future_performance_3 loaded 0.330 on satisfaction factor). Details of the EFA are shown in Appendix C3.

A measurement model was run to assess the convergent and discriminant validity of the items used in this study at both time periods. To do this, a confirmatory factor analysis (CFA) was run, which showed good fit, with all model fit indices within acceptable ranges at both times (**T1:** RMSEA: 0.035, 0.030-0.041; CFI: 0.967, TLI: 0.963, SRMR: 0.035, Chi-square: 944.941/686; **T2**: RMSEA: 0.036, 0.031-0.042; CFI: 0.964, TLI: 0.959, SRMR: 0.039, Chi-square: 956.266/686) (Gefen et al., 2011; Hu & Bentler, 1999; Steiger, 2007).

All items loaded appropriately on their constructs in the CFA for both periods. All the item loadings on their respective constructs exceeded 0.562 at both time periods. The average variance explained (AVE) of constructs in the model was 54.2% or greater. Measures of reliability (composite reliability and Cronbach alphas) were confirmed to be above recommended cutoffs (lowest Cronbach alpha: 0.798; lowest composite reliability: 0.828). Lastly, the Fornell-Larcker table confirmed that the constructs were discriminant between themselves. The correlations between constructs was consistently lower than the square root of AVE (with the smallest difference being almost 0.3). The full tables for both T1 and T2 are provided in Table 19a and 19b below.

Table 19a: Fornell Larcker Table for Time 1

	AVE	CR	Alpha	TI	TS	CA	FP	SAT	TA	NA	US	S
TISA	**0.696**	**0.919**	**0.919**	0.834								
TSTRESS	**0.746**	**0.936**	**0.935**	0.264	0.864							
CANX	**0.553**	**0.828**	**0.798**	0.205	0.583	0.744						
FUTPERF	**0.692**	**0.870**	**0.866**	-0.341	-0.429	-0.265	0.832					
SATS	**0.787**	**0.917**	**0.916**	-0.449	-0.151	-0.095	0.593	0.887				
TRANX	**0.542**	**0.892**	**0.902**	0.056	0.363	0.326	-0.027	-0.045	0.736			
NEGAFF	**0.553**	**0.908**	**0.834**	0.138	0.342	0.356	-0.221	-0.111	0.533	0.744		
USAB	**0.800**	**0.941**	**0.940**	-0.159	-0.557	-0.326	0.473	0.278	-0.227	-0.190	0.894	
SCORE	-	-	-	-0.194	-0.118	-0.144	0.322	0.532	-0.016	-0.075	0.115	-

Table 19b: Fornell Larcker Table Time 2

	AVE	CR	Alpha	TI	TS	CA	FP	SAT	TA	NA	US	S
TISA	**0.671**	**0.910**	**0.910**	0.819								
TSTRESS	**0.792**	**0.950**	**0.950**	0.274	0.89							
CANX	**0.653**	**0.881**	**0.873**	0.211	0.545	0.808						
FUTPERF	**0.665**	**0.856**	**0.853**	-0.273	-0.391	-0.35	0.815					
SATS	**0.679**	**0.864**	**0.861**	-0.297	-0.045	-0.012	0.498	0.824				
TRANX	**0.542**	**0.891**	**0.886**	0.241	0.155	0.196	-0.074	-0.027	0.736			
NEGAFF	**0.558**	**0.834**	**0.834**	0.181	0.264	0.215	-0.182	0.018	0.532	0.747		
USAB	**0.776**	**0.932**	**0.930**	-0.175	-0.566	-0.393	0.512	0.205	-0.135	-0.115	0.881	
SCORE	-	-	-	-0.171	-0.166	-0.164	0.265	0.309	-0.081	-0.034	0.235	-

Finally, common method variance was assessed on measured variables and was found to not have a significant effect on results (see details in Appendix C2).

MANOVA Results

Analysis was conducted to test that the experimental manipulations (task complexity and time pressure) had the hypothesized effects on TISA for both time periods. Because technostress was measured prior to the task, the manipulations were not expected to influence it. A MANOVA was run for T1 with the manipulations as predictors of technostress and TISA. Because of the known influence that gender has on state anxiety responses, it was included as a covariate. The results

indicate that both higher task complexity and higher time pressure led to significantly higher

TISA (H5a and H5b supported at T1). There was no effect of the manipulations on technostress.

Table 20a: MANOVA and One-Way ANOVA showing effect of manipulations and measured
variables on TISA & Technostress at T1

	Multivariate Test (F)	Univariate Tests (F)	
		Technostress	**TISA**
Gender	**5.361	*5.105	**8.064
Complexity	^2.567	0.026	*4.684
Pressure	***9.386	0.013	***18.019
Complexity * Pressure	0.862	1.581	0.449
R-Square		2.3%	9.7%
Adjusted R-Square		1.0%	8.5%

*** <0.001, ** <0.01, *<0.05, ^<0.10

The above analysis was repeated for T2. Time pressure was the only predictor included in the

MANOVA because it was the only task characteristic manipulated at T2. Gender was retained as

a covariate. The results indicate that manipulating time pressure did not have a significant effect

on TISA at T2. Given that the time pressure manipulation was successful at T2 (Table 18c) and

the sample size was the same as T1 (implying adequate statistical power), this finding is

preliminary evidence that the effect of task characteristics on TISA has changed with greater

system experience. Later in this section, further analysis is performed to demonstrate the nature of

the changing influence of both time pressure and task complexity by T2. The results of the

MANOVA at T2 are shown in Table 20b below.

Table 20b: MANOVA and One-Way ANOVA showing effect of manipulation (time pressure) on
TISA & Technostress at T2

| | Multivariate Test (F) | Univariate Tests (F) | |
		Technostress	**TISA**
Gender	1.520	1.769	2.054
Pressure	0.823	0.731	1.311
R-Square		1.1%	0.8%
Adjusted R-Square		0.5%	0.2%

*** <0.001, ** <0.01, *<0.05, ^<0.10

Structural Model

After testing parts of the model, including treatment effects, with MANOVA, an overall structural
model was fit to test all of the relationships proposed. The primary model which represents a
more parsimonious and streamlined view of the relationships between antecedents, affective
responses and outcomes is pictured in Figure 7 below. Because an identical model was fit for data
collected during T2, six weeks after the initial data collection, the path weights for both time
periods are provided in the same figure below. The overall model showed good fit at both time
periods (**T1:** RMSEA: 0.044, 0.039-0.049; CFI: 0.949, TLI: 0.944, SRMR: 0.067, Chi-square:
1119/711; **T2**: RMSEA: 0.045, 0.040-0.050; CFI: 0.942, TLI: 0.936, SRMR: 0.071, Chi-square:
1144/711) (Gefen et al., 2011; Hu & Bentler, 1999; Steiger, 2007). The hypotheses were tested
based on this base model.

Individual Traits

Trait Anxiety

0.193*
0.193*

Negative Affectivity

0.261***
0.260***

Computer Anxiety
15.9%
15.8%

0.100
-0.074

GENERAL

0.077
-0.005

0.074
0.189**

0.408***
0.185**

TIME 1:
RMSEA: 0.044 (0.039 – 0.048)
CFI: 0.949 TLI: 0.944
SRMR: 0.067
Chi-square/df: 1119 / 711

TIME 2:
RMSEA: 0.045 (0.040 – 0.050)
CFI: 0.942 TLI: 0.936
SRMR: 0.071
Chi-square/df: 1144 / 711

Technology Characteristics

Usability

-0.424***
-0.516***

Technostress
48.5%
36.9%

SPECIFIC

-0.142*
0.206**

0.233***
0.162**

Task Characteristics

Time Pressure

0.395***
0.227***

Task Complexity

0.244***
0.243***

TISA
32.9%
22.7%

-0.363***
-0.348***

-0.037
0.035

-0.071
-0.128*

-0.252***
-0.181**

Future Expected Performance
24.2%
18.4%

-0.183**
-0.142*

-0.451***
-0.315***

Accuracy
4.5%
4.5%

Satisfaction
21.3%
9.6%

Performance Outcomes

PERFORMANCE EPISODE

Significance (Two-tailed): *** <0.001, ** <0.01, *<0.05, ^<0.10 (Time 2 shaded pink)

Figure 7: Structural Model with Results

Control Variables

A more complex structural model was also run with several control variables, including age,

gender, computer self-efficacy and prior experience. This did not change any of the conclusions.

Similarly, controlling for the influence of prior experience (experience with Excel, and general

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computer experience) on performance outcomes (i.e. task accuracy, performance satisfaction and future expected performance) did not change the results or impact the conclusions drawn. Given this, the control variables were excluded from the final models for parsimony and simplicity. The detailed effects of the control variables, which were significant in some cases, are discussed as part of future research opportunities.

Results and Findings

Relationship between Computer Anxiety, Technostress & TISA

It was found that computer anxiety had a significant influence on technostress at both time periods and technostress had a significant influence on TISA at both time periods. To test the mediation hypothesis, an alternative SEM model excluding the mediator variable (technostress) was run to demonstrate the changes in path weights due to the mediator. Recommended bootstrapping methods (drawing 5,000 samples) for testing indirect effects was also performed (Preacher & Hayes, 2008). These results confirmed that a significant indirect effect existed from computer anxiety to TISA through technostress, supporting the conclusion that technostress fully mediates the relationship between computer anxiety and TISA (H1 supported at both time periods). The paths showing this full mediation effect are shown in Table 21 below.

Table 21: Test for Mediation (Hypotheses 1)

Relationship	Direct w/out Technostress	Direct w/ Technostress	Indirect[‡]
Time 1 Computer Anxiety → TISA	^0.121	0.028	***0.095
Time 2 Computer Anxiety → TISA	0.105	0.072	*0.030

‡ estimated with 5000 bootstraps

Influence of Personality Traits on Technostress and TISA

Next, the influence of negative affectivity and trait anxiety on all affective concepts was assessed.

The mediating role of computer anxiety was evaluated using a process like what was previously

described. First, it was confirmed that negative affectivity and trait anxiety had a significant

relationship with computer anxiety, a finding already established from prior literature. At T1,

computer anxiety significantly fully mediated the relationship between both concepts and

technostress. Indirect effects were significant and positive. At T2, computer anxiety had a

significant partial mediation effect on the link from negative affectivity to technostress. The

indirect effect of trait anxiety on technostress through computer anxiety was marginally

significant ($p < 0.10$). The details of the changes in direct paths and indirect effects from

personality characteristic to technostress are shown in Table 22a below (H2a supported at one

period and H2b supported at both time periods).

Table 22a: Test for Mediation (Hypothesis 2)

Relationship	Direct w/out CAnx	Direct w/ CAnx	Indirect*
Time 1			
- Trait Anxiety → TStress	**0.158***	0.100	**0.079***
- Negative Affectivity → TStress	**0.165***	0.074	**0.106****
Time 2			
- Trait Anxiety → TStress	-0.042	-0.074	0.035^
- Negative Affectivity → TStress	**0.228*****	**0.189****	**0.048***

Significance (Two-tailed): *** <0.001, ** <0.01, *<0.05, ^<0.10

Similar tests were performed to test the mediating effect of computer anxiety on TISA. Computer anxiety significantly mediated the influence of negative affectivity on TISA. Significant total indirect effects were observed at both times (H3b supported at both times). For trait anxiety, the mediation effect of computer anxiety appeared to attenuate with time. At T1, computer anxiety partially mediated the influence of trait anxiety on TISA, but no such mediating effect was observed at T2 (H3a supported at T1 only). The relationship between trait anxiety and TISA was mediated by both computer anxiety and technostress as the only significant indirect path was TraitAnx → CompAnx → TStress → TISA with path weight of 0.017 (p = 0.054). At T2 however, no indirect effects were observed. This finding is rather interesting as it strongly supports the logical pattern of relationships proposed in this paper. Details of mediation tests are provided in Table 22b below.

Table 22b: Test for Mediation (Hypothesis 3)

Relationship	Direct w/out CAnx	Direct w/ CAnx	Total Indirect *
Time 1			
- Trait Anxiety → TISA	**-0.141***	**-0.143***	**0.045***
- Negative Affectivity → TISA	0.076	0.072	**0.047***
Time 2			
- Trait Anxiety → TISA	**0.206****	**0.193****	0.008
- Negative Affectivity → TISA	-0.008	-0.021	**0.053***

Significance (Two-tailed): *** <0.001, ** <0.01, *<0.05, ^<0.10

Influence of Technology Characteristics on Specific Affective Evaluations

As expected, perceived usability had a significant negative relationship with reported levels of technostress at both time periods (H4 supported at both time periods).

Influence of the Manipulations on TISA

The earlier MANOVA results supported the influence of the manipulations on TISA and confirmed that the manipulations significantly increase TISA at T1 (H5a and H5b supported). In the structural model, perceptions of both task complexity and time pressure were tested for their effect on TISA. They also had a significant positive effect on TISA at both T1. Although the manipulations did not significantly influence TISA at T2 in the MANOVA reported above, there were significant positive paths from task complexity and time pressure to TISA at T2 also. This finding is interpreted further in the testing of H8 (the attenuating effect of task characteristics on TISA with added system experience).

Influence of TISA and Technostress on Performance

TISA had a significant negative effect on task accuracy, the user's satisfaction with their performance and future expected performance at both time periods (H6a, H6b and H6c supported at both time periods). On the other hand, technostress only had a significant influence on future expected performance at both times (H7c supported at both times). The direct paths from technostress to task accuracy and performance satisfaction were insignificant at T1 (H7a and H7b

not supported at time 1). At T2, the influence of technostress on task accuracy became significant (H7a supported at T2).

Further, the possible mediating influence of TISA on the relationships between technostress and performance outcomes was assessed. It was found that, at T1, TISA significantly fully mediated the relationship between technostress and two out of three outcomes at both times (task accuracy and satisfaction), and partially mediated the relationship between technostress and future performance. All indirect effects of technostress on performance outcomes through TISA were significant at T1. For T2, TISA only partially mediated the relationship between technostress and both task accuracy and future expected performance. There was also a significant indirect on satisfaction at T2. This weakening of the mediation effect of TISA on performance outcomes at T2 is consistent with hypotheses that the effects of technostress will strengthen while the effects of TISA attenuate with added experience. Those hypotheses are explored in more detail shortly. The paths and indirect effects at both time periods are shown in Table 23 below.

Table 23: Supplemental Test for Mediation effect of TISA

Relationship	Direct w/out TISA	Direct w/ TISA	Indirect*
Time 1			
Technostress → Task Accuracy	**-0.120***	-0.071	**-0.043***
Technostress → Satisfaction	**-0.156****	-0.037	**-0.105*****
Technostress → Future Performance	**-0.430*****	**-0.363*****	**-0.059****
Time 2			
Technostress → Task Accuracy	**-0.167****	**-0.128****	-0.023^
Technostress → Satisfaction	-0.053	-0.035	**-0.051***
Technostress → Future Performance	**-0.398*****	**-0.348*****	**-0.029***

* estimated with 5000 bootstraps

Attenuating Effect of Task Characteristics

In H8, it is proposed that the effect of task characteristics on TISA will attenuate with system experience. To test this, data collected from both time periods was considered and multiple tests were performed. First, paired sample t-tests were performed to compare the perceptions of TISA for participants at both time periods. Based on the hypotheses, it was expected that those who had experienced high pressure (high complexity) at T1 would have a lower perception of TISA at T2 in a similar high pressure (high complexity) situation. The tests confirmed this expectation (details shown in Table 24 below). For those in the high complexity condition at both times, TISA was significantly lower at T2 (H8a supported). However, TISA was only marginally significantly lower (p=0.055) for those in a high pressure situation at both times (H8b partially supported).

Table 24: Paired Sample t-tests showing attenuation of task characteristics (Hypothesis 8)

DV: TISA	Time 1	Time 2	T2 – T1	T	Sig (1-Tailed)
High Complexity Treatment (n = 153)	4.28	3.98	-0.31	-2.695	**0.004**
High Pressure Treatment (n = 86)	4.47	4.23	-0.24	-1.622	0.054

To further test the hypotheses that the manipulations would have a declining effect on TISA with added experience, multiple regressions were run for each time period and the variance explained at each point in time compared. The multi-item perceptual measures (previously used as manipulation checks) were used in the regression because they were easier to compare at both times (complexity was not manipulated at T2 so there was no categorical variable). In the two models, shown in Table 25a below, perceptions of task complexity and time pressure only

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explained half of the variance at T2 that they did at T1 (18.30% reduces to 9.10%). This

strengthens the support for the hypothesis that the influence of task characteristics on TISA

attenuates with added experience.

Table 25a: Change in Variance Explained by Task Characteristics

DV = TISA	Time 1		Time 2	
	Controls Only	Full Model	Controls Only	Full Model
Constant	**3.381	**2.111	**3.459	^2.149
Control Variables				
- Mood	-0.023	-0.027	0.028	0.001
- Gender	* 0.391	*0.352	0.171	0.098
- Age	-0.007	0.001	-0.024	-0.015
- Comp History	0.048	-0.023	0.069	0.049
- Excel History	0.000	-0.030	-0.065	-0.078
- SimNet History	-0.084	^ -0.091	-0.067	^ -0.073
- Time spent on SimNet Weekly	*0.328	0.186	***0.485	**0.405
Manipulations				
- Perceived Complexity		***0.193		***0.238
- Perceived Time Pressure		***0.232		***0.132
R-Square	4.70%	23.20%	6.30%	15.70%
Adjusted R-Square	2.50%	20.80%	4.00%	13.10%
Variance Explained by Manipulations		18.30%		9.10%

Finally, a Z-test was performed on the paths in the structural model from task characteristics to

TISA. However, no significant difference in the paths was found between both time periods

(shown in Table 25b below).

Table 25b: Z-Test for Path Differences between Time 1 and Time 2

	Time 1	Time 2	ΔTime ($T_2 - T_1$)
Task Complexity $\rightarrow$ TISA	0.244 (0.054)	0.243 (0.061)	-0.001 (ns)
Time Pressure $\rightarrow$ TISA	0.395 (0.056)	0.227 (0.064)	-0.168 (ns)

Attenuating Effects of TISA on Performance

To evaluate whether the influence of TISA on performance was attenuating with added experience (H9 only), the change in variance of the performance outcomes explained by TISA across both periods was evaluated using several regressions (Table 26a, 26b and 26c). First, the variance explained by TISA at T1 was calculated after controlling for the effect of perceptions of task complexity and time pressure (manipulation check measures were used). By T2, the variance in satisfaction (future expected performance) explained by TISA had reduced further by one-third (almost half). There was no change in the very low variance in task accuracy explained by TISA (below 1%). However, these results must be interpreted cautiously because the variance in all three outcome variables explained by TISA was very low across board.

Table 26a: Variance in Task Accuracy Explained by TISA

	Time 1		Time 2	
SEM Model				
Total Effect: TISA $\rightarrow$ Accuracy	**-0.183****		**-0.142****	
Regression Model				
	Controls Only	**Full Model**	**Controls Only**	**Full Model**
Intercept	77.863***	81.818***	52.741***	55.046***
Control Variables				
- Perceived Complexity	-6.652***	-6.350***	-4.109***	-3.837***
- Perceived Pressure	0.027	0.439	-0.321	-0.173
TISA		-1.693		-1.042
R-Square	14.8%	15.5%	9.9%	10.5%
Adjusted R-Square	14.2%	14.6%	9.2%	9.6%
Variance Explained by TISA		0.4%		0.4%

Table 26b: Variance in Performance Satisfaction Explained by TISA

	Time 1		Time 2	
SEM Model				
Total Effect: TISA → Satisfaction	**-0.451***		**-0.315***	
Regression Model				
	Controls Only	**Full Model**	**Controls Only**	**Full Model**
Intercept	5.804***	6.543***	5.199***	5.601***
Control Variables				
- Perceived Complexity	-0.613***	-0.547***	-0.534***	-0.488***
- Perceived Pressure	-0.010	0.068^	0.028	0.053
TISA		-0.329***		-0.180**
R-Square	34.5%	41.4%	20.7%	23.3%
Adjusted R-Square	34.1%	40.8%	20.2%	22.5%
Variance Explained by TISA		6.7%		2.3%

Table 26c: Variance in Future Expected Performance Explained by TISA

	Time 1		Time 2	
SEM Model				
Total Effect: TISA → Future Perf	**-0.252***		**-0.181****	
Regression Model				
	Controls Only	**Full Model**	**Controls Only**	**Full Model**
Intercept	5.782***	6.263***	5.785***	6.114***
Control Variables				
- Perceived Complexity	-0.279***	-0.235***	-0.327***	-0.290***
- Perceived Pressure	-0.011	0.039	-0.014	0.007
TISA		-0.214***		-0.147**
R-Square	12.3%	17.2%	10.9%	13.2%
Adjusted R-Square	11.7%	16.4%	10.3%	12.3%
Variance Explained by TISA		4.7%		2.0%

Next, a Z-test was used to compare changes in path weights between both time periods. While

absolute path weights became less negative between time periods and weakened in significance

for two relationships (TISA → Accuracy and TISA → Future Performance), the change in path

weights was only statistically significant for the effect of TISA on performance satisfaction.

These path difference Z-tests are shown in Table 27 below.

Table 27: Path Difference Z-Test for Attenuation of TISA

	Time 1	Time 2	ΔTime $(T_2 - T_1)$
TISA $\rightarrow$ Accuracy	-0.183** (0.061)	-0.142* (0.061)	0.041 (ns)
TISA $\rightarrow$ Satisfaction	-0.451*** (0.053)	-0.315*** (0.062)	0.136*
TISA $\rightarrow$ Future Performance	-0.252*** (0.058)	-0.181** (0.062)	0.071 (ns)

Taken together, there is only weak support overall for the hypothesis that the influence of TISA attenuates with time (H9a & H9c not supported, H9b supported). The overall variance explained by TISA is very low in this study, even though it does further reduce with added experience. This finding is further discussed along with results later in this paper.

Strengthening Effects of Technostress on Performance

Lastly, the structural model at both times were assessed to see the changes in the effect of technostress (H10 only). While there was no significant effect of technostress on task accuracy at T1, this effect became significant at T2. However, when Z-tests were performed to compare the changes in total effects of technostress across both times no significant difference was found for any of the paths between technostress and performance outcome. The results of the Z-tests are shown in Table 28 below.

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Table 28: Z-Tests Testing for Strengthening of Technostress

Total Effect	Time 1		Time 2		ΔT (T$_2$ – T$_1$)
TStress → Task Accuracy	-0.071	(0.060)	**-0.128***	**(0.059)**	-0.057 (ns)
TStress → Satisfaction	-0.037	(0.057)	0.035	(0.063)	0.072 (ns)
TStress → Future Performance	**-0.363*** (0.054)**		**-0.348*** (0.057)**		0.015 (ns)

Competing & Alternative Models

To evaluate the robustness of this paper's perspective over more complex alternative models, several alternative models were constructed. This is a recommended practice that is not often undertaken by IS researchers (Chin, 1998). They include an omnibus model, and a model with TISA being a partial mediator of task characteristics.

ARM specifies omnibus relationships between all antecedents and affective constructs. Therefore, the omnibus model with several additional paths was evaluated. While this increased the complexity of the model, it did not impact any of the conclusions from the more parsimonious model reported above.

Lastly, the robustness of the relationship between TISA and performance outcomes was tested using a partial mediation model. Direct paths were included from task characteristics to all three performance outcomes. The only significant change observed between the full mediation and partial mediation model is that the significant path between TISA and task accuracy turned insignificant due to the effect of task complexity. The implications of this finding are discussed in the next section under future research opportunities.

<div align="center">**Discussion**</div>

A summary of the hypotheses and the statistical testing results are provided in Table 29. Most

hypotheses (H1-H7) are supported at both time periods. The extensive nomological network of

affective concepts from the prior chapter is tested and confirmed for the first time in the IS

literature. Further, the theoretical value of ARM for organizing this research area is demonstrated

and a more directed pattern of relationships is proposed and confirmed empirically. The last few

hypotheses regarding the moderating influence of system experience (H8-H10) show more mixed

results. The rest of this section discusses the findings in greater detail.

<div align="center">Table 29: Summary of Research Hypotheses</div>

Hypotheses	Supported?	
	Time 1	Time 2
H1: The relationship between computer anxiety and TISA is mediated by technostress	Yes	Yes
H2: Computer anxiety mediates the relationship between (a) trait anxiety,	Yes	Partial
and (b) negative affectivity and technostress	Yes	Yes
H3: Computer anxiety mediates the relationship between (a) trait anxiety, and	Yes	No
(b) negative affectivity and TISA	Yes	Yes
H4: Perceived usability of a system will have a negative effect on technostress	Yes	Yes
H5: TISA experienced will increase with greater (a) time pressure, and	Yes	-
(b) task complexity	Yes	-
H6: TISA will have a negative effect on performance, including (a) reduced task accuracy,	Yes	Yes
(b) decreased user satisfaction, and	Yes	Yes
(c) decreased future expectations of performing well.	Yes	Yes
H7: Technostress will have a negative effect on performance, including (a) reduced task	No	Yes
accuracy, (b) decreased user satisfaction with performance, and	No	No
(c) decreased future expectations of performing well.	Yes	Yes
H8: The influence of task characteristics on TISA will attenuate with greater experience such that those initially assigned to the (a) high task complexity condition,	Partial	
(b) high time pressure condition, experience less TISA in an identical future situation	Yes	
H9. The influence of TISA on the performance outcomes of, (a) task accuracy,	No	
(b) user satisfaction, and	Yes	
(c) future expectations of performing well, will attenuate with greater experience.	No	
H10: The influence of technostress on the performance outcomes of, (a) task accuracy,	Partial	
(b) user satisfaction, and	No	
(c) future expectations of performing well, will strengthen with greater experience.	No	

The prior literature specified omnibus and reciprocal relationships between all affective concepts. This paper sought to extend this work by focusing on an important unit of analysis, technology episode, that made it possible to offer a more practical and nuanced explanation of effects. Hypotheses related to this offered pattern of effects were strongly supported. As proposed, the relationships between affective concepts follows a logical pattern during an interaction episode. The effects of general affective evaluations and dispositions to induced specific states are mediated by the specific affective evaluations towards the technology used. Technostress significantly mediates the relationship between computer anxiety and TISA at both time periods. These findings suggest that despite TISA being unaddressed in the existing literature, research efforts to identify and manage technostress which discuss 'episodic stress' or similar concepts (e.g. Galluch et al., 2015; Riedl, Kindermann, Auinger, & Javor, 2012) have ultimately been in the service of reducing TISA. As such, the introduction of the TISA construct serves to provide more clarity to this body of research.

Another question this work aimed to address was the need for a clearer understanding of which antecedents were more likely to impact certain affective concepts. Broadly, this paper finds considerable support for the proposed pattern of relationships between antecedents and affective concepts. This overall pattern of results also holds steady after six weeks of added system experience. The individual traits of negative affectivity and trait anxiety clearly have a stronger direct influence on computer anxiety which then mediates their influence on both technostress and TISA. All hypotheses related to this mediating role of computer anxiety are supported at T1. At T2 however, after six weeks of additional experience, computer anxiety no longer mediates the

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relationship between trait anxiety and TISA. The remaining three hypotheses (H2a, H2b and H3b) are either fully or partially supported, as further discussed below.

One interesting observation is that the direct influence of individual characteristics on technostress and TISA appears to strengthen with added experience. Negative affectivity had no significant influence on technostress at T1 (path: 0.074, p>0.10), but that effect became significant at T2 (path: 0.189, p<0.05). A more striking change was the reversal and strengthening significance of the path from trait anxiety to TISA (T1 path: -0.142, p <0.05 and T2 path: 0.206, p <0.01). This observation can be cautiously interpreted as individual characteristics beginning to stand out as more experience is gained. In the case of technostress, it is possible that individual characteristics do not uniquely drive their perceptions of technostress after accounting for the effect of computer anxiety. However, with more system experience, an individual's tendency to recall more negative experiences (i.e. negative affectivity) provides additional technostress towards a given system.

For TISA, the path at T1 is negative and significant, implying that more trait-anxious individuals experienced less TISA. This result goes against significant consensus in the psychology literature and is better explained by the existence of mediating relationships in the entire structural model (e.g. presence of computer anxiety and technostress). At T2, this negative path reverses and grows more significant. This can also be cautiously interpreted as follows. While all individuals will experience TISA early in the use a system, those individuals with high level of trait anxiety will continue experiencing more TISA than others. This finding requires more careful examination in future research. Individuals high in negative affectivity and trait anxiety might

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need additional targeted interventions to help them deal with negative affective responses to technology.

The technology characteristic examined in this study, perceived usability, has a strong influence on technostress at both time periods. This is consistent with the growing consensus in the literature that behavior and usage outcomes can be improved by designing technology to function better. The relationship between perceived usability and TISA was not hypothesized, neither was a significant direct effect found in post-hoc analyses of alternative explanations. This finding should not be misinterpreted to mean that technology characteristics do not influence TISA or that TISA is entirely caused by the task. Rather, given the experimental context of a single technology with users having about the same level of experience, there was little variability in perceived usability between conditions in this study. While this was enough to demonstrate the relationship between perceived usability and technostress, the absence of a significant influence of perceived usability on TISA is not surprising. Future research that varies the physical and system attributes of technology, or introduces an unexpected technology event are likely to see significant differences in TISA due to technology characteristics. Paper 3 in this dissertation explicitly manipulates perceived usability to better study this relationship.

Another contribution of this work is integrating task/organizational characteristics into ARM as a category of antecedents to affective concepts. Task characteristics have an overwhelming effect on TISA at T1 as hypothesized. This is confirmed from ANOVAs (Table 3a) and significant regression paths (Figure 7). Further, the strength of this effect attenuates with additional system experience as expected. This was tested in different ways. Regressions were used to show that the variance in TISA explained by the manipulations alone was cut in half after six weeks. Also, pair-

wise comparison tests (Table 24) showed that participants experienced significantly less TISA than they did under an identical situation six weeks prior. The reduction in TISA for participants in high pressure treatment at both times was marginally significant, $p = 0.054$, most likely due to reduced power ($n = 86$ for this test). This is in line with the expectation that while TISA may be high in the early stages of system use, it grows less severe after system experience is gained. Notably, the effect of task time pressure on TISA had the most significant drop. A possible explanation for the smaller drop in the influence of task complexity could be that it is a property intrinsic to the task, while time pressure is completely external to the task. Future research may consider how the nature of the task/organizational characteristic might lead to different patterns of changes with greater experience.

There is little IS research connecting affective responses to performance outcomes. Of this work, no papers have considered the simultaneous impact of different categories of affective concepts. This paper examined the influence of different affective responses to technology on both perceptual and objective performance outcomes (task accuracy, satisfaction with the episode and future expected performance). TISA has a significant direct effect on all performance outcomes considered in the hypothesized direction. At both time periods, negative affective states lower objectively measured performance accuracy, lead to lower satisfaction with the IT interaction episode and lower future expected performance with the technology. This finding buttresses the relevance of TISA and has important implications for research and practice, including laying a foundation for future research on interventions. Technostress, however, has a significant influence only on future expected performance at T1. At T2, in addition to retaining its influence on future expected performance, technostress also has a significant effect on objective task

performance in the hypothesized direction. The consistent influence of technostress on future

expected performance is potentially because that outcome is closely linked to the nature and

characteristics of the software. Related to this, technostress has no influence with performance

satisfaction which is focused on the performance episode, rather than the software. Additional

research is needed to strengthen support for the last two hypotheses (H9-H10) which propose that

the influence of TISA on performance will attenuate while the effect of technostress strengthens.

Lastly, supplemental analysis of an alternative model where TISA only partially mediates the

influence of the experimental treatments (i.e. task characteristics) on outcomes shows a slightly

different picture. Adding a path from task complexity to the objective measure of accuracy

eliminates the influence of TISA. Similarly, it weakens the relationship between TISA and the

other performance outcomes. There is need to understand the conditions under which TISA is an

effective mediator of the effects of task characteristics. One possible interpretation of this result is

that the nature of the task itself is so strongly driving performance outcomes – the experiment

involved a structured computing task. This calls for tests in a more less structured task situation,

something addressed in the following paper.

Limitations and Future Research

First, this paper utilizes a student sample and so may not readily generalize to businesses and

workers. Nevertheless, the structured spreadsheet task utilized is identical to the sort of tasks that

many white-collar workers are typically engaged in. Also, conclusions drawn from student

samples have been frequently found to be generalizable to professionals for many behavioral

research questions (Ashton & Kramer, 1980; Libby, Bloomfield, & Nelson, 2002). Nevertheless, future research should seek to confirm that these findings generalize within a professional sample.

Another limitation associated with the use of a student sample is that this paper does not deal with organizational characteristics despite pointing out that these are an important contextual influence of affective responses to technology. Future research should measure and control for the various organizational characteristics identified in the IS literature.

While affective responses to technology explained a significant portion of variance in perceptual performance outcomes, they explained a more limited amount of variance in the objective outcome measured in this study. This result is not unexpected given that prior research points out that objective measures tend to lack portions of systematic variance contained in subjective evaluations (Bommer, Johnson, Rich, Podsakoff, & MacKenzie, 1995; Cascio & Valenzi, 1978; Rich, Bommer, MacKenzie, Podsakoff, & Johnson, 1999). Nevertheless, this is a challenge worth addressing and more research is needed to understand this better, especially in a different task context. In the third paper of this dissertation, this limitation is addressed by considering the influence of affective responses to technology on performance in a less structured task context.

Finally, this paper does not consider the positive affective responses that can also influence performance outcomes. It is well established that positive and negative affect operate distinctly. Therefore, there is room for future research to consider these two classes of affective responses side by side. This is addressed in the third paper of this dissertation.

Conclusion

This paper builds on the prior chapter which laid a foundation for more focused study of negative affective responses to technology. ARM is extended by integrating a new category of antecedents and by connecting affective responses to performance outcomes. A much clearer and practical pattern of relationships is proposed and tested. Broadly, this work found that task characteristics, tied more closely to the performance episode of system use, had a greater influence on episode-specific affective concepts (i.e. TISA). Technology characteristics, being tied to a particular system, had a greater influence on the system-specific affective concepts (i.e. technostress). And individual characteristics, being more general and not limited to specific situations, had a greater influence on more general affective concepts (i.e. computer anxiety). Strong support is found for the majority of proposed hypotheses, lending evidence to the validity of the nomological network from the previous chapter and the usefulness of ARM as a framework for better understanding of affective responses to technology.

This work also explains and tests hypotheses related to the changes in affective concepts and the related effects that occur with additional system experience. Recent work has pointed out that there are systematic temporal changes in the influence of IS constructs over time and calls for IS researchers to do a better job of accounting for such changes (Agogo & Hess, 2016). This work answers that call by proposing and testing how different affective responses to technology evolve. Partial support is found for this idea and several future research directions to further explore this area have been proposed.

CHAPTER 4

BALANCING THE SCALES: POSITIVE AND NEGATIVE AFFECTIVE RESPONSES TO TECHNOLOGY WITH A CREATIVE TASK

<u>Introduction</u>

In the prior chapter of this dissertation, the antecedents and performance outcomes of two negative affective responses to technology, technostress and technology-induced state anxiety (TISA), are examined. Individual traits and technology attributes lead to enduring feelings of stress toward specific technologies (i.e., technostress). These enduring affective responses along with task characteristics, increased the likelihood of TISA during performance episodes with technology. Further, both technostress and TISA impede objective performance and lead to less satisfaction with the episode and diminished future expectations. Given the negative effects of these dark side affective concepts, this next chapter looks at the positive affective responses that may neutralize the negative responses, or at least reduce them.

Positive affect does not simply imply an absence or low levels of negative affect. Rather, positive affective responses have been shown to be distinct from matching negative affective concepts, and not opposite poles of a single construct (Huppert & Whittington, 2003; Warr, Barter, & Brownbridge, 1983; Watson, Clark, & Tellegen, 1988). Recent IS research acknowledges this reality (Loiacono & Djamasbi, 2010), as individuals can experience high levels of both positive and negative affect under stressful conditions (Folkman, 1997; Folkman & Moskowitz, 2000; George & Zhou, 2007). In general, when positive affect is present, individuals are better able to cope with any negative affect that exists (Folkman & Moskowitz, 2000; Fredrickson, 2001;

Fredrickson & Levenson, 1998; Ong, Bergeman, Bisconti, & Wallace, 2006). This implies that considering only negative affective responses to technology is an incomplete approach to understanding the role of affect. Therefore, this paper integrates newly proposed positive concepts from chapter two (paper 1) to offer a balanced view of affective responses to technology, and the resulting influence on performance outcomes. This effort is consistent with calls for adopting a "positive lens" in IS research (Avital et al., 2006; Avital, Boland, & Cooperrider, 2008; Avital, Boland, & Lyytinen, 2009; Zhang, 2008).

In addition, the prior chapter highlighted some opportunities for future research which this paper seeks to address. First, the prior chapter considered a structured spreadsheet task in which there were very rigid and defined steps for completing the task. While this is common in modern workplaces, users of technology are also given tasks that are less structured and warrant different approaches (Goldenberg, Mazursky, & Solomon, 1999). As such, this paper considers a less structured, creative design task. Second, the prior chapter considered only a single technology with little variability in usability, and thus only a limited examination of the effect of usability on TISA was possible. In this paper, two different technologies, with different levels of usability, are considered. Lastly, the findings from the prior chapter highlighted the need for interventions to limit negative affective responses. In this paper, a laboratory experiment is conducted to evaluate the effectiveness of mood, as a simple intervention. Study participants are placed in a positive mood prior to the performance episode to see how mood influences affective responses during the episode and the related performance outcomes.

Therefore, the following research questions drive this paper.

1. In the context of a less structured, creative computing task, which negative affective responses are more likely to influence different computing performance outcomes? Do the findings from the prior chapter replicate?

2. Do both positive and negative affective responses to technology influence computing performance outcomes?

3. Can inducing a positive mood be an effective intervention for boosting technology-based performance outcomes?

The research model for this chapter replicates the one used in the prior chapter, while also adding complementary positive affective responses, and integrating both negative and positive affective responses into one model. As a result, the first seven hypotheses from the prior chapter, concerning negative affective responses to technology, are tested again in a different task context and with different technologies. Seven new hypotheses are developed and tested using the positive complementary constructs. Further, the expanded model and hypotheses incorporate two newly proposed positive affective responses to technology - technomancy, a positive match to technostress, and computer enthusiasm, a positive match to computer anxiety. New scales to measure these constructs are developed and validated within the wider nomological network. The concept of enjoyment (Agarwal & Karahanna, 2000) which is a positive match to TISA is also considered. In addition, known positive character traits from the IS literature (computer playfulness and personal innovativeness in technology) are included in this extended research model alongside the negative character traits retained from the prior chapter (i.e. trait anxiety and negative affectivity). Lastly, an individual's free-floating mood state prior to the performance

episode is manipulated to test how a positive mood influences affective states and performance outcomes from technology use.

In the following sections, the theoretical foundations for this paper are discussed, then the research model is introduced. Hypotheses regarding negative affective concepts from the previous chapter are presented again, along with the matching hypotheses for positive affective concepts. After this, the laboratory experiment used to test the hypotheses is described and the results and analysis are presented. The paper concludes with a discussion of the major takeaways and implications for both theory and practice.

Theoretical Background

In this section, the literature on positive affective responses from psychology and information systems (IS) are reviewed. Thereafter, the Affective Response Model (ARM; Zhang, 2013) is briefly reviewed with an emphasis on the complementary positive affective concepts. The relevant literature on performance outcomes resulting from positive affect is discussed. This section is concluded by reviewing the potential intervention effects of a positive mood.

The Value of Positive Affect

While the interest in positive feelings dates back to the early 1900s and the work of William James (Froh, 2004), the systematic study of positive psychological concepts was only recently

formalized as a branch of psychology (Froh, 2004; Seligman & Csikszentmihalyi, 2000). Since then, the field of psychology has dedicated significant effort to understand and harness the value of positive emotions (Seligman, Steen, Park, & Peterson, 2005). Given that psychology serves as a major reference discipline for the IS field, IS research lags somewhat in applying recent advances in psychology, and thus far has taken a more piecemeal approach to applying these breakthroughs in knowledge. While IS research has considered the potential effects of positive affect (Beaudry & Pinsonneault, 2010; De Guinea & Markus, 2009; Djamasbi & Strong, 2008; Loiacono & Djamasbi, 2010), a comprehensive examination of the antecedents and performance outcomes has not been conducted in IS.

Positive affect has been shown to lead to greater optimism (Fredrickson, Tugade, Waugh, & Larkin, 2003; Nygren, Isen, Taylor, & Dulin, 1996) and elevated expectations of positive outcomes (Masters & Furman, 1976). It is also an important driver of behavior as people who feel positive tend to "see the brighter side of things, … be generally more optimistic, and (therefore) act accordingly" (Isen, Shalker, Clark, & Karp, 1978, p. 2). Even in the presence of negative affect, positive affect plays a critical role by improving an individual's ability to focus on and find good outcomes in bad situations. As such, positive affect has been documented to help individuals cope in the face of terminal illnesses like cancer (Antoni et al., 2001; Urcuyo, Boyers, Carver, & Antoni, 2005) and other dire health situations (Hart, Vella, & Mohr, 2008). It is thus reasonable to expect positive affect to play a role in improving the experience and outcomes of using technology.

Given the recent advances in psychology, it is common for psychology research to consider both positive and negative affective concepts at the same time, and integrate both into theory (e.g.,

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Charles, Reynolds, & Gatz, 2001; Gruenewald, Mroczek, Ryff, & Singer, 2008; Lyubomirsky, 2011). This practice is not yet common in IS, and only a handful of IS papers have studied both positive and negative affective concepts at the same time (e.g., Beaudry & Pinsonneault, 2010; Cenfetelli, 2004; D. Compeau, Higgins, & Huff, 1999; Compeau & Higgins, 1995b; Venkatesh, 2000; Venkatesh, Morris, Davis, & Davis, 2003; Webster & Martocchio, 1992). Of these papers, none have adopted matching concepts that reflect both positive and negative valence of the same concept. Fortunately, the Affective Response Model (ARM; Zhang, 2013) provides a taxonomy that accommodates the examination of both positive and negative affective responses to technology.

A Review of ARM

ARM (Zhang, 2013) is useful for defining affective responses to technology as demonstrated in the prior chapter. Five dimensions are used to distinguish affective concepts: *residing, temporal nature, particular vs. general stimulus, object vs. behavior stimulus, and process-based vs. outcome based evaluations* (Zhang, 2013). Based on these dimensions, computer anxiety, technostress and TISA were classified within ARM in chapter two (Shown in Table 30a). In chapter three, ARM was applied further to better understand how the different affective concepts are related to each other, to antecedents and to performance outcomes.

Two of these dimensions, particular/general stimulus and temporally constrained/unconstrained nature of the concept, have been applied to identify an appropriate unit of analysis, the performance episode with technology. The performance episode is a time-bound period during

which an individual is using a specific technology to complete a given task (Beal, Weiss, Barros, & MacDermid, 2005; Zhang, 2013). Prior to the performance episode, the individual possesses a certain level of negative affective evaluations towards using technology in general (computer anxiety) and towards using the particular system to be used (technostress). This bears upon the individual during the performance episode, and as a result, they experience TISA.

Further, the influence of three categories of antecedents is considered and demonstrated in the prior chapter. Individual characteristics are more likely to influence affective evaluations towards all systems (computer anxiety), technology characteristics are more likely to influence affective evaluations towards specific technologies (technostress), and task characteristics are more likely to influence the states experienced during the performance episode (TISA). Technostress and TISA are more likely to influence performance outcomes with TISA having a greater effect on performance outcomes in the prior chapter.

Table 30a: Negative Affective Responses to Technology

Temporally Constrained	Temporally Unconstrained	
	Particular Stimulus	**General Stimulus**
TISA	Technostress	Computer Anxiety

EXPERIENCED WITHIN IT INTERACTION EPISODE

OVERALL EVALUATION/ DISPOSITIONS

While the categories of ARM and the above logic was applied only to negative affective response to technology in the prior chapter, there is room to expand these ideas to explain the links

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between various positive affective responses to technology. In the following section, existing and newly proposed positive affective concepts are introduced.

Positive Affective Concepts in ARM

In chapter two, *enjoyment* was identified from the prior literature as a positive, temporally constrained state (Box 4 in ARM). The matching negative state to this concept, TISA, was proposed and empirically validated in chapters 2 and 3. Similarly, two positive affective concepts were proposed as matching computer anxiety and technostress, but they were only discussed briefly in chapter two. These concepts, *computer enthusiasm* (Box 8 in ARM) and *technomancy* (Box 6.2 in ARM), can advance our understanding of how affective responses influence performance outcomes by showing how positive affective concepts that can combat or limit negative affectivity. All three concepts, enjoyment, technomancy, and computer enthusiasm, are shown within ARM framework in Table 30b below[5]. Each of these matching positive affective concepts are discussed briefly in the following sections.

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[5] The concept of technophilia, proposed as a positive matching concept to technophobia, is also shown in Table 1b. Given that this work does not focus on technophobia, due to its severity, the consideration of technophilia is also left out of this chapter.

Table 30b: Positive Affective Responses to Technology

Temporally Constrained	Temporally Unconstrained	
	Particular Stimulus	**General Stimulus**
Enjoyment[+]	Technomancy*	Computer Enthusiasm*

EXPERIENCED WITHIN IT INTERACTION EPISODE	OVERALL EVALUATION/ DISPOSITIONS

+ New proposed classification for existing construct
* New proposed classification for new construct

Computer Enthusiasm

Computer enthusiasm is defined as an eagerness to explore and try out technology *in general*. It is a positive matching concept to computer anxiety, the feeling of apprehension, fear and aversion towards using technology *in general.* As such, it is also a learned affective evaluation/disposition based on ARM (Zhang, 2013). Individuals high in computer enthusiasm will be eager to try out new technologies of different types. Research on diffusion of innovation points out that the persuasion stage of the innovation-decision process has mainly to do with feelings (Rogers, 1962). Computer enthusiasm is a concept that captures such eagerness to adopt a new technology.

The idea of eagerness towards technology is not entirely new. Research has viewed welcoming dispositions towards technology as a part of computer attitudes (Brod, 1984), and the personal innovativeness in IT (PIIT) concept refers to a "willingness to try out any new information technology" (Agarwal & Prasad, 1998). However, PIIT represents a broader utilitarian view of using technology, while computer enthusiasm is a purely emotional disposition of eagerness and

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passion towards using technology. The definition of passion and vitality from the field of positive psychology is instrumental in the definition and measurement of this new construct, computer enthusiasm and is not present in the definition of PIIT. A person enthusiastic about computers will display "*a form of vitality, an aliveness expressed not only in ..an activity* (using computers), *but the ability to infectiously energize those with whom they come into contact*" (Peterson & Seligman, 2004, p. 273).

Technomancy

Technomancy is defined as the feeling of being able to achieve remarkable things through the use of a specific technology. It is a positive matching concept to technostress, the on-going sense of discomfort, pressure or inadequacy felt by an individual using a *specific technology*. While technostress leaves an individual feeling defeated and incapable, technomancy makes individuals feel empowered. The suffix of the word technomancy, adapted from the Greek word *manteia* which means divination, was intentionally chosen to reflect the almost magical dimension of the concept of technomancy. Technomancy captures the positive feeling of being able to successfully wield a specific technology to one's needs, goals and intentions. Borrowing Clarke's third law, an aphorism popular in technology circles, "any sufficiently advanced technology is indistinguishable from magic" (Clarke, 1962). In the same way that technostress varies significantly across technologies (demonstrated in chapter two), an individual may experience different levels of technomancy using different technologies. For example, the use of a virtual reality application may result in greater feelings of technomancy than using spreadsheets.

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The feeling of technomancy is associated with individuals' expectations that they can achieve or create things that are beneficial and desirable using a given technology. Technomancy is therefore a positive affective evaluation associated with a user's anticipation, realization and experience with a specific technology. Certain characteristics of the technology, a property known as the generative capacity of a technology (Avital & Te'eni, 2009), may influence feelings of technomancy. Further, technomancy is different from mastery or self-efficacy for multiple reasons. First, technomancy is proposed to be a purely affective concept. Second, mastery and self-efficacy relate to possessing ample experience with and detailed knowledge about a system. An individual should be able to experience the feeling of technomancy without understanding how a technology works or knowing how to use the full range of technology features.

Enjoyment

Enjoyment is a momentary (i.e., *temporally constrained*) feeling of pleasure during a performance episode with a *specific technology*. It is a positive matching concept to TISA, the momentary feeling of uneasiness and apprehension during a performance episode with a *specific technology*. Enjoyment has been extensively studied in the IS literature as a state experienced from using particular IT (Heijden, 2004; Igbaria, Parasuraman, & Baroudi, 1996; Mun & Hwang, 2003; Webster, Trevino, & Ryan, 1994; Zhang, 2013). Enjoyment has been described as being in a state of arousal and resulting in feelings of intrinsic motivation (Larson, 1990). Perceptions of enjoyment are associated with total involvement with a task (Koufaris, 2002), and are considered an essential component of higher level cognitive states such as flow (Hsu & Lu, 2004) or

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cognitive absorption (Agarwal & Karahanna, 2000). Further, the experience of enjoyment is distinct from the consequences of performing the activity that is causing it (Davis, Bagozzi, & Warshaw, 1992).

Table 31: Definitions of Affect-Related Concepts

Concept	Definition/Description
Temporally Constrained	
Enjoyment	A momentary feeling of pleasure during a performance episode with a *specific technology*
Technology induced state anxiety	A momentary feeling of uneasiness and apprehension during a performance episode with a *specific technology*
Temporally Unconstrained	
Specific Behavior Stimulus (Specific ICT Object & ICT Objects in General)	
Technomancy	An on-going sense of being able to achieve remarkable things through the use of a *specific technology*.
Technostress	An on-going sense of discomfort, pressure or inadequacy felt by an individual using a *specific technology*.
Computer Enthusiasm	A feeling of eagerness to explore and try out technology *in general*
Computer Anxiety	A feeling of apprehension, fear and aversion towards using technology *in general*

Together, these three matching, positive affective responses to technology broaden our perspective on the importance of affect, and how it influences performance outcomes. In Table 31 above, the definitions of the positive and negative matching concepts and the categories they belong to in ARM are shown. The theoretical foundations from the previous chapter, based on ARM, can also be applied to support the relationships between antecedents and positive affective concepts. All three categories of antecedents from the prior chapter are also considered in this paper, including individual characteristics, technology characteristics and task/organizational characteristics. One additional individual characteristic, the individual's free-floating mood state

prior to the performance episode, is also considered for its possible value as an intervention to limit negative affective responses to technology and to enhance the positive responses.

Positive Mood as an Intervention

Mood is defined as an individual's core affective *state* without a specific stimulus or with a quasi-stimulus (Russell, 2003). Despite being free-floating and unassociated with any given stimulus, the mood a person is in during a performance episode is expected to carry over into the interaction. One of the propositions of ARM details this expectation. A person's mood is expected to influence their affective reactions during the performance episode (P0 in ARM).

Positive affect during the performance episode should enhance cognitive resources leading to better performance (Strack & Deutsch, 2004). This beneficial effect of positive mood has been shown for creative problem solving tasks (Isen, Daubman, & Nowicki, 1987; Rowe, Hirsh, & Anderson, 2007), recall and naming tasks (Isen & Daubman, 1984), an anagram task and even while answering Graduate Record Exam (GRE) questions (Lyubomirsky, Boehm, Kasri, & Zehm, 2011). The impact of a positive mood may ultimately carry over into the individual's computing performance outcomes under the right conditions. For instance, past research has shown that being in a positive mood tends to help the performance of individuals high in computer self-efficacy (Agogo, Hess, & Wright, 2015).

Compared to individual traits and other characteristics, an individual's mood state is relatively easy to manipulate as an intervention, both in the laboratory and in the real world (Estrada, Isen,

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& Young, 1997). A range of methods have been used in the psychology literature to manipulate mood experimentally, including a writing task such as the 'Life Event Inventory' where the individual recollects and writes about an event to prime their mood (Bless et al., 1996; Schwarz & Clore, 1983), guided imagery and reflection where the individual is asked to reflect on some prompts (Mayer, Allen, & Beauregard, 1995; McKinney, Antoni, Kumar, Tims, & McCabe, 1997), a random gift (Estrada et al., 1997), videos (Farmer et al., 2006), and music (Kenealy, 1988; McKinney et al., 1997; Västfjäll, 2001). The use of multiple mood induction methods is usually recommended (Ciarrochi & Forgas, 2000; Forgas, 1994; Hill & Ward, 1989). IS research has adopted one of these methods thus far, giving research participants a random gift (e.g., Djamasbi, 2007; Djamasbi & Strong, 2008).

In this section, the value of positive affect was discussed and research from the field of psychology and IS was reviewed. In addition, three positive affective responses to technology, that are matching concepts to the negative concepts studied in the prior chapter, were introduced. Last, the potential benefits of positive mood on technology perceptions and performance were discussed. Existing approaches for manipulating mood were described, and mood was presented as an intervention that could be changed prior to a performance episode with technology to improve outcomes. In the following section, specific research hypotheses are introduced.

Research Model & Hypotheses

Building on the review of theoretical foundations from the previous chapter and the introduction of positive affective concepts, including positive mood, several hypotheses are proposed.

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Hypotheses addressing negative affective concepts based on the prior chapter will be stated first with a brief summary of the supporting literature, and then the new hypotheses that address positive affective concepts is presented. The presentation of hypotheses for both negative and positive affective concepts serves to re-test the relationships from the prior chapter in a creative task context, while also expanding the research model to include positive concepts, and an intervention in the form of manipulated mood. The overall research model for this paper is presented in Figure 8 below.
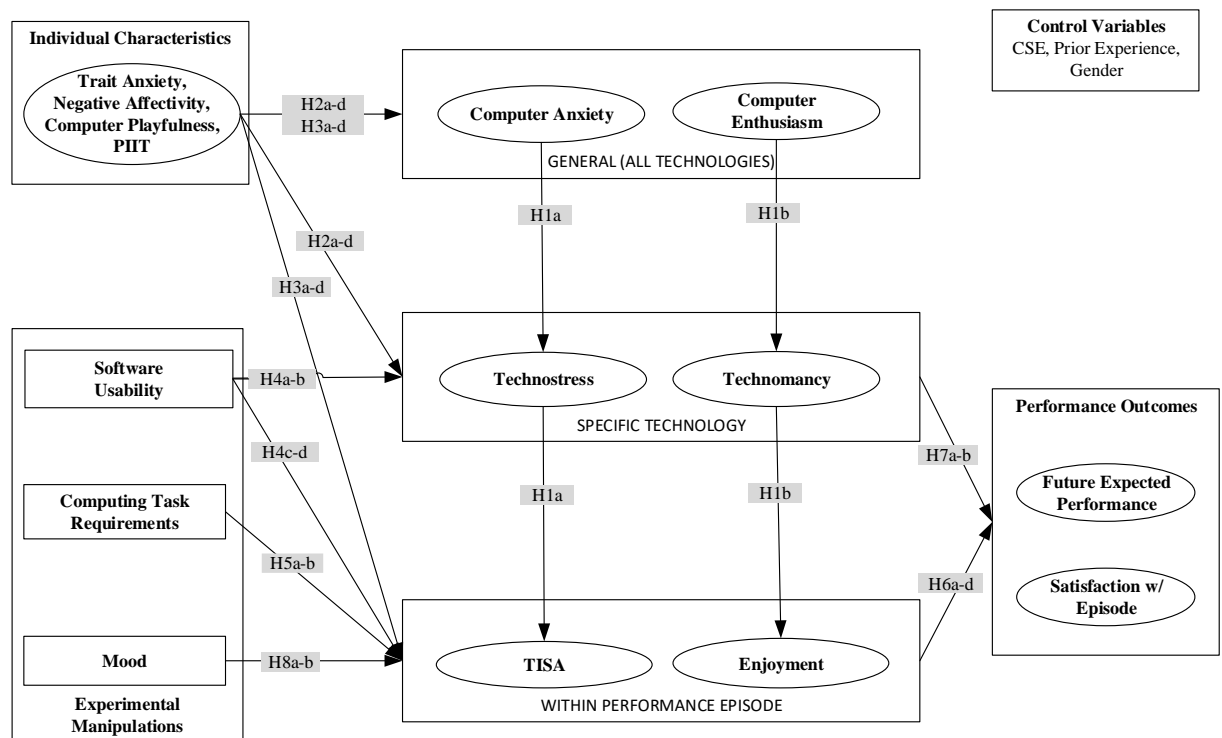
Figure 8: Research Model

Mediating Role of Technostress and Technomancy

According to ARM, affective responses to technology have omnibus and reciprocal relationships between themselves (Zhang, 2013). This very general and extensive set of relationships prompted the application of two dimensions of ARM, temporal and specific/general, to offer more directed relationships. In paper two, technostress was shown to play a mediating role in the relationship between affective evaluations towards all technologies (computer anxiety) and the state experienced during the performance episode with a specific technology (TISA). Technostress towards a specific technology, as compared to individual differences directed toward technology in general, is more informative of the feelings experienced during the performance episode and therefore plays a mediating role. This hypothesis is tested again in the different context of a less structured, creative design task. Thus:

H1a: The relationship between computer anxiety and TISA is mediated by technostress

Similarly, an identical pattern of relationships is expected for the relationship between positive affective concepts. Computer enthusiasm is a temporally unconstrained (trait-like) feeling towards technology in general, while technomancy is a temporally unconstrained (trait-like) feeling towards a specific technology (Zhang, 2013). Enjoyment is a state (temporally constrained) that that is experienced during the performance episode with a specific technology (Heijden, 2004; Mun & Hwang, 2003; Webster et al., 1994). Therefore, it is expected that technomancy will mediate the influence of computer enthusiasm on enjoyment. This leads to the following new hypothesis:

H1b: The relationship between computer enthusiasm and TISA is mediated by technomancy

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Influence of Individual Character Traits

Next, the influence of individual traits is considered. Chapter 3 proposed and confirmed that computer anxiety plays a mediating role in the link between two negative affective traits (negative affectivity and trait anxiety) and both technostress and TISA. These relationships are tested again in the context of a less structured, creative design task. Thus:

H2a: Computer anxiety mediates the relationship between trait anxiety and technostress

H2b: Computer anxiety mediates the relationship between negative affectivity and technostress

H3a: Computer anxiety mediates the relationship between trait anxiety and TISA

H3b: Computer anxiety mediates the relationship between negative affectivity and TISA

Positive individual characteristics or traits have also been examined in past IS research, including personal innovativeness in technology (PIIT) and computer playfulness. PIIT refers to a "willingness to try out any new information technology" (Agarwal & Prasad, 1998) and is a technology specific trait related to the general individual trait of innovativeness. Similarly, computer playfulness is an individual characteristic representing a type of intellectual or cognitive playfulness and describing an individual's tendency to interact spontaneously, inventively, and imaginatively with technology (Webster & Martocchio, 1992).

It is expected that these individual characteristics will exhibit a similar pattern of relationships with positive affective concepts, including the newly proposed concepts of computer enthusiasm and technomancy. The relationship from PIIT and computer playfulness to the system specific feeling of technomancy will be mediated by the general affective disposition of computer

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enthusiasm(Zhang, 2013). Similarly, computer enthusiasm will mediate the link between PIIT and computer playfulness and the positive affective state experienced during the performance episode, enjoyment. These mediating relationships have not been proposed or tested in any prior research (Zhang, 2013). This leads to the following new hypotheses:

H2c: Computer enthusiasm mediates the relationship between PIIT and technomancy

H2d: Computer enthusiasm mediates the relationship between computer playfulness and technomancy

H3c: Computer enthusiasm mediates the relationship between PIIT and enjoyment

H3d: Computer enthusiasm mediates the relationship between computer playfulness and enjoyment

Influence of Technology Characteristics

In the prior chapter, a negative relationship between the perceived usability of technology and technostress was proposed and supported. The structural model demonstrated a strong negative relationship between usability and technostress at both time periods in the context of a single technology with high usability and little variability in usability perceptions. This relationship is tested again in the current chapter with two different technologies, which were selected for the study given their different levels of usability. Higher usability is expected to result in much lower feelings of technostress.

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A relationship not hypothesized in the prior chapter was the link between technology

characteristics and the affective state of TISA. Given that this paper manipulates technology

characteristics, which would directly influence perceptions of an episode of using the technology,

this hypothesis is now included. It is expected that individuals will experience significantly lower

TISA while using a highly usable technology. This leads to the following hypotheses:

H4a: When technology is more usable, users will report lower technostress
H4b: When technology is more usable, users will report lower TISA

A similar pattern of relationships between technology characteristics and positive affective

responses is expected. Individuals are expected to feel more technomancy towards a more usable

technology. Desirable system characteristics imbue a technology with a generative capacity

(Avital & Te'eni, 2009), which make users more likely to feel they can achieve remarkable things

with the technology.

Similarly, the actual experience of using such a system is expected to be more enjoyable. This

kind of positive affective state during the performance episode will occur, irrespective of the

outcomes of the interaction. As such, this leads to the following new hypotheses:

H4c: When technology is more usable, users will report greater technomancy
H4d: When technology is more usable, users will report greater enjoyment

Influence of Task Characteristics

In the prior chapter, task time pressure and task complexity were manipulated as contextual characteristics of a structured spreadsheet computing task. In order to explore a less structured, creative design task in this study, a different kind of task characteristic was considered. This paper constrains the requirements of the task (high vs low task requirements). Providing a single correct and clear target outcome to participants during a task has been shown to cause cognitive fixation (Smith, Ward, & Schumacher, 1993), block mental activity and inhibit creativity (Smith, Linsey, & Kerne, 2011). Setting very high standards for the task, makes it inherently more complex. As a result, it is expected that participants will experience more TISA when assigned to complete a task with a high level of requirements, compared to tasks where no such requirements are demanded. This leads to the following hypothesis:

H5a: TISA experienced will be greater with higher task requirements

On the other hand, eliminating constraints of how the outcome should look frees the individual to be more exploratory (i.e. search for novel ways of doing things) (Burton-Jones & Straub, 2006) and enjoy the task. The presence of more basic or lower task requirements should result in more enjoyment during the performance episode. This leads to the following hypothesis:

H5b: Enjoyment experienced will be greater with lower task requirements

Affect and Performance Outcomes

In the prior chapter, the limiting influence of TISA on performance outcomes is described, tested and confirmed. Users who experience TISA have lower subjective performance outcomes, such as satisfaction with the performance episode and expectations of being able to perform well in the future. This relationship is tested again in the context of a less structured, creative design task. Thus:

H6a: TISA will have a negative effect on performance, decreasing satisfaction with the episode
H6b: TISA will have a negative effect on performance, leading to lower future expectations of performing well

On the other hand, it is expected that experiencing a positive state of enjoyment during the performance episode will positively impact performance outcomes. The experience of enjoyment is intrinsically motivating and supports exploration in system usage (Burton-Jones & Straub, 2006). Enjoyment, being a positive state itself, has been documented to increase user engagement and intentions towards a system (Mun & Hwang, 2003; Vorderer, Hartmann, & Klimmt, 2003; Wu & Liu, 2007). The same way negative feelings during a task can be integrated into the individual's self-perceptions (Clore, Gasper, Garvin, & Forgas, 2001; Clore & Storbeck, 2006; Zhang, 2013), the positive feeling of enjoyment will lead to more positive self-perceptions (Scanlan & Lewthwaite, 1986). As such, individuals that experience more enjoyment within the performance episode can also be expected to feel subjectively better about their performance, and future prospects in a similar situation. As such, enjoyment is expected to have a positive effect on

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both satisfaction with the performance episode and future expectations of being able to perform well in similar situations. This leads to the following new hypothesis:

H6c: Enjoyment will have a positive effect on performance, increasing satisfaction with the episode

H6d: Enjoyment will have a positive effect on performance, leading to higher future expectations of performing well

Similarly, in the prior chapter, technostress is shown to have a negative influence on subjective performance outcomes. The enduring feeling of being incapable of coping and dealing with a specific system had a negative effect on performance outcomes, especially the subjective outcome of future expected performance. This relationship remained consistent even after additional system experience was obtained, and is now tested in the context of a less structured, creative design task. Thus:

H7a: Technostress will have a negative effect on performance, decreasing future expectations of performing well

Technomancy should have the opposite effect on this performance outcome. Feeling that one is able to achieve remarkable feelings with a given technology can influence the nature of intentions formed towards the technology (Strack & Deutsch, 2004). As such, experiencing technomancy

with a given technology should lead to optimistic expectations about future performance with that technology. This leads to the following new hypothesis:

H7b: Technomancy will have a positive effect on performance, increasing future expectations of performing well

Positive Mood as an Intervention

Another major contribution of this paper is the inclusion of positive mood as a possible intervention. Prior IS research has demonstrated the helpful influence of a positive mood to technology acceptance, the use of a decision support tool, and other perceptions related to technology use (Ang, Cummings, Straub, & Earley, 1993; Loiacono & Djamasbi, 2010; Venkatesh & Speier, 1999; Zhang, 2013).

A positive mood helps individuals cope better with negative situations (Raghunathan & Trope, 2002). Therefore, placing individuals in a positive free-floating mood prior to the performance episode, should help limit the influence of any negative antecedents, resulting in lower TISA. This leads to the following new hypothesis:

H8a: Positive mood prior to starting a task lowers TISA experienced during the episode

On the other hand, being in a positive mood prior to completing the task is expected to influence the subsequent affective states experienced. A positive mood state is documented to open up individuals to be more explorative and creative (Fredrickson, 2001; Isen et al., 1987; Rowe et al., 2007). This mood is anticipated to carry over and influence the affective states during the

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performance episode (Zhang, 2013). As both prior positive mood and the experience of enjoyment are positive states, they are expected to complement each other, as is common with other forms of positive affect (Garland et al., 2010). It is therefore expected that being in a positive mood prior to starting a task will heighten the experience of enjoyment during the performance episode. This leads to the following new hypothesis:

H8b: Positive mood prior to starting a task increases enjoyment experienced during the episode

The relationship between technostress/technomancy and satisfaction with the performance episode is excluded given the findings of the prior chapter. The measure of satisfaction used in the study is specific to the episode, thus only the states experienced within the episode can be expected to influence it. Technostress and technomancy are affective evaluations that are the result of numerous episodes of use, and thus are only weakly linked to a single episode of use. However, because future expected performance transcends the episode, it is an outcome that can be influenced by technostress/technomancy, which also transcends a single episode. Second, a direct influence of mood on performance outcomes is not hypothesized as the mood literature does not support such a direct relationship. Rather, indirect effects of mood on performance outcomes will be assessed through supplemental analyses.

Research Design

A 2 x 2 x 2 laboratory experiment (high/low usability, high/low requirements, positive/neutral mood) was conducted to test the hypotheses and overall research model. Participants were from a large undergraduate introduction to IS class in a public university in the USA. Participants were asked to design a flyer using one of two randomly assigned software applications, Paint and PowerPoint, which were chosen to manipulate usability (high/low). Task requirements (high/low) were the second factor manipulated with participants in the high task requirements condition provided with a professional quality flyer design and asked to create a flyer as close to that example as possible. No such target was provided to participants in the low requirements condition. Third, the mood state of participants prior to working on the task was manipulated (neutral vs positive mood).

Procedure

At the start of the laboratory experiment, participants were assigned a software application (Paint vs PowerPoint) and then asked to evaluate their familiarity with the system and their perceptions of how usable the system is (as a manipulation check). They also reported their level of technostress and technomancy towards the system. Participants were then informed that they would be creating an event flyer using the software they had been assigned. After this, participants were exposed to the mood manipulations according to their assigned group (neutral or positive mood), immediately followed by a measure of their current mood state as a manipulation check (details of the mood manipulation used are shown in Appendix C2). The

details of the task were then presented to the participants according to whether they were in the high or low requirements condition (details of manipulation also shown in Appendix C2). Participants then completed the design task. After the flyer had been uploaded, participants were given a post-survey and were asked to report how much enjoyment and TISA they felt during the task. Questions measuring perceived task complexity (manipulation check), performance satisfaction and future expected performance were also included in the post-survey. Individual characteristics and other control variables were measured at an earlier time, prior to the study being conducted, to avoid a lengthy pre- or post-survey during the laboratory experiment session.

Measures

New measurement scales were created to measure computer enthusiasm and technomancy. The scale measuring computer enthusiasm was adapted from the subscale measuring 'vigor' in the student engagement scale (Schaufeli, Salanova, González-Romá, & Bakker, 2002) and the sub-scale measuring 'zest' in the *Character Strengths and Virtues* handbook (Peterson & Seligman, 2004). The scale for technomancy was created based on the definition of the contruct and from reviewing the concept of generative capacity in IS research (Avital & Te'eni, 2009). Multiple pre-tests were used to improve both new scales and ensure they were discriminant from other positive constructs in IS (e.g. PIIT and playfulness, measured in this study).

Scales created and validated in the prior chapters were used to measure satisfaction with the performance episode, future expected performance, TISA and technostress. Existing scales were used to measure enjoyment (Cheung, Chang, & Lai, 2000; Igbaria et al., 1996), computer anxiety

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(Heinssen, Glass, & Knight, 1987; Thatcher & Perrewe, 2002), usability (Barnes & Vidgen, 2002), mood (Mayer & Gaschke, 1988), negative affectivity (Thatcher & Perrewe, 2002), trait anxiety (Thatcher & Perrewe, 2002), computer playfulness (Webster & Martocchio, 1992), and PIIT (Agarwal & Prasad, 1998). Details of the scales used are provided in Appendix C1.

Participants

This study was administered to undergraduate students enrolled in a large introductory IS class in a public university in the USA with participants randomly assigned to conditions. A total of four hundred and thirty-two students participated in the study. Fifty-nine responses were excluded because they had incomplete data or they had never heard of either Microsoft Paint or Microsoft PowerPoint before the study. Their exclusion had no impact on the manipulation checks or the analysis. A total of 377 responses were used for all analyses. 91% of the sample were between 18 and 21 years old. 57% were male. The number of participants assigned to each condition is shown in Table 32 below.

Table 32: Distribution of Sample across Experimental Conditions

Low Requirement Task

	Paint	PowerPoint
Neutral	45	47
Happy	47	48

High Requirement Task

	Paint	PowerPoint
Neutral	46	51
Happy	40	53

Analysis & Results

The statistical tools used included SPSS 22.0 and Mplus 7.0. In this section, descriptive statistics by experimental conditions are presented. Afterwards, the statistical checks confirming that the manipulations were successful are described. The measurement validity of all constructs is assessed (using both an EFA and a CFA). After this, a MANOVA is used to test for the influence of the manipulations as hypothesized. Finally, a structural model is fit to test the expanded model including both positive and negative concepts at the same time. Despite the preponderance of related affective concepts in this paper, common method bias was confirmed not to be an issue. The details of the test performed is included in Appendix C4.

Descriptive Statistics & Manipulation Checks

In Table 33 below, descriptive statistics for the affective concepts and outcome variables are presented by experimental conditions.

Table 33: Descriptive Statistics of Measured Variables and Outcomes by Condition

	Mood		Software		Task Requirements	
	Neutral	Happy	Paint	PPT	Low	High
Technostress	2.55	2.49	2.67	2.39	2.46	2.57
Technomancy	3.65	3.57	3.35	3.85	3.66	3.56
TISA	3.33	3.28	3.39	3.23	3.07	3.53
Enjoyment	3.09	3.39	2.98	3.47	3.46	3.03
Computer Anxiety	2.23	2.18	2.25	2.16	2.26	2.15
Computer Enthusiasm	3.78	3.86	3.81	3.84	3.80	3.84
Satisfaction w/ Episode	3.59	3.65	3.43	3.78	4.04	3.20
Future Expected Performance	4.39	4.45	4.02	4.77	4.66	4.19

A MANOVA was conducted to confirm that the experimental manipulations were successful using recommended guidelines (Perdue & Summers, 1986). This was followed up with univariate tests which confirmed that there was significant variation for all of the manipulation check variables as anticipated. The results of these tests are shown in Table 34a below. Given that there was a significant two-way effect on usability and a three-way effect on complexity, the dataset was split by the task requirements condition (high vs. low) and the multivariate analysis was repeated. This additional analysis confirmed that usability was significantly different at both levels. This operation was repeated after splitting the dataset by software usability, confirming successful manipulations overall. The means of the manipulation check variables by condition is provided in Table 34b below.

Table 34a: Multivariate and Univariate Tests for Successful Manipulations

Multivariate Tests		Univariate Tests: F(P-value)		
	F	**Usability**	**Mood**	**Complexity**
Software	**12.620***	**36.06***	0.55	1.10
Mood	**9.276***	4.55*	**24.05***	0.51
Requirements	**37.796***	0.86	0.59	**107.57***
Software x Mood	0.088	0.04	0.08	0.19
Software x Requirements	0.188	0.04	0.07	0.40
Mood x Requirements	**3.708***	**6.29***	2.23	2.65
Software x Mood x Requirements	**3.267***	2.03	1.42	**6.74***

Table 34b: Means of Manipulation Check Variables by Conditions

MC: Usability		Paint	PPT	MC: Mood		Neutral	Happy
Neutral	Low Requirements	5.26	5.69	Low Requirements	Paint	3.66	4.68
	High Requirements	4.95	5.69		PPT	3.79	4.43
Happy	Low Requirements	5.10	5.77	High Requirements	Paint	3.94	4.27
	High Requirements	5.55	5.98		PPT	3.69	4.26

MC: Complexity		Low Requirements	High Requirements
Neutral	Paint	1.99	4.06
	PPT	2.06	3.55
Happy	Paint	2.66	3.48
	PPT	2.09	3.86

It was also confirmed that there was no significant difference in any of the individual characteristics (negative affectivity, trait anxiety, computer playfulness and PIIT) by the condition participants were assigned to.

Measurement Model

First, an exploratory factor analysis (EFA) was conducted to evaluate the factor structure of the items used in this study. The first EFA conducted included only the core positive and negative affective concepts (computer anxiety, computer enthusiasm, technostress, technomancy, TISA and enjoyment). It was confirmed that all items loaded on their respective factors and there were no cross-loadings above 0.174. The smallest loading of an item was 0.520 (item 2 from the existing computer anxiety scale). The details of the EFA are shown in Appendix C3.

Thereafter, a much larger EFA was conducted which included the core concepts referenced above

and both positive and negative individual character traits. In this extended EFA, the core affective

constructs retained their unique and high loadings on their distinct factors, but there were some

moderate cross-loadings for items measuring the individual character traits. Three items from the

existing PIIT scale cross-loaded with the existing computer playfulness (0.471, 0.473 and 0.504),

and one PIIT item cross-loaded on technomancy (0.309). Similarly, three items from the existing

negative affectivity scale cross-loaded on the factor for trait anxiety (0.324, 0.359, and 0.390).

The details of this extended EFA are shown in Appendix C3. Because these measures are existing

ones from the IS literature, they were retained for the confirmatory factor analysis (CFA) and

only then were very poorly loading or cross-loading items eliminated.

Next, a measurement model was run using MPlus 7.0, and the convergent and discriminant

validity of the items was confirmed. After dropping some items from measures of individual

traits[6], the CFA model showed good fit with all model fit indices within acceptable ranges (CFI:

0.959, TLI: 0.954, RMSEA: 0.037; 0.033 – 0.041, SRMR: 0.045, 1397.376/923) (Gefen et al.,

2011; Hu & Bentler, 1999; Steiger, 2007).

Next, a Fornell-Larcker criterion table was created (shown in Table 35 below). It confirmed that

the variance explained for each construct was reasonably high (lowest was 53% for trait anxiety),

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[6] Several items, predominantly from the multi-item individual trait scales, were dropped due to
poor loadings or cross-loadings with related constructs. These include comp_anx_2, TISA_1,
enjoy_4, PIIT_3, Tranx_3, Tranx_5 to Tranx_8, Playfulness_4. The items dropped are provided
in Appendix C1. Crossloadings among these individual difference variables are not uncommon
and have been documented in the literature.

the composite reliability and Cronbach alphas were also above recommended cut-offs (smallest

CR = smallest crobach alpha = 0.83, for computer anxiety).

Table 35: Fornell-Larcker Table showing correlations & square-root of AVE on shaded diagonal

	AVE	CR	Alpha	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) CANX	0.62	0.83	0.83	0.79											
(2) CENTHUS	0.65	0.88	0.88	-0.08	0.81										
(3) TSTRESS	0.72	0.93	0.93	0.29	0.08	0.85									
(4) TMANCY	0.65	0.85	0.84	0.21	0.26	0.11	0.81								
(5) TISA	0.82	0.95	0.94	0.21	0.11	0.25	0.06	0.90							
(6) ENJOY	0.74	0.89	0.89	-0.06	0.20	-0.06	0.29	-0.21	0.86						
(7) FUTPERF	0.66	0.85	0.85	-0.17	0.04	-0.24	0.20	-0.42	0.47	0.81					
(8) SATS	0.84	0.94	0.94	-0.03	0.04	-0.13	0.08	-0.39	0.43	0.75	0.92				
(9) NEGAFF	0.57	0.84	0.84	0.12	0.13	0.16	0.13	0.18	0.02	-0.07	-0.02	0.75			
(10) TRANX	0.53	0.85	0.85	0.23	0.06	0.22	0.04	0.20	-0.06	0.00	0.00	0.67	0.73		
(11) PLAY	0.65	0.92	0.92	-0.12	0.37	-0.04	0.19	-0.09	0.10	0.22	0.10	0.04	-0.07	0.81	
(12) PIIT	0.67	0.86	0.86	-0.24	0.51	-0.03	0.13	-0.04	0.11	0.16	0.05	0.04	-0.03	0.68	0.82

It is important to point out that there were high correlations between the pairs of trait anxiety and

negative affectivity (0.67), and computer playfulness and PIIT (0.68). However, those

correlations were lower than the square-root of the AVE of each construct. Similarly, the two

performance outcomes (performance satisfaction and expected future performance) were also

highly correlated (0.75) but that value was also lower than the square-root of the AVE of each

construct[7].

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[7] This same pattern of correlations was observed in the prior chapter, although the correlations
were .1 to .15 lower. The longer survey, given the inclusion of both negative and positive
affective constructs, may account for the higher correlations.

MANOVA

To assess the effect of experimental manipulations and particularly technology characteristics on technostress and technomancy, a MANOVA was run with all the manipulations as predictors, as shown in Table 36. It was found that technostress and technomancy were significantly different by software usability. A further examination showed that the patterns of difference were just as expected. Participants reported significantly lower technostress and significantly greater technomancy with the more usable software (H4a and H4c supported). As expected, neither technostress nor technomancy varied by the mood and task requirements. Computer enthusiasm and computer anxiety were included as covariates. While computer enthusiasm had a significant effect on technomancy only, computer anxiety had a significant effect on both technostress and technomancy.

Table 36: Two MANOVAs Showing Effect of Manipulations and Affective Covariates on TISA, Enjoyment, Technostress and Technomancy

	MV Test (F)	Univariate Test (F)		MV Test (F)	Univariate Test (F)	
		TStress	TMancy		TISA	Enjoy
Technomancy	-	-	-	9.232***	0.31	18.39***
Technostress	-	-	-	6.514**	12.97***	0.21
Computer Enthusiasm	12.068***	1.77	22.80***	5.818**	4.21*	4.99*
Computer Anxiety	23.629***	32.23***	16.52***	4.172*	7.46**	2.27
Software	12.460***	5.81*	18.53***	3.611*	0.13	7.20**
Mood	0.306	0.05	0.57	2.228	0.08	4.44*
Requirements	1.521	2.19	0.78	8.012***	8.04**	11.35***
Software x Mood	0.087	0.01	0.16	0.526	0.67	0.19
Software x Requirements	0.270	0.53	0.00	0.896	0.00	1.71
Mood x Requirements	1.059	0.02	2.09	0.085	0.10	0.11
Software x Mood x Requirements	0.653	0.14	1.19	3.091*	4.98*	2.40
R-Square		10.2%	14.1%		11.4%	16.0%
Adjusted R-Square		8.0%	12.0%		8.7%	13.4%

To assess the influence of the manipulations on both TISA and enjoyment, another MANOVA was run. All three manipulations had significant main effects on enjoyment, as expected. Participants assigned a more usable software experienced greater enjoyment (H4d supported). So did participants in a positive mood prior to the task (H8b supported) and those assigned to the lower task requirement condition (H5b supported). For TISA, only the task requirements had a significant main effect, with greater TISA experienced under greater task requirements (H5a). While there was no main effect of mood or software on TISA, there was a significant three-way interaction. Further analysis was then used to understand the nature of the three-way interaction.

It was found that participants assigned to the less usable technology (MS Paint) and to the more difficult task condition (greater task requirements) while in a neutral mood reported the greatest level of TISA. However, being in a positive mood in that same situation (low usability and greater task requirements) resulted in much lower TISA (just about as much as those assigned to the more usable software, PowerPoint). Further, those assigned to the more usable technology (PPT) and to the lower requirements condition reported the lowest level of TISA. This information is represented in Figure 9 below. In summary, H8a was partially supported. Being in a positive mood led to lower TISA when task requirements were lower and technology usability was low. Similarly, H4b was partially supported as well. Being assigned to a more usable technology led to lower TISA when in a neutral mood and when task requirements were higher. These findings are interesting and are explored in more detail in the discussion section.

In examining the effects on TISA and Enjoyment, technostress and technomancy were included as covariates in addition to computer anxiety and computer enthusiasm. The results indicate that technostress had a significant effect on TISA only, and technomancy had a significant effect on

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enjoyment only, both in the directions expected. Computer enthusiasm had a significant effect on both TISA and enjoyment, while computer anxiety only had a significant effect on TISA. Including age and gender as control variables in both of the analyses above did not change any of the results. As such, they were excluded for parsimony.
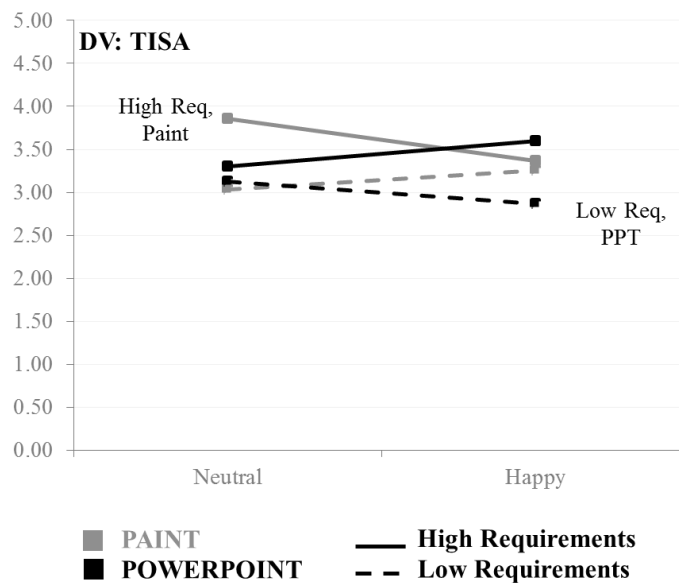
Figure 9: Effect of Manipulations on TISA

Structural Model

Next, an overall covariance-based structural equation model (SEM) was fit to test all the relationships proposed – i.e. for both negative and positive constructs at the same time. In the figure below, the path coefficients for the positive constructs are placed next to the coefficients of the negative constructs for readability and to reduce the complexity of the large model. The

overall model showed good fit at both time periods (RMSEA: 0.038, 0.035-0.041; CFI: 0.945, TLI: 0.940, SRMR: 0.053, Chi-square: 2023.605/1318) (Gefen et al., 2011; Hu & Bentler, 1999; Steiger, 2007). The manipulations were included in this model as categorical dummy variables[8]. The full model with all the paths is shown in Figure 10.

Mediating Influence of Technostress and Technomancy

The mediation test results (see Table 37 below) showed that computer anxiety had a significant direct effect on technostress (as in the prior chapter), and computer enthusiasm had a significant direct effect on technomancy. Similarly, technostress had a significant direct effect on TISA (as in the prior chapter) and technomancy had a significant direct effect on enjoyment. To test for the hypothesized mediation effect of technostress/technomancy, an alternative model was fit with those constructs excluded. This alternative model was run to demonstrate the changes in the path weights when these mediating constructs were excluded. Also, the indirect effects were estimated from the full model using recommended bootstrapping methods (with 5,000 samples drawn) (Preacher & Hayes, 2008). This tests confirmed that technostress significantly mediated the relationship between computer anxiety and TISA in this context (H1a supported). A partial mediation effect was observed in this chapter compared to a full effect in the prior chapter. And,

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[8] Categorical variables were used in this chapter, but could not be used for the treatments in the prior chapter, due to the comparison of T1 and T2, and the lack of categorical variables at T2.

technomancy fully mediated the relationship between computer enthusiasm and enjoyment (H1b supported).
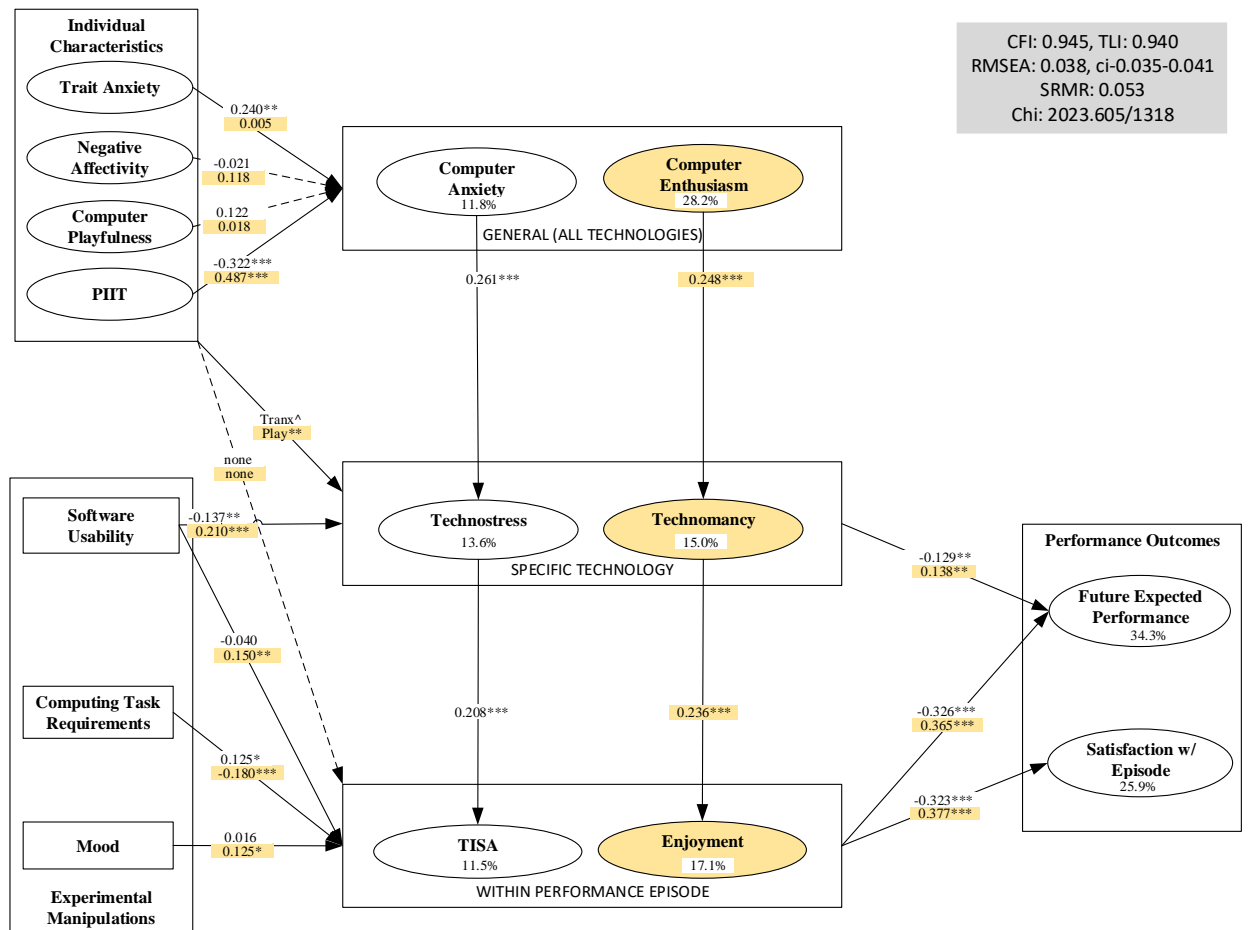
Figure 10: Structural Model

Table 37: Test for Mediation Effect of Technostress/Technomancy (Hypotheses 1)

Relationship	Direct w/out Technostress	Direct w/ Technostress	Indirect
Computer Anxiety → TISA	***0.196	*0.151	**0.054
	Direct w/out Technomancy	Direct w/ Technomancy	Indirect
Computer Enthusiasm → Enjoy	*0.162	0.111	**0.058

Influence of Personality Traits on Technostress/Technomancy and TISA/Enjoyment

The influence of individual characteristics on affective responses to technology was then assessed. Although only relationships between positive (negative) affective character traits and positive (negative) affective concepts were hypothesized, the model tested all relationships. It was observed that only trait anxiety and PIIT had significant paths to computer anxiety. Both were in the direction expected. For the positive matching concept of computer enthusiasm, only PIIT had a significant influence in the structural model. Notably, computer playfulness and negative affectivity had no significant effects on either computer anxiety or computer enthusiasm. One possible explanation for this finding are the high correlations observed between PIIT and computer playfulness and between negative affectivity and trait anxiety. Given these high correlations, one individual trait may have overshadowed the other.

Mediation tests were also performed to test the mediating influence of computer anxiety on the more specific constructs of technostress and TISA. Recall that in the prior chapter, computer anxiety mediated the influence of trait anxiety and negativity on both technostress and TISA at both times (all mediations significant at time 1, three out of four significant or partially significant at time 2). In this paper, computer anxiety also fully mediated the influence of trait anxiety on

both technostress and TISA (H2a and H3a supported). However, negative affectivity had no

direct or indirect effect on any of the affective responses to technology (H2b and H3b not

supported). These repeated mediation tests are shown in Table 38a below.

Table 38a: Test for Mediation

Relationship			
	Direct w/o CA	Direct w/ CA	Indirect
Negative Affectivity → Technostress	0.032	0.035	-0.005
Trait Anxiety → Technostress	*0.213	^0.149	*0.063
Negative Affectivity → TISA	0.095	0.092	-0.001
Trait Anxiety → TISA	0.123	0.076	*0.013

Similar tests were performed to assess the mediating effect of computer enthusiasm in the

relationship between the positive individual character traits and more specific affective concepts.

It was found that technomancy significantly and fully mediated the relationship between PIIT and

technomancy (H2c supported), but there was no mediating effect on the relationship between

computer playfulness and technomancy (H2d not supported). Rather, computer playfulness had a

significant direct influence on technomancy that grew more significant when the mediating paths

were included in the model. In other words, including computer enthusiasm in the model

enhanced the effect of playfulness in the model.

Next, the mediating influence of computer enthusiasm on the link between individual character

traits and the state of enjoyment during the performance episode was assessed. The results are

shown in Table 38b below. Computer enthusiasm significantly and fully mediated the link from

PIIT to enjoyment (H3c supported), but did not mediate the relationship between playfulness and

enjoyment (H3c not supported). However, technomancy played a significant mediating role on

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this relationship instead. It is possible that the nature of the technology is very critical to the influence of computer playfulness. Recall that computer playfulness had a direct influence on technomancy, and the effect of computer playfulness was strengthened after the effect of computer enthusiasm was accounted for. Further technomancy mediates the influence of computer playfulness on enjoyment. This suggests that this general trait may be getting activated towards specific kinds of technology more than others. As such, while it bears no relationship to an affective response to technology in general, it bears a relationship to the affective responses towards specific technologies, software used in a design task in this case.

Table 38b: Test for Mediation

Relationship			
	Direct w/o CE	Direct w/ CE	Indirect
Playfulness → Technomancy	***0.217**	****0.230**	0.006
PIIT → Technomancy	-0.028	^-0.168	****0.121**
Playfulness → Enjoyment	0.049	-0.030	***0.055**
PIIT → Enjoyment	0.082	0.118	****0.034**

Influence of Affective Concepts on Performance Outcomes

As observed in the prior chapter, TISA had a negative effect on both satisfaction with the episode and future expected performance, at both times. This result remained consistent in this task context. TISA had a significant negative influence on satisfaction and future expected performance (H6a and H6b supported). As expected, enjoyment had an opposite effect (H6c and H6d). There was a positive effect of enjoyment on both outcomes, with the magnitude of the effect being of equal or greater magnitude to the effect of TISA.

Similarly, technostress was found to have a significant negative effect on expectations of performing well in the future (H7a supported), and as expected, technomancy had a positive influence on future expected performance of about the same or greater magnitude (H7b supported).

To assess the added value of including positive concepts side by side with negative concepts, two subsets of the model were run. The first subset included only negative affective concepts and negative individual traits, while the second model included only positive affective concepts and traits. The variance in the performance outcomes explained by the full, balanced model and by these two subsets is shown in Table 39 below. The positive-only model explained marginally higher variance in future expected performance (4% more) and satisfaction with performance (4.3% more). However, combining both positive and negative concepts explained over a third more variance in performance outcomes.

Table 39: Variance Explained by Negative-Only, Positive-Only and Balanced Models

	Negative Only	Positive Only	Combined
Future Expected Performance	19.0%	23.0%	33.9%
Performance Satisfaction	15.3%	19.6%	25.6%

Influence of Positive Mood Intervention

In the MANOVA section, it was demonstrated that those in a positive mood experienced a significantly greater amount of enjoyment during the performance episode. This effect remained consistent in the structural model with the path from mood to enjoyment being positive and significant (H8b supported).

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The MANOVA also showed the absence of a main effect of mood on TISA experienced. This remained consistent in the structural model with the path from mood to TISA being not significant. Given the conclusions from the earlier probing of the three-way interaction, it can be concluded that there was only partial support for H8a. For individuals working with a less usable software and completing a more difficult task (greater requirements), being in a positive mood does in fact lower the TISA experienced.

Lastly, although not hypothesized, the indirect effect of a positive mood on performance outcomes was assessed. Mood had a significant positive indirect effect on future expected performance (path: 0.046, $p = 0.020$) and satisfaction (path: 0.047, $p = 0.019$). Only enjoyment served as a mediator in this relationship. This can be interpreted to mean that being in a positive mood improves enjoyment and also carries over into more favorable evaluations of the episode and expectations of future performance. This is an interesting finding that is consistent with the findings from the IS literature that a positive mood can ultimately improve technology related expectations and intentions (Beaudry & Pinsonneault, 2010; Djamasbi & Strong, 2008).

<u>**Discussion**</u>

A summary of the hypotheses testing results is provided in Table 40 below. Most of the hypotheses in the prior chapter are tested a second time with a less structured, creative design task. Similarly, hypotheses pertaining to matching positive affective concepts are also tested, and the effectiveness of a positive mood as an intervention is assessed. The majority of hypotheses in this paper are supported.

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Table 40: Summary of Research Hypotheses

	Combined Table of Positive and Negative Hypotheses	Support?
H1	(a) The relationship between computer anxiety and TISA is mediated by technostress (b) The relationship between computer enthusiasm and TISA is mediated by technomancy	Yes$^+$ Yes
H2	Computer anxiety mediates the relationship between (a) trait anxiety and technostress, and (b) negative affectivity and technostress Computer enthusiasm mediates the relationship between (c) PIIT and technomancy, and (d) playfulness and technomancy	Yes$^+$ No$^+$ Yes No
H3	Computer anxiety mediates the relationship between (a) trait anxiety and TISA, and (b) negative affectivity and TISA Computer enthusiasm mediates the relationship between (c) PIIT and enjoyment, and (d) playfulness and enjoyment	Yes$^+$ No$^+$ Yes No
H4	When technology is more usable, users will report (a) lower technostress, (b) lower TISA (c) greater technomancy, and (d) greater enjoyment	 Yes$^+$ Partial Yes Yes
H5	(a) TISA experienced will be greater with higher task requirements (b) Enjoyment experienced will be greater with lower task requirements	Yes Yes
H6	TISA will have a negative effect on performance, including (a) decreased satisfaction w/ episode, and (b) lower future expectations of performing well Enjoyment will have a positive effect on performance, including (c) increased satisfaction w/ episode, and (d) higher future expectations of performing well	 Yes$^+$ Yes$^+$ Yes Yes
H7	Technostress has a negative effect on (a) future expectations of performing well Technomancy has a positive effect on (b) future expectations of performing well	Yes$^+$ Yes
H8	Positive mood prior to starting a task (a) lowers TISA, and (b) increases enjoyment experienced during the episode	Partial Yes

$^+$ Hypotheses repeated from chapter three.

In this paper, positive affective responses to technology are examined simultaneously with negative affective responses using a 2x2x2 (high/low software usability, high/low task requirements, positive/neutral mood) experimental design. New measures are developed and validated for the concepts of technomancy and computer enthusiasm, and were tested within a comprehensive model of affective responses to technology. The results suggest that these constructs are distinct, explaining additional variance in perceptions and outcomes, and providing

a stronger foundation for future research into affective responses to technology. Similarly, the existing concept of enjoyment from the IS literature is formalized and properly integrated into the nomological network as a matching positive concept to TISA.

ARM proposed omnibus and reciprocal relationships between antecedents, and affective responses. In the prior chapter, a more nuanced and directed pattern of relationships was proposed, tested and confirmed for negative affective concepts. While the prior chapter considered a structured spreadsheet task, this chapter considered a less structured, creative design task. The pattern of relationships between antecedents and negative affective concepts was tested again in this new context, and was largely supported. Except for hypotheses relating to the influence of the individual characteristic, negative affectivity, all other hypotheses from the prior chapter were strongly supported.

Further, the logic from the prior chapter is applied to test matching hypotheses pertaining to positive affective constructs. Overall support is found for this pattern of relationships between antecedents, positive affective responses to technology, and performance outcomes. Technomancy significantly mediates the link between computer enthusiasm and enjoyment. One of the two individual characteristics tested, PIIT, indirectly influences technomancy through computer enthusiasm, while computer playfulness has a direct link with technomancy. This pattern of relationships differs somewhat from expectations, likely due to the higher correlations observed between PIIT, computer playfulness and computer enthusiasm. It is also worth noting that PIIT and computer playfulness are existing constructs with existing scales, and not all scale items align with ARM definitions. Technology characteristics were more likely to influence affective evaluations towards specific technology (technomancy), and task characteristics had a

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direct influence on affective states during the performance episode, i.e., enjoyment. This finding further confirms the usefulness of ARM as a theoretical framework for studying affect in IS.

Another important contribution of this work is connecting technology characteristics to affective states during the performance episode. In the prior chapter, a single technology was considered and there wasn't adequate variance in usability to test the influence of this technology characteristic on affective states during the performance episode. In the current chapter, two technologies, with low and high usability, were used to further examine this relationship. In this setting, usability, a technology characteristic, was shown to influence enjoyment (an affective state associated with the episode), with enjoyment being higher when a more usable technology is being used. However, technology characteristics influenced TISA only when the task was more difficult (i.e., greater requirements) and the individual was in a neutral mood. In that case, being assigned to a more usable technology reduces the TISA experienced.

While TISA and technostress are shown to be negatively related to performance outcomes in this paper, enjoyment and technomancy are shown to have an opposite, positive effect. Technomancy led to significantly higher future expectations of performing well, while enjoyment positively influenced both future expectations and satisfaction with the recent performance episode. Interestingly, the variance explained in performance outcomes was increased by considering both positive and negative affective responses. Including positive affective responses to technology explains over 50% more variance than only negative affective concepts alone.

Finally, this paper demonstrates that being in a positive mood prior to a performance episode may serve as an intervention in two ways. First, those in a positive mood experience significantly

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greater enjoyment during the task, regardless of usability and task requirements. Second, positive

mood reduces TISA under more adverse conditions, i.e., when task requirements are greater and

the technology is less usable. This finding suggests that positive mood can indirectly influence

performance outcomes through two routes – by increasing enjoyment during all kinds of

technology-related tasks, and by minimizing TISA when the tasks and technology create

particularly adverse conditions. This finding has important practical implications for managers

and for businesses worried about how to limit the negative affective responses to technology

among workers.

Future Research

There is need for future research to explore the moderating conditions under which positive

affective responses to technology may leading to undesirable outcomes. One important future

direction supported through this dissertation is the study of technology addiction. The newly

proposed concepts may provide an indication of individuals who are likely to become addicted or

dependent on technology. For instance, consider the concept of computer enthusiasm. While the

eagerness to use different technologies seems positive, excessively high levels of enthusiasm

towards technology can exert a "*dangerous influence on the human personality by encouraging a

symbiotic relationship with the machine*" leading to "*over identification with computers and

adoption of mind states that mirrors the computer itself*" (Brod, 1984, p. 17). Such high levels of

identification can then translate to negative outcomes both for the individual and for entire

organizations and societies.

Future research should also consider more objective performance outcomes with the less structured, creative design task reported in this paper. For example, objective measures of effort and overall quality or creativity could provide new insight into how affective states and mood states influence technology-related performance in this context. There has been little IS research that has examined the influence of technology with creative or hedonic tasks and such tasks are becoming more prevalent and relevant with technology-savvy youth, and with game-based training.

<u>Conclusion</u>

This paper complements the findings from the earlier chapters of this dissertation by replicating the findings in the context of a different task; demonstrating the importance of considering matching positive affective concepts; and showing that a positive mood state prior to the performance episode can serve as intervention. Along with these contributions, new measures are created and validated for the concepts of computer enthusiasm and technomancy, matching positive affective concepts to the negative affective concepts of computer anxiety and technostress.

The prior chapter extended ARM to include task/organizational characteristics as an antecedent category, and linked affective responses to performance outcomes. This chapter further confirms the validity of ARM as a useful theoretical framework for studying affect in IS research, and adds to the evidence that ARM is effective for studying both positive and negative affective responses to technology.

CHAPTER 5

IMPLICATIONS, FUTURE RESEARCH AND CONCLUSION

<u>Summary of Chapters</u>

To examine the dark side and explore the bright side of affective responses to technology use, the following broad research questions were addressed in this dissertation:

1. How are computer anxiety, technophobia and technostress conceptually distinct? How are they related to each other?

2. What are the similarities and differences in the studied antecedents and outcomes of these concepts based on existing IS (and related) literature? What gaps exist?

3. Which of these affective responses are more likely to influence different computing performance outcomes, and why?

4. Can inducing a positive mood be an effective intervention for boosting technology-based performance outcomes?

In paper one, an integrative literature review is conducted on computer anxiety, technophobia and technostress, the main negative affective concepts in the IS literature. The known antecedents, dimensions, and outcomes of each concept are organized into nomological networks which are then combined to identify inconsistencies and relationships yet to be tested in the literature. Further, a new IS theoretical framework, the Affective Response Model (ARM; Zhang, 2013) is applied to differentiate the three constructs and to introduce technology-induced state anxiety (TISA), a new temporal (state-like) negative response to a specific instance of technology. Two

empirical studies are conducted using existing and newly developed scales, and demonstrate that computer anxiety, technophobia, technostress and TISA are conceptually and empirically distinct, laying a foundation for further exploration into how these constructs are related. Several positive, matching affective concepts are also proposed in this paper for the first time.

In paper two, much of the integrated nomological network from paper one is tested in the context of a laboratory experiment with a spreadsheet application. The relationship between computer anxiety, technostress and TISA is explored in more depth with the mediating influence of technostress on TISA proposed and confirmed. ARM is further extended in two ways (1) by demonstrating the impact of the characteristics of the task/organizational context, a new category of antecedents identified from paper one, and (2) connecting affective responses to computing performance outcomes (e.g. satisfaction with performance, expected future performance, and an objective measure of task accuracy). Finally, this paper concludes by evaluating how the relationship between antecedents, affective responses and performance outcomes may change with system experience. The laboratory experiment is repeated after six weeks of regular system usage to test whether the strong influence of TISA observed at time 1 diminishes as expected. The majority of research hypotheses in this paper are supported. Marginal support is found for the expectation that the influence of affective responses to technology on performance outcomes will change with added system experience.

In paper 3, the research model from paper 2 is expanded by integrating positive affective concepts. It is known that positive and negative concepts are distinct and individuals can experience high levels of both positive and negative affect at the same time. Therefore, ARM is further extended by demonstrating the practical and theoretical importance of considering both

positive and negative affective responses. This paper explores the domain of a less structured, creative design task, employing a laboratory experiment in which participants design a flyer. Computer anxiety, technostress and TISA are measured alongside enjoyment, and two newly proposed concepts, technomancy and computer enthusiasm. The hypotheses from the prior chapter pertaining to negative affective concepts are tested again in this different task context, and overwhelmingly supported. Matching hypotheses for positive affective concepts are also supported. The unique impact of these positive and negative affective responses on performance outcomes is demonstrated with variance explained increasing significantly when a balanced view is adopted. Lastly, a positive mood prior to working on a computing task is shown to enhance enjoyment, and reduce the TISA experienced when an individual is faced with completing a more difficult task with a less usable technology.

Contributions to Theory

This dissertation offers several theoretical contributions to IS scholarship. Paper one represents the first known effort to apply ARM to differentiate affective concepts that seemingly overlap. As a result, more precise descriptions for computer anxiety, technophobia and technostress are offered, and the omissions in the antecedents and outcomes that have been studied are identified.

The integrated nomological network of these three concepts, which is based on the IS literature, identifies individual characteristics, technology characteristics and task/organizational characteristics as the common antecedents to affective concepts. This provides a pathway to understanding the associations between sociological and psychological approaches to studying

affect. Sociological theory and psychological theory typically operate on different levels - the organizational level and individual level respectively. The convergence offered by the nomological network from the first paper of this dissertation is desirable for the advancement of our understanding of important concepts (Levinson, 1964). For example, studies that focus on how personal characteristics relate to organization level outcomes such as job satisfaction or job performance (i.e., psychological perspective) will do well to consider how organizational conditions (i.e., sociological perspective) or task characteristics can influence those outcomes.

Paper one also calls attention to the need to develop unidimensional measures for these concepts to enhance future research in this area. For example, research on technostress has identified the stressors and the resulting strain or burnout that results from technostress (Ayyagari et al., 2011), often conceptualizing technostress as a second order construct with first order dimensions (Tarafdar, Tu, Ragu-Nathan, & Ragu-Nathan, 2007). However, existing research has yet to measure the higher order factor reflectively or formally represent this multi-level construct. Appropriate new measures for technostress are developed and validated using two different studies, a survey of a working population and a laboratory experiment with an undergraduate sample. This work lays a foundation for future researchers that will study these concepts, or other related concepts within the broad nomological network.

While ARM proposes reciprocal and omnibus relationships between computer anxiety, technostress and TISA, the second paper of this dissertation applies two dimensions of ARM and psychological theory on the processing of affect to better explain how these concepts are related. The *performance episode* is offered as a unit of analysis based on ARM, with which future

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research can study directed relationships. This unit of analysis also helps explain why some antecedents are more likely to influence certain affective responses more than others.

ARM already proposed two categories of antecedents (individual characteristics and technology characteristics), but did not connect affective responses to performance outcomes. The second paper extends ARM by integrating a new category of antecedents (task/organizational characteristics) based on prior literature and by connecting affective responses to performance outcomes. Further, this paper offers a pattern of relationships between antecedents, general affective concepts, and specific affective concepts, and confirms these relationships empirically. Task characteristics, tied more closely to the performance episode of system use, had a greater influence on episode-specific affective concepts (i.e. TISA). Technology characteristics, being tied to the ongoing use of a particular system, had a greater influence on the system-specific evaluative affective concepts (i.e. technostress). And individual characteristics, being more general and not limited to specific situations, had a greater influence on more general affective concepts (i.e. computer anxiety).

In the second paper, a longitudinal design is also used to evaluate how the link between task characteristics, affective concepts, and performance outcomes would change with added system experience. Only partial support is found for the proposition that affective states (e.g. TISA) will have less of an impact on performance outcomes with more experience, while affective evaluations (e.g. technostress) will have a stronger influence. This work lays a foundation for the retesting of these temporal changes in future work.

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The third paper makes additional theoretical contributions to IS research by addressing both negative and positive affective concepts. First, the research model from the prior paper is expanded by including matching positive affective concepts side-by-side. This balanced view enables a richer understanding of how affective responses to technology come about and how they shape performance outcomes. The concepts of technomancy and computer enthusiasm are introduced and new scales are developed and validated within the extended nomological network.

The intervention effect of a positive mood is also assessed in the third paper. It is found that a positive mood serves as an intervention, enhancing the positive state of enjoyment, and reducing the negative state of TISA under the most difficult of conditions (low usability technology and more difficult tasks).

Contributions to Practice

This dissertation also has significant practical implications. It is demonstrated that a positive mood states carries over to performance outcomes, indirectly boosting both satisfaction with the performance episode and future expectations of performing well. This updates managers' understanding of the conditions under which individuals' may have the best performance outcomes with technology and provides additional evidence of the benefits of positive moods at work (Ashforth & Humphrey, 1995; Ashkanasy & Daus, 2002; Barsade & Gibson, 2007).

Further, this work informs practitioners of the antecedents that are more likely to lead to each distinct category of affective response to technology. This provides increased insight into the

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factors that could be modified to minimize negative affective experiences. For example, the characteristics of the task could be modified to reduce TISA and increase enjoyment. The features and capabilities of the system could be modified to increase technomancy and reduce technostress. Also, personal characteristics known to associate with these negative affective responses could also be assessed to determine which users might benefit from individual management or intervention to reduce their computer anxiety and make them more eager to use technology in general (computer enthusiasm).

This dissertation also points out to practitioners that the effect of affective concepts may change over time. This is critical to understanding the best times for conducting interventions or how to modify intervention and training programs based on the level of system experience the user has acquired.

In addition, a better understanding of which antecedents are more likely to influence the performance episode can help designers think of dynamic ways of reducing TISA and increasing enjoyment using design. It is shown that more usable technology leads to greater enjoyment. Given that more beautiful interfaces are considered easier to use (Tractinsky et al., 2000), updating user interfaces with affective cues to make users perceive the system as more usable may heighten the enjoyment experienced. Similarly, designers can think of ways to reduce technostress and improve technomancy. Features such as dynamic difficulty adjustment (DDA) are used by video game designers to change parameters of the game environment based on the player's abilities to prevent them from becoming too frustrated or too bored. This idea can be applied to business systems also. The findings from this paper imply that such system features

could boost the user's feeling of being able to achieve remarkable things with the technology and therefore drive overall performance.

Future Research

Not all negative and positive affective responses to technology identified in this paper are considered in detail. For instance, the first paper examined technophobia, but the following two papers did not include the concept due to its severity and limited applicability to samples studied. Related to that, the matching positive concept of technophilia was also not explored in the third paper. Future research should take a closer look at both constructs for their influence on other affective responses to technology, performance outcomes and general well-being. Such an examination should be done in collaboration with psychologists who have expertise in studying specific phobias.

Technophilia, the extreme feeling of liking and affinity towards ICT objects in general, has some interesting future directions of study. There is a growing use of language and slogans in the popular press which imbue technology with life-like attributes. Such tendencies of anthropomorphism towards technology are only expected to increase as robotics, artificial intelligence, augmented reality and other advanced technologies become more common. While this is still far from being severe to the extent of objectophilia (Mirsky, 2016; Stasieńko, 2015), some believe that it is only a matter of time before stories like that captured in the Oscar-nominated film *Her* become commonplace, and human beings depend on technology rather than other humans to meet their emotional and psychological needs for intimacy (Orr, 2013). Future

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research that develops the concept of technophilia further may help equip mental health professionals to deal with such challenges if they do occur.

Related to this, future research should also apply concepts from this dissertation to study cyberpathologies and disorders such as computer and internet addiction, computer rage and other obsessive compulsive technology use behaviors. For example, research on technology addiction can integrate these new concepts that capture positive, affective evaluations of technology use to better understand what triggers overly high levels of engagement with technology that may then become compulsive and interfere with daily life (Turel, Serenko, & Giles, 2011). Addictions are known to be motivated as much from pleasure-seeking motivations as the desire to avoid the aversive symptoms of withdrawal (Robinson & Berridge, 2000). Positive affective experiences (e.g. enjoyment, technomancy, computer enthusiasm) may reinforce problematic technology use, and this work lays a foundation for evaluating this.

Cognitive responses to technology were excluded from the first paper (literature review), and only treated as control variables in subsequent chapters. Individual traits such as computer self-efficacy are documented to play an important role in shaping attitudes and behavior, even interacting with affect. For instance, Agogo, Hess, & Wright (2015) found that the effect of a positive mood on performance is moderated by the individual's level of computer self-efficacy. Future research that integrates both affective and cognitive concepts is needed to more completely understand the impact of affective responses to technology.

Another direction for future research is the consideration of how the newly proposed concept of TISA relates to neurophysiological markers of episodic stress. Recent research on IT enabled

interruption in the workplace appropriately focuses on episodic stress rather than lasting or chronic stress (e.g., Galluch et al., 2015), and therefore tends to utilize such neurophysiological measures. However, some inconclusive findings have been observed when perceptual measures of stress are triangulated with neurophysiological measures (e.g.,Tams, Hill, Guinea, Thatcher, & Grover, 2014). The temporally constrained concept of TISA may hold the potential to resolve such inconclusive findings if used instead within such experimental studies. Future research should measure TISA explicitly and see how strongly it relates with these markers.

Further research is required into the possible relationship between technomancy and flow. Technomancy is an affective concept while flow includes both affective and cognitive dimensions. Flow research offers several competing theories in the IS literature (Finneran & Zhang, 2005), therefore future studies need to take a closer look at the theoretical foundations of flow in the light of ARM to establish how the affective aspects of flow are similar or different from the feeling of technomancy.

Future research should repeat these studies with different organizational characteristics and conditions. That class of antecedents was not considered in this dissertation because the samples studied in the empirical papers (chapter three and four) were all domiciled within the same organization (undergraduates enrolled in the same class).

Lastly, the question of how affective states build into more enduring specific affective evaluations (e.g. technomancy, technostress) and more general affective evaluations (computer enthusiasm, computer anxiety) is need of empirical examination. This can be done using an experience

sampling diary study in which each performance episode with a technology is monitored and changes in the individual's overall affective evaluations are tracked.

<u>Conclusion</u>

This three-paper dissertation set out to examine dark side affective concepts in IS, and to explore positive concepts as well as interventions. Overall, this work (1) synthesizes the IS literature through the application of ARM, (2) proposes new affective concepts, (3) theorizes about and tests the relationships between relevant antecedents and outcomes of these affective responses, and (4) demonstrates that positive mood is an intervention to enhance outcomes of the performance episode with technology. Along the way, an attempt is made to integrate forty years of research on negative and positive emotional responses to technology, create and validate an extensive nomological network, create new measurement scales and clear a path for future research on how to better understand and predict the responses of individuals to technology. While many new and interesting insights are uncovered, several even more interesting future directions are identified, providing tools and clear steps for advancing our understanding of the affective responses to technology use.

APPENDICES

APPENDIX A

PAPER 1

APPENDIX A1: DEFINITIONS OF AFFECTIVE CONCEPTS

Table A1.1: Five Dimensions of ARM (adapted from Zhang 2013)

Dimension	Definition
Residing	This dimension describes where the affective concept resides, which can be within a person, a stimulus, and between a person and a stimulus. A concept can reside independently within a person (e.g., mood, personality trait), It may also reside within the stimulus, as an objective property of a stimulus, such as an affective quality or cue. Last, an affective concept can reside between a person and stimulus (e.g., emotional response or affective evaluation of a stimulus).
Temporal	The temporal nature of an affective concept describes whether the concept is constrained or *state-like*, or unconstrained and *trait-like*. This temporal classification applies to affective concepts residing within a person or between a person and a stimuli. For example, mood resides within a person and is temporary and state-like, while trait anxiety, an individual personality trait, describes the stable, general disposition of a person. Similarly, a person can temporarily experience enjoyment when using an ICT (state-like) and can also feel computer anxiety on an on-going basis whenever they use an ICT (trait-like), with both concepts residing between a person and a stimuli.
Object versus Behavior Stimulus	An ICT-related stimulus can result in a response to the object versus a response to the behavior associated with the object. For example, *computers* and *using computers* are different kinds of stimuli – one referring to an object, the other to behavior – and individuals may have different attitudes and responses toward these different stimuli.
Specific versus General Stimulus	An ICT-related stimulus can result in a response to a particular ICT object versus general ICT objects. For example, mobile websites are a general stimulus whereas the ESPN.com mobile website is a particular stimulus.
Process-based vs. Outcome-based Affective Evaluations	An ICT-related stimulus that resides between a person and a specific stimulus, can be a process-based affective evaluation related to the essence or substance of an interaction, or an outcome-based affective evaluation representing a final judgment or high level evaluation that occurs after a process is complete. In other words, process-based affective evaluations occur during active use of an ICT, while outcome-based affective evaluations occur after active use and are based on the goals and overall outcomes of an interaction with a specific ICT object.

Table A1.2: Definitions of Affect-Related Concepts

Concept	Definition/Description
Affective Antecedences Residing within the Individual	
Mood	A core affective *state* without a specific stimulus or with a quasi-stimulus (Russell, 2003)
Trait Playfulness	An individual's inherent predisposition to be playful (Webster & Martocchio, 1992)
Personal Innovativeness	An individual's willingness to change (Agarwal & Prasad, 1998)
Trait Anxiety	A temporally unconstrained predisposition to respond to a stimulus with feelings of apprehension, dread, and tension. Trait anxiety reflects a view of the world in which a wide range of stimulus situations are perceived as dangerous or threatening as well as a tendency to respond to such threats with state anxiety reactions (Spielberger, 1966).
Affective Antecedences Residing within the ICT	
ICT Physical Attributes	Attributes which determine the kind of operations that can be carried out on inputs and the kind of outputs that are produced by the system (Chung et al., 2000), i.e., what the system does. ICT physical attributes are established via functional requirements. *Examples* of affective cues based on physical attributes are graphical user interface characteristics such as layout, graphics and colors, the logic and sequence of steps required to carry out operations, system features, etc.
ICT System Attributes	Attributes that describe the performance of the system and the data it produces (Chung et al., 2000), i.e., how the system does. System attributes are often difficult to test and therefore are usually evaluated subjectively. ICT System attributes are established via non-functional requirements. *Examples* of affective cues based on system attributes include how the system performs, how adaptable to changing situations the system is and how interoperable the system is with other systems, etc.
Affective Responses Residing between Person & Stimulus: Temporally Constrained	
Enjoyment	A momentary feeling of pleasure during an episode of using a *specific ICT*
Technology induced state anxiety	A momentary feeling of uneasiness and apprehension during an episode of using a *specific ICT*
Affective Responses Residing between Person & Stimulus: Temporally Unconstrained	
Object Stimulus (Specific ICT Object & ICT Objects in General)	
Affective Fit	A feeling associated with the individual's evaluation of the fit between the features of a *specific ICT* and the goals of using it
Technophobia	A feeling of fear and aversion towards *ICT objects in general*
Technophilia	A feeling of liking and affinity towards *ICT objects in general*
Specific Behavior Stimulus (Specific ICT Object & ICT Objects in General)	
Technostress	An on-going sense of discomfort, pressure or inadequacy felt by an individual using a *specific ICT*.
Technomancy	An on-going sense of being able to achieve remarkable things through the use of a *specific ICT*.
Computer Anxiety	A feeling of apprehension, fear and aversion towards using *ICTs in general*

Computer Playfulness	A feeling of spontaneity, creativity and openness to explore and try out *ICTs in general*

APPENDIX A2: VALIDATING TECHNOSTRESS SCALE WITH TECHNOSTRESS-CREATORS

The new, six-item technostress measure was validated using the existing scales for the five technostress-creators, which are commonly represented as a formative second order construct with five, first order reflective dimensions (Tarafdar et al., 2007). An exploratory factor analysis was first performed on the technostress-creators using pilot data run and revealed weak loadings and some cross-loading of items among dimensions. In order to maintain the 'spirit' of the initial technostress creators, which are widely adopted in the IS literature, these items were retained with only minor modifications to clearly specify a referent object[9]. The slightly modified measures of the technostress creators were then used with the workers sample described in study 1. Three progressively comprehensive models are introduced below and include (1) the five technostress creators, (2) the five technostress creators modeled as a second-order latent construct, and (3) the five technostress creators modeled as a second-order latent construct that was allowed to covary with the new reflective measure of technostress. The three respective models are described in more detail below.

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[9] A pilot data collection (not reported) identified this cross-loading of items in the technostress-creator scale. The decision to retain the scale without major modifications from the original items was done intentionally to preserve the original scale for this validation exercise.

Table A2.1: Descriptive Statistics of Concepts (Workers Sample)

		N	Mean	Std Dev	Min	Max
Negative affective responses to technology	Computer Anxiety	191	1.71	0.99	1.00	6.00
	Technophobia	191	1.18	0.56	1.00	4.60
	Technostress	191	1.80	1.03	1.00	6.38
Technostress Creators	Techno-complexity	191	1.96	1.08	1.00	7.00
	Techno-overload	191	2.37	1.36	1.00	7.00
	Techno-invasion	191	2.43	1.40	1.00	6.75
	Techno-insecurity	191	2.04	1.10	1.00	7.00
	Techno-uncertainty	191	4.39	1.53	1.00	7.00

Model 1 describes a first order model with a CFA of the five technostress-creators only. This model allows the dimensions of technostress-creators to vary freely between themselves. The correlation matrix below in Table A2.2 shows the strength of the relationships between the formative dimensions of this technostress-creators scale.

Table A2.2: Correlations, AVEs, Reliabilities (Workers Sample)

	T-CMPX	T-OVER	T-INVAS	T-INSEC	T-UNCE	AVE	CR	Alpha
Techno-Complexity	0.73					0.535	0.851	0.841
Techno-Overload	0.66	0.77				0.595	0.879	0.870
Techno-Invasion	0.30	0.44	0.75			0.569	0.840	0.833
Techno-Insecurity	0.66	0.74	0.69	0.70		0.495	0.829	0.818
Techno-Uncertainty	0.23	0.23	0.13	0.24	0.84	0.714	0.909	0.908

Note: Square root of the AVEs are on the diagonal

Model 2 depicts the five technostress-creators represented as a second-order latent construct. The paths from each dimension to the second-order latent factor are shown in Table A2.3. All paths are significant ($p \leq 0.001$). The AVE of this second-order construct is 0.503 and construct reliability is 0.819.

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Model 3 depicts the second order latent construct correlated with the newly created technostress measure. These results indicate that the new measure is very highly correlated (0.742, p<0.000) with the technostress-creators measures currently used in the literature, suggesting that the new reflective measure of technostress is appropriate and highly correlated with the originally developed measures for this construct. The results also show that despite assumptions that the technostress-creators scale is formative, the measurement items for the technostress-creators cross-load with one another. Future research is needed to examine the measurement scales for these technostress-creator constructs. Also, there is wide variation in the correlations between dimensions (range from 0.13 to 0.74) as well as path weights from the dimensions to the second order latent factor (range from 0.261 to 0.977).

A comparison of the model fit for the three models is shown in Table A2.4. While this analysis suggests that further consideration and validation efforts are needed with the original representation and measures for the technostress creators, the inclusion of the new reflective measure of technostress does not reduce model fit, and this new measure seems to align with the original conceptualization for the technostress construct.

Table A2.3: Technostress-Creators EFA Factor Loadings & Cross-Loadings, CFA Factor Loadings

	EFA Loadings & Cross-Loadings					CFA
	t-over	t-compl	t-invas	t-uncert	t-insec	Loadings
Techno-Complexity						
I do not know enough about these technologies to handle my job satisfactorily	0.260	**0.575**	0.023	0.125	0.090	0.645
I need a long time to understand how to use these technologies	0.283	**0.705**	0.025	0.117	0.100	0.774
I do not find enough time to study and upgrade my skills to use these technologies	0.282	**0.686**	0.163	-0.060	0.035	0.749
I find new recruits to my organization know more about these technologies than I do	0.036	**0.637**	0.184	0.094	0.163	0.645
I often find these technologies too complex to understand and use	0.212	**0.806**	0.105	0.047	0.122	0.827
Techno-Overload						
I am forced by these technologies to work much faster	**0.615**	0.272	0.138	0.045	0.243	0.753
I am forced by these technologies to do more work than I can handle	**0.667**	0.370	0.240	0.049	0.214	0.842
I am forced by these technologies to work with very tight time schedules	**0.829**	0.184	0.147	0.051	0.074	0.813
I am forced to change my work habits to adapt to these technologies	**0.747**	0.184	0.124	0.143	0.100	0.762
I have a higher workload because of these technologies	**0.586**	0.224	0.235	0.084	0.117	0.675
Techno-Invasion						
I spend less time with my friends and family due to these technologies	0.205	0.106	**0.649**	0.075	0.042	0.703
I have to be in touch with my work even during vacations due to these technologies	0.083	0.004	**0.655**	0.004	0.043	0.662
I have to sacrifice my vacation and weekend time to keep current on these technologies	0.136	0.065	**0.766**	0.056	0.183	0.809
I feel my personal life is being invaded by these technologies	0.107	0.118	**0.819**	0.014	0.111	0.83
Techno-Insecurity						
I feel constant threat to my job security due to these technologies	0.303	0.356	**0.544**	0.057	0.279	0.8
I have to constantly update my skills with these technologies to avoid being replaced	**0.416**	0.221	0.389	0.160	0.192	0.68
I am threatened by co-workers with newer technology skills	0.201	**0.418**	0.385	0.199	0.327	0.741
I do not share my knowledge of these technologies with my coworkers for fear of being replaced	0.278	0.224	0.206	-0.028	**0.716**	0.621
I feel there is less sharing of knowledge of these technologies among coworkers for fear of being replaced	0.232	0.202	0.239	0.046	**0.767**	0.661
Techno-Uncertainty						
There are always new developments in these technologies in our organization	0.152	0.070	0.075	**0.810**	0.018	0.85
There are constant changes in computer software in our organization	0.131	0.072	0.046	**0.893**	-0.034	0.912
There are constant changes in computer hardware in our organization	0.042	0.065	0.045	**0.808**	0.060	0.796
There are frequent upgrades in computer networks in our organization	-0.005	0.084	0.036	**0.838**	0.023	0.817

Table A2.4: Model Fit Statistics for the Three Validation Models

Model Fit Statistics			
	Model 1	Model 2	Model 3
Chi-Square / df	586.946 / 242	609.429 / 247	867.917 / 371
CFI	0.870	0.863	0.860
TLI	0.852	0.847	0.846
SRMR	0.063	0.072	0.076
RMSEA	0.086	0.088	0.084
Path Coefficients^			
T-CMPX → TSC (2nd Order)		0.694	0.827
T-OVER →TSC (2nd Order)		0.774	0.825
T-INVAS → TSC (2nd Order)		0.643	0.533
T-INSEC → TSC (2nd Order)		0.977	0.853
T-UNCER → TSC (2nd Order)		0.261	0.262
r (TSC, Tstress)			0.739

^All paths significant at the 0.001 level

APPENDIX A3: DISCRIMINANT VALIDITY FROM PSYCHOLOGICAL CONSTRUCTS

In this appendix, the three primary, negative affective responses to technology (CA, technophobia and technostress) are differentiated from general psychological constructs (negative affectivity and trait anxiety) which are unrelated to technology. To illustrate discriminant validity between key psychological traits (negative affectivity and trait anxiety) and these negative affective concepts, an expanded CFA and structural model was fit using the workers sample and that showed good fit (CFI = 0.948, TLI = 0.941, RMSEA = 0.062, SRMR = 0.050, Chi-Square = 417.85, df = 242). The correlation table from that analysis is shown below in Table A3.1. The results indicate that the concepts of computer anxiety, technophobia and technostress are both conceptually and empirically distinct from psychological constructs such as negative affectivity and trait anxiety.

Table A3.1: Correlation Table, Square Root of AVEs on diagonal

	Negative Affectivity	Trait Anxiety	Computer Anxiety	Technophobia	Technostress
Negative Affectivity	0.77				
Trait Anxiety	0.69	0.84			
Computer Anxiety	0.16	0.12	0.74		
Technophobia	0.04	0.06	0.56	0.89	
Technostress	0.29	0.32	0.47	0.34	0.82

APPENDIX A4: COMMON METHOD BIAS EVALUATION

This appendix describes analysis conducted to test for the effect of common method variance (CMV) on the observed relationships between affective concepts. To achieve this, Harman's one-factor test was first performed (Podsakoff et al., 2003). The emergence of a single factor that accounts for the majority of variance from all variables is a sign that CMV exists. In addition, the marker-variable technique, a more conservative test, was also used (Lindell & Whitney, 2001; Malhotra, Kim, & Patil, 2006; Podsakoff et al., 2003). Similar to Malhotra et al. (2006), the three-item "fashion involvement index" (Tigert, Ring, & King, 1976) was included in both studies to be used as the marker variable since no relationship is expected between this scale and measures of the focal constructs.

Workers Sample: Harmon's single-factor test (computer anxiety, technostress, technophobia, technostress-creators and marker variable) showed that 27% of the variance in all variables was explained by a single factor, suggesting that CMV is not a concern. Following this, the marker variable technique for identifying CMV was conducted. A CFA model in which items measuring computer anxiety, technophobia, technostress and the marker variable were allowed to load on distinct factors. The results indicate that this baseline model showed good fit (CFI = 0.959, TLI = 0.949, RMSEA = 0.067, SRMR = 0.053, Chi-Square = 182.91, df = 98). The correlations between the marker variable and these constructs was then assessed, with all of these correlations being statistically non-significant ($p \geq 0.193$), and having an average correlation of 0.043. According to guidelines in Malhotra et al (2006), the CMV-adjusted correlations were computed and the differences between the original and CMV-adjusted correlations were seen to be small ($\Delta r \leq 0.029$) (shown in Table A4.1 below). This indicates a negligible impact of CMV on the relationships observed. Finally, a model in which items load on respective factors and also load on the marker-variable was fit. A significant improvement of this model over the baseline model would indicate significant CMV exists. The results (CFI = 0.958, TLI = 0.948, RMSEA = 0.068, SRMR = 0.053, Chi-

Square = 182.905, df = 97) did not suggest any significant changes to model fit (ΔChi-square = 0.005, Δdf = 1, p = 1.00). This supports the conclusion that common method bias is not substantial in this analysis. Therefore, the rest of the analysis in this paper is conducted without including the common method factor.

Student Sample: The Harmon's single-factor test showed that 30% of the variance in all variables (computer anxiety, technostress, technophobia, TISA, marker variable), was explained by a single factor, suggesting that CMB is not a concern. Similar to the above procedure, a measurement model with computer anxiety, technophobia, technostress, TISA and the marker variable loading uniquely was tested. The baseline model indicates good fit (CFI = 0.965, TLI = 0.958, RMSEA = 0.057, SRMR = 0.032, Chi-Square = 379.75, df = 179). However, a weak correlation between the marker variable and two constructs, technophobia and computer anxiety, was observed (p=0.041 and p = 0.006 respectively). The average absolute correlation of the variables with the method factor was 0.084, a value treated as the method correlation (rM) partialled out of the CMV-adjusted correlations shown in Table A4.1. The difference in relationships due to CMV-adjustment was also relatively small (Δr $\leq$ 0.069), supporting the conclusion that CMB is not a major concern in this sample. Finally, to test changes to the model when items are allowed to load on the marker variable, an additional model was fit (CFI = 0.964, TLI = 0.958, RMSEA = 0.057, SRMR = 0.032, Chi-Square = 379.69, df = 178). A chi-square difference test confirms that this new model does not have statistically worse fit than the baseline model (ΔChi-square = 0.06, Δdf = 1, p = 0.806), supporting the existing evidence that CMV is not substantial in this analysis. Therefore, the rest of the analysis using this sample is conducted without including the common method factor.

Table A4.1: Uncorrected and CMV-corrected correlations between focal constructs

	Workers Sample		Student Sample	
	Uncorrected Estimates	CMV-Corrected estimate	Uncorrected Estimates	CMV-Corrected estimate
Factor Correlations		(rM = 0.043)		(rM = 0.084)
r (CA, TP)	0.561	0.541	0.521	0.477
r (CA, TS)	0.461	0.437	0.409	0.355
r (TP, TS)	0.344	0.315	0.348	0.288
r (CA, TISA)			0.306	0.242
r (TP, TISA)			0.332	0.271
r (TS, TISA)			0.250	0.181

Fashion Involvement Index:

- When I must choose between the two, I usually dress for fashion, not for comfort
- An important part of my life and activities is dressing smartly
- A person should try to dress in style

PAPER 2

APPENDIX B1: EXPERIMENTAL TASK DETAILS

Low Complexity

Assigned Questions (8)		
Difficulty	Module Name	Question Text
Easy	SIMnet 2013 - Excel Practice Exams	Use AutoSum to enter a SUM function in the selected cell.
Easy	SIMnet 2013 - Excel Practice Exams	Add a new worksheet to the right of the *Purchase Orders* sheet.
Easy	SIMnet 2013 - Excel Practice Exams	Insert a 3-D pie chart based on the selected data.
Easy	SIMnet 2013 - Excel Practice Exams	In cell **D2**, enter a formula to display the value of cell **E3**.
Easy	SIMnet 2013 - Excel Practice Exams	Copy cell **F5** and paste it into cell **F6**.
Easy	SIMnet 2013 - Excel Practice Exams	Bold the selected cell.
Easy	SIMnet 2013 - Excel Practice Exams	Change the table design so the Total row is showing.
Easy	SIMnet 2013 - Excel Practice Exams	Clear the filter from this data.
		Count : 8

High Complexity

Assigned Questions (8)		
Difficulty	Module Name	Question Text
Medium	SIMnet 2013 - Excel Practice Exams	Modify the status bar so it displays the maximum of the selected cells.
Difficult	SIMnet 2013 - Excel Practice Exams	The *August Purchase Orders* data point has been selected for you. Rotate the pie chart exactly **130°** so this data point appears at the right side of the chart near the legend.
Difficult	SIMnet 2013 - Excel Practice Exams	Unhide column D.
Medium	SIMnet 2013 - Excel Practice Exams	This worksheet has been split into four panes. Remove the split.
Medium	SIMnet 2013 - Excel Practice Exams	Change the scaling option so all columns will print on one page.
Difficult	SIMnet 2013 - Excel Practice Exams	Create and apply a new conditional formatting rule to apply **italic** font formatting to only cells that are **equal to or above the average** for the selected range.
Difficult	SIMnet 2013 - Excel Practice Exams	Clear the selected Sparklines from the worksheet.
Medium	SIMnet 2013 - Excel Practice Exams	Change the width of column A to best fit the data.
		Count : 8

Technostress (Adapted from Cohen et al. 1983)
Please answer by selecting how well the statement describes feelings you have felt towards using _____ in recent times. Think about the past month of active use of these technologies when answering the questions that follow.
- You have felt that the application was stopping things from going your way
- You have found that you could not cope with all the things that you had to do using the application
- You have lost the ability to control irritations resulting from using the application
- You have felt that you were NOT on top of things because of the application
- You have lost the ability to control the way you spend your time when using the application

TISA (Adapted from Marteau and Bekker 1992; Spielberger et al. 1970)
While working on the task you just completed using this technology, how did you feel?
- Tense
- Strained
- Nervous
- Worried
- Anxious

Trait Anxiety (Lehrer & Woolfolk, 1982; Thatcher & Perrewe, 2002)
To what degree do the following statements describe how you feel on A TYPICAL DAY
- I picture some future misfortune
- I can't get some thoughts out of my head
- I keep busy to avoid uncomfortable thoughts
- I have to be careful not to let my real feelings show

Negative Affectivity (Thatcher & Perrewe, 2002; Watson et al., 1988)
This scale consists of a number of words that describe different feelings and emotions. Read each item and then select the appropriate answer on the scale from "Not at all" to "Extremely" that best decribes you. Indicate to what extent you generally feel this way, that is, how you feel on the average.
- Scared
- Irritable
- Ashamed
- Distressed
- Hostile (dropped)
- Jittery (dropped)
- Afraid (dropped)
- Guilty
- Upset
- Nervous

Computer Self-Efficacy (Compeau & Higgins, 1995b)
How well do the following statements describe you.

- If there is no one around to tell me what to do as I go. (dropped)
- If I have never used a package like Excel before. (dropped)
- If I have only the Excel software manuals for reference. (dropped)
- If I have seen someone else using it before trying it myself. (dropped)
- If I could call someone for help if I get stuck.
- If someone else helps me get started.
- If I have a lot of time to complete the Excel task
- If I have just the built-in help facility for assistance.
- If someone shows me how to do it first.
- If I have used similar packages before this one to do the same task.

Task Complexity
On a scale of 1 to 7,
- How complex was the Excel task you just completed [Not complex at all → Very complex]
- How challenging did you find the Excel Task? [Not challenging at all → Extremely challenging]

Time Pressure
On a scale of 1 to 7,
- How much time pressure were you under during this task? [No time pressure → a lot of time pressure]
- how adequate was the TIME allocated for this task? [very adequate → very inadequate]

Continuance Intentions (Adapted from Bhattacherjee, 2001)
How well do the following statements describe you?
- I intend to continue using Excel for these type of tasks
- I plan to continue using Excel for these type of computing tasks
- I will continue using Excel for these type of computing tasks
- I am very likely to recommend Excel to other people trying to complete such tasks

Future Expected Performance
On a scale of 1 to 7,
- How well do you think you will perform with Excel in the future? [Very poorly → Very excellent]
- How well do you think you will perform in such a computing task in the future? [Very poorly → Very excellent]
- In the future, how well do you think your performance in the use of Excel will be compared to other students? [One of the lowest → One of the highest]

Usability (Barnes & Vidgen, 2002)
Based on your current use of Microsoft Excel, Please select the option below that applies to your experience using the software.
- I find Excel easy to learn to operate
- My interaction with Excel is clear and understandable
- I find Excel easy to navigate
- I find Excel easy to use (dropped)
- Excel has an attractive appearance (dropped)

- The design is appropriate to the type of tool (dropped)
- Excel is competent at what it is supposed to do (dropped)
- Using Excel is a positive experience for me

APPENDIX B3: EXPLORATORY FACTOR ANALYSIS

EFA Factor Matrix for Affective Concepts and Outcomes at both times are shown below. All loadings below 0.3 are shaded grey for readability.

Time 1

	1	2	3	4	5	6	7	8	9
CMV_1	-0.05	0.00	-0.01	-0.03	0.03	0.00	0.03	**0.78**	0.02
CMV_2	0.06	-0.09	0.01	-0.06	0.00	0.01	-0.01	**0.83**	-0.02
CMV_3	0.04	-0.09	0.01	-0.07	0.02	0.01	0.00	**0.71**	-0.10
compAnx_1	0.03	0.10	0.15	0.01	0.03	**0.53**	0.25	0.00	0.00
compAnx_2	0.16	0.08	0.20	-0.09	-0.06	**0.64**	0.11	0.03	-0.04
compAnx_3	0.12	0.08	0.24	-0.13	0.02	**0.78**	0.08	-0.04	-0.07
compAnx_4	0.17	0.05	0.25	-0.11	-0.03	**0.76**	0.05	0.03	-0.08
Tstress_1	0.15	0.15	**0.74**	-0.24	-0.05	0.20	0.11	0.08	-0.11
Tstress_2	0.17	0.11	**0.77**	-0.25	0.04	0.23	0.05	0.02	-0.14
Tstress_3	0.20	0.05	**0.78**	-0.15	-0.01	0.23	0.11	0.00	-0.14
Tstress_4	0.11	0.09	**0.79**	-0.24	-0.07	0.22	0.13	-0.03	-0.08
Tstress_5	0.19	0.14	**0.77**	-0.23	-0.02	0.20	0.09	-0.05	-0.10
TISA_1	0.04	**0.87**	0.09	-0.06	-0.13	0.04	0.03	0.00	-0.05
TISA_2	0.03	**0.80**	0.05	-0.02	-0.18	0.05	0.02	-0.01	-0.06
TISA_3	0.02	**0.82**	0.11	-0.02	-0.09	0.09	0.02	-0.05	-0.08
TISA_4	-0.01	**0.78**	0.05	-0.02	-0.15	0.08	-0.01	-0.08	-0.07
TISA_5	-0.03	**0.79**	0.11	-0.05	-0.09	0.07	0.12	-0.08	-0.10
SATS_1	0.01	-0.18	-0.01	0.14	**0.83**	-0.03	-0.05	0.06	0.26
SATS_2	0.00	-0.30	-0.03	0.10	**0.84**	-0.01	-0.03	0.01	0.18
SATS_3	-0.07	-0.27	-0.02	0.11	**0.78**	0.01	-0.01	0.02	0.20
fut_perf1	0.03	-0.14	-0.20	0.21	0.25	-0.14	-0.10	0.01	**0.67**
fut_perf2	0.06	-0.16	-0.18	0.22	0.29	-0.07	-0.06	-0.12	**0.76**
fut_perf3	0.02	-0.16	-0.18	0.22	0.27	-0.02	-0.12	-0.06	**0.68**
Usab_1	-0.11	-0.06	-0.22	**0.86**	0.09	-0.05	-0.04	-0.01	0.14
Usab_2	-0.09	-0.06	-0.28	**0.89**	0.09	-0.08	-0.07	-0.03	0.09
Usab_3	-0.08	-0.04	-0.23	**0.84**	0.15	-0.14	-0.02	-0.06	0.15
Usab_4	-0.14	-0.01	-0.21	**0.73**	0.06	-0.08	0.01	-0.15	0.18
NegAffect_1	0.28	0.02	0.07	-0.01	-0.01	0.17	**0.62**	0.05	-0.05
NegAffect_2	0.27	0.01	0.03	-0.02	-0.02	0.03	**0.71**	-0.01	-0.10
NegAffect_3	0.20	0.06	0.12	0.01	-0.07	0.14	**0.68**	-0.05	-0.01
NegAffect_4	0.25	0.07	0.14	-0.10	0.00	0.12	**0.72**	0.03	-0.08
TraitAnx_1	**0.78**	0.06	0.10	-0.02	0.02	0.17	0.08	0.01	0.01
TraitAnx_2	**0.58**	0.06	0.08	-0.06	-0.03	0.06	0.16	0.15	0.03
TraitAnx_3	**0.75**	-0.05	0.08	-0.09	0.01	0.11	0.17	-0.04	-0.01
TraitAnx_4	**0.74**	-0.03	0.15	-0.06	-0.04	0.00	0.19	0.01	0.05
TraitAnx_5	**0.64**	-0.08	0.08	-0.03	-0.04	0.08	0.08	-0.10	0.00
TraitAnx_6	**0.76**	0.04	0.12	-0.05	0.00	0.02	0.17	0.06	-0.03
TraitAnx_7	**0.71**	0.06	0.05	-0.09	0.03	0.07	0.13	-0.01	0.00

Time 2

	1	2	3	4	5	6	7	8	9
CMV_1	-0.04	0.02	0.03	-0.05	-0.02	0.04	0.04	**0.76**	-0.04
CMV_2	0.06	0.04	-0.05	-0.08	0.05	-0.02	-0.07	**0.86**	-0.07
CMV_3	0.02	0.04	-0.03	-0.11	0.05	-0.02	-0.02	**0.71**	-0.07
compAnx_1	0.11	0.04	0.05	-0.03	**0.54**	0.08	0.24	-0.03	0.01
compAnx_2	0.10	0.16	0.13	-0.14	**0.65**	-0.02	0.11	0.02	-0.08
compAnx_3	0.13	0.13	0.11	-0.09	**0.80**	0.04	0.07	0.06	-0.20
compAnx_4	0.20	0.19	0.03	-0.12	**0.77**	-0.03	0.05	0.07	-0.05
Tstress_1	**0.83**	0.11	0.11	-0.25	0.10	0.01	0.10	-0.01	-0.07
Tstress_2	**0.85**	0.06	0.11	-0.21	0.15	-0.03	0.09	-0.01	-0.09
Tstress_3	**0.82**	0.07	0.13	-0.19	0.13	0.04	0.07	-0.02	-0.11
Tstress_4	**0.86**	0.04	0.09	-0.24	0.12	-0.03	0.07	0.01	-0.10
Tstress_5	**0.83**	-0.01	0.14	-0.19	0.13	0.04	0.08	0.07	-0.09
TISA_1	0.09	0.03	**0.82**	-0.04	0.01	-0.15	0.06	-0.04	0.01
TISA_2	0.12	0.16	**0.76**	-0.03	0.11	-0.12	0.01	0.03	-0.06
TISA_3	0.10	0.11	**0.74**	-0.12	0.11	-0.05	-0.04	0.11	-0.09
TISA_4	0.09	0.08	**0.82**	-0.03	0.05	-0.07	0.07	-0.09	-0.06
TISA_5	0.10	0.12	**0.83**	-0.01	0.07	-0.10	0.08	-0.06	-0.07
SATS_1	-0.04	0.03	-0.13	0.07	0.02	**0.81**	-0.02	0.01	0.19
SATS_2	0.03	-0.06	-0.18	0.06	0.02	**0.79**	0.04	0.02	0.14
SATS_3	0.06	0.01	-0.13	0.10	0.04	**0.76**	0.03	-0.02	0.18
fut_perf1	-0.20	0.01	-0.05	0.19	-0.13	0.26	-0.01	-0.05	**0.70**
fut_perf2	-0.17	-0.01	-0.18	0.28	-0.12	0.19	-0.08	-0.14	**0.74**
fut_perf3	-0.12	0.00	-0.07	0.17	-0.12	0.33	-0.11	-0.09	**0.66**
Usab_1	-0.27	-0.03	-0.07	**0.84**	-0.13	0.10	-0.06	-0.08	0.13
Usab_2	-0.30	-0.08	-0.03	**0.87**	-0.10	0.06	0.03	-0.11	0.14
Usab_3	-0.28	-0.02	-0.12	**0.76**	-0.13	0.11	0.02	-0.08	0.18
Usab_4	-0.29	-0.07	-0.02	**0.73**	-0.08	0.05	-0.04	-0.09	0.15
NegAffect_1	0.07	0.28	0.11	0.01	0.15	0.04	**0.63**	0.07	-0.03
NegAffect_2	0.02	0.27	-0.02	-0.06	0.05	-0.04	**0.73**	0.00	0.04
NegAffect_3	0.08	0.21	0.00	0.01	0.15	-0.02	**0.68**	-0.07	-0.10
NegAffect_4	0.18	0.27	0.09	-0.01	0.13	0.07	**0.70**	-0.06	-0.09
TraitAnx_1	-0.02	**0.78**	0.11	-0.05	0.19	-0.07	0.09	-0.02	0.07
TraitAnx_2	0.08	**0.58**	0.06	0.03	0.07	-0.10	0.17	0.05	-0.02
TraitAnx_3	0.10	**0.76**	0.09	-0.03	0.08	0.06	0.15	0.03	-0.06
TraitAnx_4	0.06	**0.76**	0.05	-0.08	0.00	0.03	0.17	-0.01	-0.05
TraitAnx_5	0.00	**0.65**	0.02	-0.03	0.08	0.05	0.07	0.00	0.01
TraitAnx_6	0.04	**0.76**	0.05	-0.02	0.05	-0.02	0.18	0.04	0.02
TraitAnx_7	-0.02	**0.71**	0.14	-0.02	0.08	0.01	0.13	0.02	0.01

APPENDIX B4: COMMON METHOD BIAS

This study provided some assurance against the potential for common method bias (CMB)

through the collection of the dependent variables from different sources (SimNet vs. self-reported

perceptions) and the use of objective measures of performance (task accuracy measured through

SimNet). Further, experimental treatments were used for two of the independent variables. Such

procedures have been strongly encouraged in the IS and related literature (Podsakoff, MacKenzie,

Lee, & Podsakoff, 2003; Sharma, Yetton, & Crawford, 2009). In addition, the Harman's Single

Factor test was conducted in SPSS 22.0. At T1, the test showed that only 15.24% of the variance

was explained by a single factor. At T2, only 24.56% was explained by single factor. These

results suggest that CMB did not significantly affect the study results.

APPENDIX C

PAPER 3

APPENDIX C1: MEASURES

Technostress (Adapted from Cohen et al. 1983)
Please answer by selecting how well the statement describes feelings you have felt towards using _____ in recent times. Think about the past month of active use of these technologies when answering the questions that follow.

- You have felt that the application was stopping things from going your way
- You have found that you could not cope with all the things that you had to do using the application
- You have lost the ability to control irritations resulting from using the application
- You have felt that you were NOT on top of things because of the application
- You have lost the ability to control the way you spend your time when using the application

TISA (Adapted from Marteau and Bekker 1992; Spielberger et al. 1970)
While working on the task you just completed using this technology, how did you feel?

- Tense (dropped)
- Strained
- Nervous
- Worried
- Anxious

Computer Anxiety (Shortened version of Heinsenn et al, 1987 from Thatcher & Perrewe, 2002)
Indicate how well the statement below describes you

- I feel apprehensive about using computers
- It scares me to think that I could cause the computer to destroy a large amount of information by hitting the wrong key (dropped)
- I hesitate to use computers for fear of making mistakes that I cannot correct
- Using computers is somewhat intimidating to me

Technomancy (newly created)
How much do the following statements describe HOW YOU FELT when you used ...

- Using this software feels so intuitive, it's almost like magic
- Using this makes me feel as if anything is possible
- This software opens a new horizon of possibilities for me

Enjoyment (Cheung et al., 2000; Igbaria et al., 1996)
Please rank what you were feeling during the time you were completing the task

- This is Disgusting:This is Enjoyable
- This is Dull:This is Exciting
- This is Unpleasant:This is Pleasant
- This is Boring:This is Interesting (dropped)

Computer Enthusiasm (Adapted from Peterson & Seligman, 2004; Schaufeli et al., 2002)
To what extent do the following statements describe the way you feel towards technology in GENERAL.
- Technology excites me more than most things I can think of
- I feel bursting with energy when I have a chance to use technology
- I am excited at the thought of spending a long period of time using all kinds of technology
- The prospect of using new technology excites me

Negative Affectivity (Thatcher & Perrewe, 2002; Watson et al., 1988)
To what degree do the following statements describe how you feel on A TYPICAL DAY
- I picture some future misfortune
- I can't get some thoughts out of my head
- I keep busy to avoid uncomfortable thoughts
- I have to be careful not to let my real feelings show

Trait Anxiety (Lehrer & Woolfolk, 1982; Thatcher & Perrewe, 2002)
This scale consists of a number of words that describe different feelings and emotions. Read each item and then select the appropriate answer on the scale from "Not at all" to "Extremely" that best decribes you. Indicate to what extent you generally feel this way, that is, how you feel on the average.
- Scared
- Irritable
- Ashamed (dropped in this paper)
- Distressed
- Hostile (dropped in both papers)
- Jittery (dropped in both papers)
- Afraid   (dropped in both papers)
- Guilty   (dropped in this paper)
- Upset
- Nervous

PIIT (Agarwal & Prasad, 1998)
Which of the following statements best describes you?
- If I heard about a new information technology, I would look for ways to experiment with it
- Among my peers, I am usually the first to try out new information technologies
- In general, I am hesitant to try out new information technologies (dropped)
- I like to experiment with new information technologies

Computer Playfulness (Webster & Martocchio, 1992)
The following questions ask how you would characterize yourself when you use technology.
- Spontaneous
- Imaginative
- Flexible
- Creative
- Playful
- Original
- Inventive (dropped)

Performance Satisfaction
- On a scale of 1 to 7, how would you rank your performance on the task?
- On a scale of 1 to 7, how satisfied are you with your performance on the task?
- On a scale of 1 to 7, how confident are you that you performed excellently on the task?

Future Expected Performance
On a scale of 1 to 7,
- How well do you think you will perform with (the application) in the future? [Very poorly → Very excellent]
- How well do you think you will perform in such a computing task in the future? [Very poorly → Very excellent]
- In the future, how well do you think your performance in the use of (the application) will be compared to other students? [One of the lowest → One of the highest]

Usability (Barnes & Vidgen, 2002) (Manipulation Check)
Based on your current use of (the application), Please select the option below that applies to your experience using the software.
- I find (the application) easy to learn to operate
- My interaction with (the application) is clear and understandable
- I find (the application) easy to navigate
- I find (the application) easy to use
- Excel has an attractive appearance (dropped in both papers)
- The design is appropriate to the type of tool (dropped in both papers)
- Excel is competent at what it is supposed to do (dropped in both papers)
- Using (the application) is a positive experience for me (dropped in this paper)

Task Requirements (Manipulation Check)
- On a scale of 1 to 7, how COMPLEX was the TASK you just completed? [Not Complex at all → Very Complex]
- On a scale of 1 to 7, how challenging did you find the task? [Not Challenging at all → Extremely Challenging]
- On a scale of 1 to 7, how would you describe THE REQUIREMENTS of this TASK? [Simple Requirements → Difficult and Restrictive Requirements]

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Mood State (Manipulation Check) (Mayer & Gaschke, 1988)

Before we begin this study, we would like to find out what mood you are in right now. Please select the response on the scale below that indicates how well each adjective or phrase describes your present mood [Definitely do not feel → Definitely feel]

- Happy (happy, lively)
- Loving (loving, caring)
- Calm (calm, content)
- Energetic (active, peppy)
- Fearful/anxious (jittery, nervous) (dropped)
- Angry (grouchy, fed up) (dropped)
- Tired (tired, drowsy) (dropped)
- Sad (gloomy, sad) (dropped)

Requirements Manipulation

Low Requirements
Find the information for the flyer below. You are free to design the flyer anyway you like. When you are done, please save and upload the completed file here and click continue. (Please do not spend more than 15 minutes on this task.)
High Requirements
Find the information for the flyer below. You MUST design a flyer that looks AS CLOSE to the sample shown below AS POSSIBLE. Try your best to do this. When you are done, please save and upload the completed file here and click continue. (Please do not spend more than 15 minutes on this task.)
Information to be put in flyer (same for both conditions): Information Systems Careers Are you looking for a career that offers excitement, opportunity, high earning potential, and satisfaction? If so, consider one in information systems. Information systems students are industrious, confident, and positive when it comes to looking for a job; 76% of information systems graduates are satisfied with their jobs and confident they will perform well; Information systems students can work in every type of industry imaginable and are in increasingly high demand! Find out more, visit www.afutureinis.com

Mood Manipulation

The mood manipulations were pre-tested to confirm their viability in the context of the laboratory and among the study sample (young undergraduates studying in the Northeastern USA).

Neutral Mood
1. Video (adapted to use a boring video) After completing the writing task, participants were asked questions about the video.   2. Life-Event Inventory Writing Task Please think about the last few months. Think about a typical day in your life. Try to remember the things that you do in a typical day and write about them here. Describe your day. Please do not spend more than 2-3 minutes on this question Source: (Bless et al., 1996; Schwarz & Clore, 1983)
Happy Mood Manipulation
1. Videos (Adapted to use funny animated gif images & short video clips): Look at the following pictures (and vines) carefully, you will answer questions about them shortly.

The Left Shark from Super Bowl 49

Zebra Shuffle

Funny dude with turtle neck

Throwback Dancer

Look at the following vines, you will answer questions about them later.

Participants were asked to recall which of the vines and the video they had found the most funny/amusing after they completed the brief writing task. This was done to heighten the positive mood through the process of recall.
Source: (Farmer et al., 2006)

2. Life-Event Inventory Writing Task

Please think about the last few months. What made you really feel happy recently and continues to make you feel happy even when you think about it today? Please imagine what this event was like that made you really feel happy and try to relive it again in your mind's eye. Then describe what made you feel happy as vividly as you can.

The following questions may help you with this task: What were you feeling? What made you feel that way? What was important for you? What lead up to that feeling? Did that event set off some chain of thoughts or fantasies that enhanced your feelings? What were they?

Please do not spend more than 1-2 minutes on this question

Source: (Bless et al., 1996; Schwarz & Clore, 1983)

3. Guided Imagery Task (Using Hashtag Creation)

Do you know what a #hashtag is?

Before we begin this study, I would like you to quickly come up with some hashtags that you may use when you experience possible events in your life. To do this, some scenarios have been listed below. For each of the scenarios, please imagine yourself in that situation at this very moment. Think about how you might feel if you were experiencing that situation right now and then write down a #hashtag that describes the feeling. If the situation matches something you experienced in the past, try remembering how you felt at that time and capture it in a #hashtag.

Example:
You just watched a new movie and you really enjoyed it.

Hashtag:
#BestMovieEver #TwoHoursWellSpent

- You just got a new job and it is much better than you expected
- you wake up on a Saturday after a number of wintry-cold rainy days, and the temperature is in the high sixties
- You buy a lottery ticket and you win $100.00 instantly
- You and a friend go to a nice restaurant. The meal, the conversation, and the atmosphere are all perfect.
- You get out of class or work early. It's a beautiful day and you and some friends go for an ice cream.
- You spend a day in the mountains; the air is clean and sharp, the day sunny, and you take a swim in a beautiful lake.
- You unexpectedly run into someone you like. You go for coffee and have a great conversation. You discover you think alike, and share many of the same interests.
- It's your birthday and friends throw you a terrific surprise party.

Adapted from: (Mayer et al., 1995; McKinney et al., 1997)

APPENDIX C3: EXPLORATORY FACTOR ANALYSIS

The factor matrices from the EFAs performed are shown below. All loadings below 0.3 are shaded grey for readability.

EFA of Affective Concepts Only

	1	2	3	4	5	6
Technostress_1	0.10	**0.77**	-0.01	0.05	0.12	-0.01
Technostress_2	0.07	**0.81**	0.01	0.07	0.17	0.00
Technostress_3	0.08	**0.88**	0.00	-0.03	0.10	0.03
Technostress_4	0.09	**0.89**	-0.04	0.01	0.07	0.02
Technostress_5	0.17	**0.81**	0.00	-0.01	0.07	0.07
Technomancy_1	-0.05	-0.05	0.16	0.15	0.06	**0.65**
Technomancy_2	0.03	0.09	0.15	0.08	0.06	**0.85**
Technomancy_3	0.03	0.07	0.12	0.09	0.12	**0.84**
TISA_1	**0.83**	0.15	-0.16	0.03	0.04	0.01
TISA_2	**0.84**	0.10	-0.17	0.00	0.02	-0.03
TISA_3	**0.92**	0.12	-0.03	0.08	0.12	0.03
TISA_4	**0.90**	0.12	-0.04	0.04	0.15	0.01
TISA_5	**0.88**	0.06	-0.07	0.07	0.12	-0.01
Enjoyment_1	-0.23	-0.04	**0.77**	0.09	-0.02	0.14
Enjoyment_2	-0.07	0.00	**0.86**	0.06	-0.02	0.11
Enjoyment_3	-0.15	-0.03	**0.86**	0.10	-0.03	0.10
Enjoyment_4	0.01	0.02	**0.87**	0.04	-0.04	0.14
Computer_Anxiety_1	0.04	0.13	-0.03	-0.02	**0.70**	0.10
Computer_Anxiety_2	0.14	0.06	-0.01	0.04	**0.52**	-0.02
Computer_Anxiety_3	0.07	0.11	-0.04	-0.07	**0.79**	0.06
Computer_Anxiety_4	0.06	0.15	-0.01	-0.11	**0.80**	0.10
Computer_Enthus_1	0.00	0.05	0.14	**0.83**	0.03	0.09
Computer_Enthus_2	0.08	0.08	0.09	**0.83**	-0.01	0.16
Computer_Enthus_3	0.01	0.05	0.04	**0.84**	-0.03	0.11
Computer_Enthus_4	0.09	-0.08	0.01	**0.67**	-0.12	0.00

EFA of Affective Concepts and Individual Character Traits

	1	2	3	4	5	6	7	8	9	10
Technostress_1	-0.01	0.08	0.10	**0.77**	-0.01	0.05	0.12	0.01	-0.01	-0.01
Technostress_2	-0.03	0.11	0.06	**0.80**	0.00	0.07	0.17	0.04	0.00	0.00
Technostress_3	0.01	0.13	0.07	**0.88**	-0.01	-0.04	0.09	0.06	0.03	-0.01
Technostress_4	-0.06	0.05	0.08	**0.89**	-0.04	0.02	0.08	0.05	0.02	-0.02
Technostress_5	-0.02	0.11	0.17	**0.80**	0.00	-0.01	0.06	0.01	0.07	0.02
Technomancy_1	0.12	-0.01	-0.05	-0.05	0.16	0.12	0.08	0.07	**0.65**	0.07
Technomancy_2	0.14	0.07	0.03	0.08	0.16	0.06	0.08	0.01	**0.82**	-0.04
Technomancy_3	0.07	0.03	0.03	0.07	0.12	0.09	0.14	0.02	**0.82**	0.01
TISA_1	-0.08	0.06	**0.83**	0.14	-0.16	0.03	0.04	0.05	0.02	0.02
TISA_2	-0.08	0.09	**0.83**	0.09	-0.18	0.00	0.02	0.06	-0.02	0.03
TISA_3	-0.03	0.13	**0.92**	0.11	-0.02	0.08	0.13	0.04	0.03	-0.02
TISA_4	-0.04	0.11	**0.89**	0.11	-0.03	0.04	0.15	0.03	0.00	-0.02
TISA_5	-0.05	0.09	**0.87**	0.05	-0.07	0.06	0.13	0.07	-0.01	-0.01
Enjoyment_1	0.07	-0.02	-0.23	-0.04	**0.77**	0.08	-0.02	0.01	0.14	0.02
Enjoyment_2	0.03	-0.01	-0.07	0.00	**0.86**	0.06	-0.01	0.03	0.10	-0.02
Enjoyment_3	0.01	-0.03	-0.16	-0.03	**0.86**	0.09	-0.02	0.04	0.10	0.04
Enjoyment_4	0.08	0.02	0.01	0.02	**0.87**	0.03	-0.01	-0.04	0.12	-0.01
Computer_Anxiety_1	-0.02	0.05	0.03	0.12	-0.04	-0.04	**0.71**	0.01	0.10	0.07
Computer_Anxiety_2	-0.02	0.09	0.13	0.05	-0.02	0.03	**0.52**	0.10	-0.04	-0.02
Computer_Anxiety_3	-0.02	0.19	0.04	0.10	-0.06	-0.07	**0.76**	0.01	0.05	-0.09
Computer_Anxiety_4	-0.10	0.15	0.03	0.14	-0.02	-0.10	**0.78**	0.00	0.10	-0.08
Computer_Enthus_1	0.15	0.10	0.00	0.04	0.14	**0.84**	0.03	0.00	0.09	0.02
Computer_Enthus_2	0.22	0.10	0.09	0.08	0.09	**0.80**	0.00	0.03	0.15	0.07
Computer_Enthus_3	0.26	-0.05	0.04	0.05	0.04	**0.80**	0.00	0.02	0.09	0.07
Computer_Enthus_4	0.19	-0.07	0.10	-0.07	0.01	**0.62**	-0.10	0.09	-0.02	0.22
Neg_afftvt_1	-0.04	0.36	0.04	0.02	0.01	0.05	0.07	**0.63**	-0.01	-0.03
Neg_afftvt_2	0.00	0.26	0.08	0.05	-0.01	-0.01	0.02	**0.72**	-0.04	-0.03
Neg_afftvt_3	0.02	0.32	0.10	0.06	0.03	0.03	0.03	**0.68**	0.10	0.05
Neg_afftvt_4	0.10	0.39	0.01	0.04	0.03	0.10	0.04	**0.61**	0.11	0.02
Trait_Anx_1	0.02	**0.73**	0.03	0.07	0.07	0.00	0.15	0.10	0.05	0.03
Trait_Anx_2	-0.10	**0.61**	-0.02	-0.01	-0.03	-0.06	-0.07	0.19	0.04	-0.05
Trait_Anx_3	-0.02	**0.75**	0.08	0.06	0.02	0.02	0.08	0.04	0.05	-0.01
Trait_Anx_4	-0.07	**0.66**	0.05	0.06	0.00	0.01	0.05	0.23	0.01	0.00
Trait_Anx_5	-0.10	**0.62**	-0.06	0.02	-0.03	-0.01	0.00	0.01	0.10	-0.05
Trait_Anx_6	0.12	**0.61**	0.14	0.01	0.07	0.04	0.02	0.15	-0.02	-0.02
Trait_Anx_7	0.04	**0.75**	0.07	0.08	0.05	0.04	0.26	0.02	-0.02	0.02
Trait_Anx_8	0.04	**0.66**	0.11	0.11	-0.10	0.04	0.20	0.01	-0.01	0.02
Trait_Anx_9	-0.05	**0.74**	0.06	0.11	-0.04	0.01	0.01	0.19	-0.05	0.03
Trait_Anx_10	0.00	**0.67**	0.13	0.10	-0.04	0.01	0.07	0.29	-0.09	0.02
Comp_play_1	**0.70**	0.07	-0.01	0.05	0.03	0.08	-0.01	0.00	0.11	0.16
Comp_play_2	**0.86**	0.01	-0.04	0.00	0.05	0.09	-0.02	0.04	0.02	0.07
Comp_play_3	**0.78**	-0.10	-0.08	-0.04	0.01	0.04	-0.08	0.04	0.03	0.09
Comp_play_4	**0.85**	-0.04	-0.05	-0.01	0.01	0.09	-0.05	0.06	0.01	0.05
Comp_play_5	**0.76**	-0.03	-0.03	0.02	-0.05	0.20	-0.01	0.01	0.13	0.05
Comp_play_6	**0.80**	-0.05	-0.02	-0.07	0.08	0.08	0.04	-0.08	0.05	-0.02
Comp_play_7	**0.77**	0.02	-0.06	-0.07	0.07	0.16	0.00	-0.02	0.01	0.03
PIIT_1	0.50	0.02	-0.02	0.00	-0.02	0.25	-0.08	0.01	-0.01	**0.69**
PIIT_2	0.47	0.02	0.03	-0.02	0.10	0.31	-0.14	-0.03	0.12	**0.53**
PIIT_3	-0.01	0.04	0.12	0.05	0.07	0.06	0.27	-0.01	0.11	-0.05
PIIT_4	0.47	-0.06	-0.03	-0.01	0.01	0.20	-0.12	0.01	0.00	**0.57**

APPENDIX C4: COMMON METHOD BIAS

Finally, common method variance was assessed using the Harmon Single Factor Test (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). All measured were included in this test, and it was found that only 18.81% variance was explained by single factor. Given these results and the use of both objective (three treatments) and perceptual measures, common method bias was not a concern in this study.

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