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CREATIVITY AND INFORMATION SYSTEMS: A THEORETICAL AND
EMPIRICAL INVESTIGATION OF CREATIVITY IN IS

A Dissertation
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy
Business Administration

by
Jackie Patrick London Jr.
August 2019

Accepted by:
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ABSTRACT

Be productive. Since the industrial revolution, managers have had an almost singular focus on equipping employees with productivity tools in productivity-supportive environments. Information technologies—systems designed to increase productivity—entered the marketplace in the 1980's and were initially credited with the subsequent boom. Eventually, innovation was shown to be the primary spark, and the managerial focus shifted. Increasingly, the imperative is: be creative. This dissertation investigates how a technology environment designed to be fast and mechanistic influences the slow and organic act of creativity. Creativity—the production of novel and useful solutions—can be an elusive subject and has a varied history within Information Systems (IS) research so the first essay is devoted to conducting an historical analysis of creativity research across several domains and developing a holistic, technologically-aware framework for researching creativity in modern organizations. IS literature published in the Senior Scholar's journals is then mapped to the proposed framework as a means of identifying unexplored regions of the creativity phenomenon. This essay concludes with a discussion of future directions for creativity research within IS. The second essay integrates task-technology fit and conservation of resources theory and employs an experimental design to explore the task of being creative with an IS. Borrowing from fine arts research, the concept of IS Mastery is introduced as a resource which, when deployed efficiently, acts to conserve resources and enhance performance on cognitively demanding creative tasks. The third essay investigates an expectedly strong but unexpectedly negative relationship between technology fit and creative performance.

This finding launches an exploration into alternate study designs, theoretical models and performance measures as we search for the true nature of the relationship between creativity and technology fit. The essay concludes with an updated map of the technology-to-performance chain. These essays contribute to IS research by creating a technology-aware creativity framework for motivating and positioning future research, by showing that the IS is neither a neutral nor frictionless collaborator in creative tasks and by exposing the inhibiting effects of a well-fitting technology for creative performance.

DEDICATION

This dissertation is dedicated to my wife, Sarah, and to my goobers, Jacks and Eva. You have waited patiently for a time “when the dissertation is done” and it is only through your steadfast love that such a time has arrived.

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Though the words that fill this dissertation may be my own, this work was not produced in isolation and it is with unending gratitude that I acknowledge those who made this dissertation possible. First and foremost, I must thank my parents, Jack and Patsy London who are unyielding in their support of me and my family. You have been a constant backstop in our lives to ensure that our burdens are neither heavy nor overwhelming. Second, I must acknowledge the steadfast friendships of the mancationeers—Chuck, Dan and Doug—who are as constant and reliable a group of friends as anyone could find. You have kept me sane throughout, and maybe next year we can try the mountains. Third, I must thank the leaders and members of CrossPoint Church who ministered to my family throughout our time in Clemson. You married us, counseled us, fed us, loved our babies and reminded us of the solid rock that stands firm amidst the rising tide, howling winds and driving rain. Fourth, I need to thank my fellow graduate students Kevin, Brandon, Remi, Marie, Min and Grace for the study sessions, griping sessions and eating sessions. We made it! Fifth, I would not have come so far without the support of those in the management department. Specifically, I appreciate Ryan Toole’s willingness to aid me in data collection. Finally, it is with deep gratitude that I thank my committee, especially Dr. Varun Grover and Dr. Heshan Sun, for their tireless support and guidance. You all gave countless hours to mentoring me and refining my work and, with your help, I have accomplished more than I could have imagined possible.

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CHAPTER ONE

1. INTRODUCTION

Overview of Dissertation Research

“We live in a moment where individual creativity and continuous innovation are essential. We should be thinking in terms of ‘return on inspiration.’” Natascia Radice, CMO, United Arab Emirates¹

“What tools do my employees need to be creative and to go from having an idea and building a solution?” Mamie Rheingold, Developer Relations Program Manager, Google²

Creativity is an emerging concern for organizations across a variety of industries. Though innovation has long been heralded as a source of competitive advantage and a driver of organizational performance, many modern organizations have adopted the view that individual employee creativity is a necessary pre-condition to innovation. The quotes above are illustrative of this mindset as well as the challenges managers and executives face. Though they are cognizant of the latent creative potential of their employees, they are uncertain what resources and structures are most conducive to stimulating creative action at all levels and across all functions of the organization.

Further complicating this push for greater individual creativity is the current state of best practices for encouraging creativity which are based on research that is decades old. When Guilford gave the keynote address to the American Psychological Association that is credited with launching modern creativity research, the first commercial

¹ “IBM - Global C-suite Study.” 2016. (available at <http://www.ibm.com/services/c-suite/study/study/>; retrieved May 8, 2017).

² Kohrman, M. 2013. “Google’s Creativity Secret: No Experience Required,” Fast Company, October 9 (available at <https://www.fastcompany.com/3019636/googles-creativity-secret-no-experience-required>; retrieved May 2, 2017).

information system—the Lyons Electronic Office—was still twelve months shy of installation (Guilford 1950). Similarly, Wallas’s stage model (1926), Rhode’s 4 P’s model (1961) and Amabile’s componential model (1983) are all dominant in modern creativity research and yet all precede the commercial expansion of the internet. That is not to say that these perspectives on individual creativity are no longer valid, but that they are silent on the interplay of a digital, connected and dynamic workplace and the salient factors influencing creativity. There are indicators that some business leaders sense an inherent conflict between creativity and technology—where one thrives on slack while the other demands control—but they have little beyond anecdotes (Catmull 2008) and Steve Jobs quotes³ to aid their drive to leverage both.

Unfortunately, management information systems (MIS) research has largely ignored creativity as an information systems (IS) phenomenon. In two recent reviews of creativity research in IS, the authors found a dearth of interest. First, Seidel et al. (2010) found just 27 relevant articles published in the Senior Scholars’ Extended Basket of Journals which represented 0.49% of all published research in the history of these eight journals. In a second review, Muller and Ulrich (2013) found a similarly small sample of 34 articles in top 20 ranked journals in the AIS list of MIS journal rankings⁴. The lack of interest within the discipline juxtaposed by the intense interest practitioners have expressed suggests the need for a reevaluation and modernization of the creativity

³ “There’s a temptation in our networked age to think that ideas can be developed by e-mail and iChat. That’s crazy...Creativity comes from spontaneous meetings, from random discussions. You run into someone, you ask what they’re doing, you say ‘Wow,’ and soon you’re cooking up all sorts of ideas.” Quoted from Isaacson, W. 2011. *Steve Jobs*, Simon and Schuster.

⁴ For reference, *Harvard Business Review* published 72 articles with “creativ*” keywords since 2006.

phenomenon within IS creativity research. Thus, the meta-goal for this dissertation is to develop a robust understanding of the use of information systems for individual creativity, with each essay contributing toward this goal.

In the first essay, we begin with the assumption that individual creativity is a phenomenon of great scientific and practical importance and then seek to understand how the creativity phenomenon has been explored in the field of IS research. We find that though creativity research has a long and rich history in many academic fields interest within the IS discipline is weak and inconsistent. To better understand this trend, we synthesize three prevailing conceptualizations of the creativity phenomenon (i.e. as a series of stages, collection of factors, or hierarchy of systems) and decompose creative behavior into an iterative and recursive process model of creative activities. These models are then used to map extant IS creativity research. We find that IS research has tended toward a narrow view of both the creativity phenomenon and the role of the IS in affecting individual creativity. To widen these views, we use the activity-centric view of creativity as a stimulant for future investigations of the interplay between creativity and IS phenomena. Also, we present two emerging perspectives on the role of an IS in modern, digitized organizations as potential avenues for future research.

In the second essay, we are motivated by the continuing digitization of work and investigate how IS might serve as conduits for individual creativity. As more creative work tasks are mediated through information technologies, it is important to understand how the user and the technology interact during the creative task, and this research begins by arguing that ISs are tools of translation and that, like similar creative implements, they

must be wielded by individuals who have invest time and effort into their mastery. These periods of deliberate practice transform the user's relationship with and knowledge of the IS and enable resource-conserving and creativity-enhancing actions during creative tasks. To structure our investigation of this phenomenon, we adopt a conservation of resources lens through which we envision creativity to be an effortful working out of creative ideas and argue that the user's technology-specific resources (i.e., IS Mastery and Creative IT Identity) will supplement their resource pool prior to the creative task. During the task, these resources will affect the extent to which users are capable of efficiently directing cognitive resources toward the creative task. Those who are more efficient in their allocation resources will more successfully stave off depletion effects and will achieve higher levels of creative performance. We find that users benefit from a more robust mastery-focused knowledge of an IS and that this knowledge has downstream effects throughout the creative task. We also find that perceptions of task-technology fit have a complex and surprising relationship with creative performance, a finding which we further explore in the third essay.

In the third essay, we expand our investigation of the relationship between Task-Technology Fit (TTF) and creativity to better understand why the relationship deviates from accepted theory. Though TTF Theory has been a staple of IS research for more than 20 years, some researchers contend that the theory is lacking in its ability to explain why performance on a task would increase when the user is equipped with a technology well-suited for the task. Also, as work tasks become increasingly heuristic and/or complex, it is unclear why or how TTF might improve performance. These concerns coupled with

our finding in the second essay motivate this research as we investigate TTF in the context of a creative task across five studies. Across five independent studies, we search for alternate study designs, theoretical explanations and performance measurements that might shed light on the unusual finding that users who believe the IS to be a good fit for their task tend to produce less creative solutions. We find that TTF is highly dependent on first-hand knowledge of both the IS and the task, that TTF is a necessary but insufficient requirement for improved performance and that TTF may cause users to discount their own ideas and instead defer to the technology, thus limiting the creativity of their solutions. Our work both illustrates TTF's value as a predictor of performance and the need for further theorizing in this area.

CHAPTER TWO

2. CREATIVITY IN IS RESEARCH - A CONCEPTUAL OVERVIEW AND PROGRAM OF RESEARCH

Abstract

Individual creativity is an increasingly valuable organizational resource and performance outcome. Though creativity research has a long and rich history in many academic fields; interest within the IS discipline is weak and inconsistent. This essay sets out to understand this discrepancy and to identify potential opportunities for future IS creativity research. We begin by synthesizing three predominant views of the creativity phenomenon—process view, interaction view, ecological view—into a unified systems model of creativity. Then we decompose creative behavior into an iterative and recursive process model of creative activities. We use these models to classify extant IS creativity research, a classification which reveals a narrow view of both the IT artifact and the creativity phenomenon. To expand the prevailing view of the IS, we suggest two emerging perspectives on the role of an IS in modern, digitized organizations. Then, use the activity-centric view of creativity to illustrate how it can support a more expansive view of creativity. Together, these perspectives help the enlarge our understanding of the ways in which creativity is expressed through an IS or affected by the presence of ISs. Our hope is that these suggestions serve as a stimulant for future investigations of the interplay between creativity and IS phenomena.

Introduction

Adobe's State of Creative global benchmark study found that over 80% of survey respondents from the United States indicated that "creativity is key to driving economic

growth” *and* that “there is increasing pressure to be productive rather than creative at work” (Brady and Edelman 2012). How can both be true? Consistently, creativity among workers and teams throughout all levels of an organization is generally understood to be an unalloyed good that leaders and managers should encourage and support to the best of their ability. Surveys of organizational leaders and industry experts continually rank innovation and creativity as a top concern (“IBM - Global C-Suite Study” 2016). Despite this, the ways in which work is rewarded at the individual level and performance is measured at the organizational level still adhere to a productivity mindset that is an artifact of a management economy. So, while leaders and workers in organizations across the U.S. acknowledge the increasing strategic potential of creativity, they continue to grapple with a productivity paradigm that prioritizes efficiency over innovation.

Since the industrial revolution, managers have had an almost singular focus on equipping employees with productivity tools in productivity-supportive environments. As productivity became a less durable source of competitive advantage, more organizations turned to innovation as a means of differentiating themselves from the competition. This is evidenced in a recent shift from a “managerial” to an “entrepreneurial” economy where growth is no longer primarily the result of improved efficiency but instead is found in innovation—new products and services for new customers in new markets (Drucker 2014). According to Drucker (2002), organizations identify these opportunities through the embrace of a disciplined approach to creating “purposeful, focused change in an enterprise's economic or social potential” (2002, p. 96) Thus, in this emerging economy,

organizations thrive through the adoption or creation of innovations that exploit market opportunities.

As organizations began to prioritize innovation over productivity, leaders expanded their focus to incorporate individual creativity as an essential dimension of performance such that, increasingly, the management imperative is: be creative. In this way, innovation and creativity are integrated into a symbiotic process of invention and innovation where individual creativity provides the “functional inspiration” that drives the hard work of organizational innovation (Amabile 1988, 1997; Drucker 2002). For managers, an entrepreneurial focus stresses the importance of leveraging the creativity of individual employees as a source of new ideas and potential innovations. Researchers responded to this shifting paradigm by investigating and explicating the various ways in which organizational structures influence employee creativity (Amabile 1996; Ford 1996; Unsworth 2001; Woodman et al. 1993). Their findings have shown that individual creativity is a somewhat fragile phenomenon, sensitive to the various factors that constitute an employee’s work environment. These contextual factors interact with the employee’s cognitive and emotional state and exert a constraining or facilitating influence on creativity (Ford 1996).

Increased digitization has created a new technology-centric workplace and introduced interdependencies between workers, their tools and their work that may have consequences for employee creativity and prior theories of creativity (Nambisan et al. 2017). Changes in technology functionality, ubiquity, connectivity, mobility, performance, and use patterns have fundamentally changed the ways in which employees

experience and do creative work. First, the ways in which employees experience the work environment is changing as the technology environment becomes more enmeshed at all levels of the organization (Leonardi 2011; Orlikowski and Scott 2008). At the organizational level, information technologies (IT) have led to the restructuring of control mechanisms, decision making and governance. Within groups, ITs have altered team dynamics, dispersion and representation. For individuals, ITs have been shown to have consequences for cognition, emotion (Ortiz de Guinea and Markus 2009) and well-being (Ayyagari et al. 2011). Across all levels, ITs augment the flow, creation, retrieval and processing of information, and creativity researchers have shown that similar contextual changes at each level and across levels influence individual creativity (Hennessey and Amabile 2010; Zhou and Hoever 2014). A second change that technological advancement has wrought is the digitization of work products. When the output of work is a digital product, creators must manipulate digital tools—word processors, graphic design software, cloud-based business intelligence applications, database management systems, etc.—in order to achieve a satisfactory outcome. Whereas ‘dumb’ tools are static and lifeless, the ‘smart’ tools at the heart of digital creation are relational, complex, active and evolving. These new tools will create new interdependencies between worker and work that will have consequences for individual and organizational performance. Throughout much of the field’s history, IS researchers have sought to show how the idiosyncrasies of ISs and ITs affect productivity (Drnevich and Croson 2013), but as more organizations expand their strategic focus to include creativity as an indicator of individual performance, their need for a holistic understanding of the interplay between

ITs and individual creativity exposes a gap within the field. Evolutions in work and the workplace will have consequences for employee creativity and will establish new opportunities for IS researchers to make contributions to both management research and practice.

Though organizations continue to express explicit and unyielding interest in employee creativity, the stream of information systems (IS) research into this phenomenon is surprisingly shallow when contrasted with the related, but distinct topic of the innovation adoption and diffusion (Cooper and Zmud 1990; Rogers 2010)⁵. Much of the extant research on the role of an IS in supporting and encouraging creativity in organizations embraces a tool-based view of computing technologies whereby the technology is external to or the consequent of the creative act. One major interest within IS creativity research focuses on the design and use of creativity support systems (CSS) which are specialized decision support systems intended to support and enhance creative activities such as brainstorming, creative process maintenance, thinking strategies and idea generation (Müller and Ulrich 2013; Seidel et al. 2010). A second topic of research is devoted to the investigation of information systems as co-creation platforms. While co-creation research is not primarily concerned with individual creativity, a subset of researchers have identified creativity as a key indicator of success in co-creation initiatives (Blohm et al. 2016; Füller et al. 2009; Majchrzak and Malhotra 2016). A final

⁵ Though we discuss the distinction between the two topics in more depth later in this essay, it is important to note that most creativity researchers acknowledge a link between creativity and innovation in organizations such that creativity represents a process of invention—bringing something new into existence—whereas innovation represents a process of application—bringing something new into use (Amabile 1988; Mohr 1969).

stream of creativity research in IS seeks to identify the information systems development (ISD) practices that are most likely to result in creative routines or technology products. While these streams are important within the IS and management disciplines, they reveal a bias toward viewing both the IS artifact and the creativity phenomenon as special cases in which a tailored IS is used to perform an idiosyncratic creative task. This approach to the IS's role in affecting performance on creative tasks is at odds with more the general approaches to technology-to-performance relationship that are common throughout IS research (DeLone and McLean 1992; Goodhue and Thompson 1995) and with the recent push toward establishing a more creative workplace and workforce⁶.

This research aims to offer guidance for future researchers interested in the evolving role of ITs and ISs in affecting individual creativity performance. Specifically, this research is motivated by a single overarching goal of *identifying new opportunities for integrating creativity research into the IS discipline*. To achieve this, we ask a series of probing questions which explore the current state of both the creativity phenomenon and the IT artifact. First, we address the question: *What is individual creativity?* Through an extensive review of creativity literature from multiple disciplines, we develop a unified view of creativity which incorporates three views of creativity: stage, factor and system. Next, we address the question: *how do ITs interact with individual creativity?* We respond to this question by following Shneiderman's (2000) lead in deconstructing the creative process into its constituent parts, and develop a decomposed model of

⁶ <https://www.theglobeandmail.com/report-on-business/careers/management/how-will-companies-empower-their-employees-in-the-workplace-of-the-future/article37803669/>

creative activities. These two models of creativity will serve as a map of the creativity phenomenon that we will use to answer the third probing question: *Where have IS researchers focused their investigations of the creativity phenomenon?* This diagnostic question will expose trends and identify new opportunities for future research, and will lead to our final probing question: *How should future IS creativity research proceed?* To answer this question, we again turn to the activity model of creativity and use this to guide our suggestions.

Theoretical Development

Creativity

Creativity is an emerging concern for organizations across a variety of industries. Though innovation has long been heralded as a source of competitive advantage and a driver of organizational performance, many modern organizations have adopted the view that individual employee creativity is a necessary pre-condition to innovation (Anderson et al. 2014). Though many business leaders are aware of and want to leverage the latent creative potential of their employees, they are uncertain what resources and structures are most conducive to stimulating individual creative action. As technology continues to play an increasingly important and disruptive role in organization life and performance, managers and executives have yet another factor compounding their uncertainty. In an attempt to bring clarity to this problem, we begin by defining creativity and distinguishing creativity from innovation. Next, we review three prominent views of creativity to establish a holistic understanding of the creativity phenomenon and use this perspective to develop a unified framework of creativity. Finally we deconstruct creative

behavior and develop an activity-centric model of creativity that will help us understand how ISs might interact with this the creativity phenomenon.

Innovation and Creativity

The Oxford Dictionary of English defines creativity as “the use of imagination or original ideas to create something; inventiveness.”⁷ As a synonym, the dictionary suggests *innovation*; unfortunately, the relationship is not reciprocal. This confusion is not limited to lexicography. In management disciplines, innovation is often described as the application or adoption of a new-to-the-organization technology (Daft 1978; Downs and Mohr 1976; Tornatzky and Klein 1982). Innovation researchers sometimes decompose innovation into the concepts of invention and innovation where “[i]nvention implies bringing something new into being [and] innovation implies bringing something new into use” (Mohr 1969, p. 112) The invention/innovation dichotomy is helpful in that it segments innovation into creativity and diffusion sub-processes which each have distinct stages with unique activities (Amabile 1988). In the following sections we will focus on the creativity component of the innovation process.

Creativity Defined

What do employees need to be creative? Though this question is pervasive in the business press, it feels, at this point, like a question that can wait. Before we can satisfactorily identify the resources that influence or enhance employee creativity, we

⁷ Stevenson, A. 2010. *Creativity*. (http://www.oxfordreference.com/view/10.1093/acref/9780199571123.001.0001/m_en_gb0979150).

must first turn our focus to the explication of the term *creativity*. To that end, we must be able to answer the question *what is creativity* before we will be able to adequately describe the factors that influence it. Because creativity is often held up as the *output of individual action* (Amabile 1983), researchers often divide creativity into three components—output, individual, action—and define it accordingly. A fourth component implied this conceptualization is that creativity is contingent upon a local environment which is neither passive nor neutral in its influence on the creative output, individual or process. Each component emphasizes a different aspect of creativity and thus results in slightly divergent conceptualizations depending upon the particular focus of the researcher. In the following paragraphs, we will discuss each of the four components which are common to most definitions of individual creativity.

“I know it when I see it” (“*Jacobellis v. Ohio*” 1963, p. 184) Though Justice Potter Stewart was describing his heuristic for identifying pornographic material, the quote is often equally applied to the identification of *creative output*. Interest in the creative product dominates much of creativity research. The subjectivity involved in the identification of creative products as varied as jazz performances and business models has led many researchers to turn to the various characteristics of these works as a means of isolating the true nature of creative output. Thus, outputs are creative when they are new, novel, radical, unconventional, non-obvious, appropriate, etc (Dean et al. 2006). Management researchers often group these characteristics into two necessary and sufficient properties: new and useful (Amabile 1996; Mednick 1962). The emphasis on novelty emerges from the organizational need for innovation as a source of competitive

advantage. To survive in a competitive environment, organizations must cultivate new ideas and use those ideas as seeds for further organizational improvement (e.g. efficiency, revenue). The usefulness requirement stems from the reality that novel ideas that are inappropriate solutions to the focal problem or incompatible with the processes of an organization will be of no benefit. Therefore, in management disciplines, a creative output is any product or process that is both novel and useful.

When J. P. Guilford took the stage at Pennsylvania State College on September 5, 1950 and delivered the presidential address to the American Psychological Association that is widely credited with launching modern creativity research, he defined creativity as the set of “abilities that are most characteristic of creative people” (Guilford 1950, p. 444). Though interest in the traits and abilities of creative individuals has waned in the intervening years, its logic is alluring, and ever-present in current research: creative people do creative things. More recent research has trended away from seeking to identify creative traits and toward more fungible attributes of creative individuals such as the emotional and psychological states which are most often associated with creative behavior (Amabile et al. 2005; Hennessey and Amabile 2010; Shalley et al. 2004). The motivating principle behind this shift is the presumption that individuals who are primed for these creative states will be better able to express their innate and latent creativity. Within the management sciences, researchers frequently point to three components which together define the creative individual as one who is motivated to perform a task, possesses knowledge relevant to the task and has the requisite creativity skills to generate novel and useful solutions (Amabile 1983, 1988).

Inspired by German physician and physicist Hermann Helmholtz's speech at his own birthday celebration, Graham Wallas began a search for clues to reveal how great thinkers think; he sought to understand and explain the emergence of creative action (Sadler-Smith 2015). Through the investigation of the Helmholtz's speech and the writings of French mathematician and philosopher Henri Poincare, Wallas proposed what would come to be known as the four-stage model of creativity (Wallas 1926). He argued that creative works (e.g. ideas, inventions, artistic expression) emerged from a logical process which is marked by four distinct stages of action: 1) preparation, 2) incubation, 3) illumination, 4) verification. Together, these stages represent the action of creativity. Though Wallas' findings were originally published in 1926's *The Art of Thought*, they have found support in modern creativity research, and some form of these stages are found in most models of the creative process (Lubart 2001). In management disciplines, particular emphasis is placed upon identifying the factors that influence the illumination stage as this stage represents the point at which new ideas are generated, and is arguably, the genesis of innovation and competitive advantage.

Though ideas for innovation come from "anywhere and nowhere" (Drucker 2014, p. 26) creativity happens somewhere. Creativity is sometimes romanticized as the product of a lone genius toiling away in isolation, but the reality is that creative production and invention are ecological phenomena which arise in response to social and environmental stimuli (Glăveanu 2010; Isaksen et al. 1993). First, because creativity is an iterative process whereby the final product emerges through a series of revisions, creative works often benefit from the direct or indirect influence of peers (Csikszentmihalyi 1996). The

social environment of creativity may serve as a refinery of ideas, or as a source of patronage and encouragement to endure the difficulties of creation. Additionally, the context of creativity is essential in that it provides stimulus for and reaps benefits from the creative output. Even in the fine arts, creativity is often a response to some problem that persists in an individual's environment (Sawyer 2012). This environmental anomaly serves as the initial spark for the creative work, and once complete, the novel and useful solution is introduced into the environment as a benefit for others. An environmental perspective has been used in management research to identify the organizational conditions and resources that most influence individual creativity and to show that while an organization cannot control creativity, it can control for creativity (Amabile et al. 1996; Ford 1996; Woodman et al. 1993).

In summary, though creativity is a nebulous concept that is difficult to both identify and predict, it is not beyond comprehension. Researchers often segment creativity into a single component for the sake of scientific inquiry, but the phenomenon itself is the result of an interactive relationship among the individual facets present within its definition. Therefore, we define individual creativity is *an artifact that emerges from a motivated, knowledgeable and skilled individual's actions occurring over a series of iterative and additive stages and is deemed novel and useful within a particular setting*. This comprehensive conceptualization of creativity, first suggested by (Rhodes 1961), has led to distinct streams of research which tend to investigate creativity from one of three perspectives: the stage view, factorial view or systems view. In the following section, we will use these three prominent views to erect a holistic understanding of the

creativity phenomenon. From this perch, we will then decompose creative behavior into a series of activities through which ISs enter into the creative process.

Creativity Views

Stage View

The stage view of creativity asserts that most creative output can be traced back to activities occurring in discernible, discrete stages. The number of stages has varied over the years but most researchers who conceptualize creativity as a series of stages frame their model around Wallas's 4-stage model which begins with preparation, proceeds through incubation and insight, and concludes with verification (Lubart 2001; Wallas 1926). Amabile (1988) suggested a similar process which bookends task presentation and outcome assessment stages around the preparation, illumination and verification stages. Couger (1995) proposes a 5-stage process consisting of opportunity delineation, combining relevant information, generating ideas, evaluating ideas and implementation planning. For Couger each phase is connected by a sub-process of divergent and convergent thought. Csikszentmihalyi (1996) also embraces a 5-stage model—preparation, incubation, inspiration, verification, elaboration—but cautions against a too-literal conceptualization of a process that is more recursive than linear and is “constantly interrupted by periods of incubation” and “punctuated by small epiphanies” (Csikszentmihalyi 1996, p. 89). Sawyer offers a later adaptation of Wallas's stages that expands creativity to an 8-stage progressive, but non-linear process (Sawyer 2012). Irrespective of the number of stages, this view argues that creative expression is a response to heuristic (Amabile 1983), ill-formed (Sawyer 2012) problems that progresses

through a series of logical, additive, and occasionally cyclical stages and culminates in the development of a solution that is both new to the individual and appropriate for the problem stimulus.

There has been no shortage of creativity in the development of models of the creative process, and there are almost most as many stage models of creativity as there are researchers of creativity. The proliferation of models creates obstacles to the accumulation of knowledge and may sow confusion within the field as future researchers seek to position their work within the larger tradition of the field. To avoid these problems, we will embrace a version of Wallas's original 4-stage model of creativity which incorporates an explicit problem identification stage⁸ in addition to Wallas's original stages of preparation, incubation, illumination and verification.

The problem identification stage is primarily concerned with formulating and defining the problem. Sometimes called problem finding (Getzels and Csikszentmihályi 1976), problem construction (Reiter-Palmon et al. 1997) or task presentation (Amabile 1988), this stage and its activities had previously been subsumed in the preparation stage (Lubart 2001). Prior to its elevation as a distinct stage, some argued that the creative process is a special type of problem solving process (Newell et al. 1959), and necessarily involves a preliminary stage of problem-finding (Csikszentmihalyi 1996). For example, Einstein claims that this initial stage is invaluable and that “the formulation of a problem

⁸ For many models, additional stages and inter-stage processes are best subsumed as activities within one of the four original stages which we illustrate in Figure 2.2 and will discuss later. The explicit inclusion of a fifth problem-finding stage is motivated by recent research (Getzels and Csikszentmihályi 1976) which suggests problem-finding activities are distinct from preparation activities in that each set of activities differ in the set of factors which enhance performance in each stage.

is often more essential than its solution, which may be merely a matter of mathematical or experimental skill” (Einstein and Infeld 1966, p. 95). Later research confirms the importance of problem-finding and problem-defining activities in creativity and argues that problem identification represents a distinct stage of action that initiates the creative process. In an early investigation of impact of problem-finding, (Getzels and Csíkszentmihályi 1976) found that artists who devote time to analyzing the problem before formulating their solution produce works that are judged to be more creative than fellow artists who more quickly put paint to canvas. During this stage, individuals would seek to identify gaps or messes (Treffinger 1995) within the status quo (e.g. process inefficiencies, product opportunities) through an intentional search of their environment (Baer 1988) or through interaction with stakeholders (Perry-Smith 2006). Many problems begin as a hunch or notion which the employee will need to frame within the context of their role or within the larger context of the organization (Mumford et al. 1991). Later organizational research has shown that real-world creative problem finding tasks are predictive of subsequent creativity (Basadur et al. 1982).

Preparation refers to the accumulation and integration of problem-relevant skills and knowledge. During the preparation stage, the employee would seek to gather any potentially relevant information or skills from as many sources as possible (Sadler-Smith 2015). Possible sources may be external or internal to the individual (Sawyer 2012). Examples of external sources include information resources such as industry publications, organizational archives and knowledgebases, or peers such as co-workers, subject matter experts and focus groups. Internal resources are found in the individual’s

prior experience and training, analytical skill and knowledge of the problem domain. If an individual is skilled in or knowledgeable of the problem domain, the individual may move through this stage quickly as they activate resources or skills stored in long-term memory. In the event that the problem is or expands to a level of complexity that exceeds the individual's current stock of problem-relevant resources, this stage may be quite long (Amabile and Pratt 2016) as the focus of the stage shifts from reactivation of relevant extant knowledge to acquisition and integration of new information. Deductive thinking (Norlander 1999), associative thinking (Bink and Marsh 2000; Sawyer 2012), persistent effort and autonomy (Reiter-Palmon et al. 1997) during this stage have been shown to influence creative work during the later stages of the process.

The Incubation stage is described as a phase involving the unconscious processing of the problem. Incubation is a controversial stage in the creative process in that opinions vary on the legitimacy of incubation as a distinct stage, and the value of incubation in generating creative insights (Guilford 1950). While some authors exclude incubation as a distinct stage in the creative process (Amabile et al. 1996; Isaksen et al. 1993; Mumford et al. 1991; Shneiderman 2000; Treffinger 1995), many researchers acknowledge that a period escaping from a task through relaxing or engaging in unrelated cognitive stimulation is often interrupted or followed by sudden insight into the original problem (Couger 1995; Csikszentmihalyi 1996; Einstein and Infeld 1966; Norlander 1999; Sadler-Smith 2015). Those researchers who incorporate incubation as a distinctive stage argue that this stage is unique to the creative process and a primary activity that distinguishes creative from non-creative problem solving (Bink and Marsh 2000; Mitchell et al. 2015;

Sawyer 2012). Cognitive scientists hypothesize that incubation occurs in the unconscious where trains of associations between task- and problem-relevant thoughts are generated while attention is elsewhere (Guilford 1979; Hélie and Sun 2010; Sadler-Smith 2015). Many of these connections never emerge as conscious thought and are thus discarded (Dijksterhuis and Nordgren 2006). The more useful associations continue to grow in the unconscious awaiting activation through an environmental cue or resumption of conscious work on the problem. Despite the central role incubation has on the creative process, empirical research has been rare and inconclusive (Hélie and Sun 2010). Unconscious Thought Theory (UTT) is a recent contribution to this area and studies have shown that incubation improves complex decision-making (Dijksterhuis et al. 2006; Dijksterhuis and Nordgren 2006). However, subsequent research has been unable to confirm these findings and some researchers object that UUT has failed sufficiently account for prior work in cognitive and decision-making research (González-Vallejo et al. 2008).

The Illumination stage occurs once the train of association emerges from the unconscious and arrives in the consciousness as a “happy idea;” the germ from which the final solution will grow (Wallas 1926). Illumination is colloquially known as the “Aha!” or “Eureka!” moment when a new idea first arrives (Lubart 2001). Though the terms illumination, Aha and Eureka elicit a sense of accidental suddenness, the illumination stage is best understood as an intentional process of generating new ideas and refining them to accommodate the problem stimulus. Some refer to this as an evolutionary process where ideas are manipulated (variation), chosen for their fitness (selection) and

incorporated into a conceptualization of the solution (retention) (Campbell 1960; Simonton 2003). Others describe the ideating process as consisting of two phases of thinking: a divergent phase which involves wide-ranging associational thinking as a means of generating novel and original ideas, and a convergent phase which is focused on restructuring those ideas to fit the problem context (Basadur et al. 2000; Couger 1995). While invoking different base assumptions about the nature of creative thinking—contra the divergent/convergent perspective which emphasizes intentionality, the evolutionary perspective emphasizes randomness—both sub-processes comport with the reality that good ideas are rarely full-grown at conception. Rather, creative ideas emerge and grow through the combination and integration of a collection of relevant but discrete ideas, and the extent to which an individual is persistent in the task will influence the overall creativity of the idea and the final product. Illumination research is extensive and has shown that individual cognitive processes (Koestler 1964; Roskes et al. 2012), group characteristics (Osborn 1957; Perry-Smith and Shalley 2014) and ideation strategies (Basadur et al. 2000; Mednick 1962) influence the generation and evaluation of ideas.

The final stage, verification, is concerned with the translation of ideas into workable solutions. This stage is the embodiment of Edison's 99% perspiration aphorism (Cropley 2006) during which ideas are "worked into shape" (Ghiselin 1952, p. 5). That is to say that creative ideas are precursors to solutions and are not solutions in themselves (Sawyer 2012), and the ideas must be translated into one or more functional artifacts. As creative ideas grow into creative artifacts that are potential candidates for adoption and diffusion, the translation process may reveal deficiencies in the seed idea or

incompatibilities between the concept and its operationalization. The product gradually emerges through an iterative verification process of translation and evaluation during which team members or knowledgeable peers may offer suggestions for improving the current work-in-progress. Upon completion, the final product is communicated or transferred to the community which would be the beneficiary of the creative solution (Mumford and Gustafson 1988).

Table 2.1 offers a brief description of each stage.

Table 2.1: Stages of Creativity	
Stage	Description
Problem Identification	Deliberate effort to structure problems that are or have become ambiguous and need clarity of focus or direction.
Preparation	Conscious gathering of relevant information and reactivating of prior education, analytical skills and problem-relevant knowledge.
Incubation	Unconscious processing of problem-relevant information during periods where the individual's attention is diverted from the problem.
Illumination	Conscious recognition and cultivation of problem-relevant ideas.
Verification	Intentional working out of an idea as a material solution to the focal problem.

Factorial View

The factorial (or confluence or interactionist) view of creativity argues that while creative solutions may emerge from an iterative, logical process, creative action is ultimately the result of an interaction among the individual, their process and the environment. Rhodes (1961) first popularized this perspective with his Four P's Framework in which he proposes that the person, process, press and product are essential to the creative act and "only in unity do the four strands operate functionally" (Rhodes 1961, p. 307). Though Rhodes's framework is sometimes visualized as an interactive model (Seidel et al. 2010), his original intent was that the framework be used as a tool for classifying prior research and positioning future studies (Glăveanu 2013). Believing that

creativity research had floundered due to conceptual confusion, he isolated commonalities existing in 40 definitions of creativity to develop a consistent and comprehensive definition of creativity. He claims prior research had existed as four independent threads with each thread focusing on a unique aspect of creativity—person, product, press, process—while claiming to investigate creativity itself. Like the five blind men holding different parts of an elephant, each believing they had grasped a unique animal, creativity researchers had developed a disjointed view of creativity which sowed frustration within the field and confusion without. Rhodes argues that creativity will only be legitimized within academic research if the threads are clarified and interwoven into an integrated collection of the factors of creativity which he defines as “a noun naming the phenomenon in which a person communicates a new concept (which is the product). Mental activity (or mental process) is implicit in the definition, and of course no one could conceive of a person living or operating in a vacuum, so the term press is also implicit” (Rhodes 1961, p. 305)

Research investigating the creative *person* is focused on understanding what traits or characteristics are indicative of creative people or creative personalities (Runco 2004). Person research would involve any study of the impact of personality, intelligence, temperament, traits, habits, attitudes, self-concept, behavior or emotion on creativity. Personality research on the “Big Five” personality traits has shown that creative individuals are more likely to express an openness to experience (Shalley et al. 2004). Motivation is believed to be essential to individual creativity (Amabile et al. 1996). Though this effect was initially thought to be limited to intrinsic forms of motivation,

later research has shown extrinsic motivation is similarly influential when the rewards are aligned with the goals of the individual or are expressive of individual achievement (Hennessey and Amabile 2010). Affect also has an effect on creative action such that positive affect is related to higher levels of creativity while feedback inducing negative affect stifles creativity (Amabile et al. 2005). Early research on the creative person tended to study the individual in isolation with a focus on identifying the characteristics that are most closely related to performance on some measure of creativity or some creative task, but later work employs a more contextual and ecological perspective (Ford 1996; Madjar and Shalley 2008; Oldham and Cummings 1996; Woodman and Schoenfeldt 1990).

Process research encompasses investigations of the stages and strategies of creativity or the training thereof. These studies tend to focus on the temporal and cognitive processes which structure problem solving or idea generation tasks. Typically, process research investigates either the issues related to the stages of creativity or the efficacy of techniques or methods intended to increase creativity. As discussed above, a stage approach to the creative process typically presents a series of discrete stages that are essential to creative action (e.g. Amabile (1988); Couger (1995); Isaksen and Treffinger (2004); Mumford et al. (1991); Sawyer (2012); Wallas (1926)). In addition to studying the process as a series of stages, creative process research would also encompass any investigation of strategies or methods intended to enhance creativity. For example, (Mednick 1962) argues that creative ideas emerge from new combinations of associated mental concepts. Also, experimental research on the efficacy of techniques such as brainstorming (Osborn 1957), search for ideas in associative memory (Mednick 1962)

and convergent and divergent (Koestler 1964) thinking tasks on the activation of existing or generation of new associations has contributed to process research. Creativity training is a popular stream within process research as this research is committed to operationalizing creative processes as a means of enhancing individual and group creativity (Elam and Mead 1990; Runco 2003).

Press research refers to efforts to probe the interactions between the human and his environment including attempts to measure the congruence and conflict between the two. Press, a term borrowed from educational research, is a shorthand to describe external social and material pressures that affect the creative process or creative persons (Glăveanu 2013). This implies that factors external to the individual and their creative process may press in on one or both and thus influence the final creative product. Though press has a negative connotation, environmental pressures may have positive or negative effects (Amabile et al. 1996). These effects may result from objective (alpha) pressures or perceptual (beta) pressures (Murray 1938). Press factors have been called “situational influences on creativity” and include encouragement, autonomy, resources, good role models, leadership support, competition and extrinsic rewards (Amabile et al. 1996; Runco 2004; Shalley et al. 2004). Because press factors can be both objective and subjective, the individual’s perception of these pressures will determine the valence such that competition will have differing effects on creativity depending on whether the individual perceives the competitive environment as encouraging or stifling. Press research is popular topic among organizational researchers who researchers have sought

to identify the organizational and leadership factors which enable and inhibit employee creativity (Shalley and Gilson 2004; Zhou and Hoever 2014).

Product research involves the study of creative outputs and their evolution from idea to artifact. This research is premised on two assumptions: 1) creative works are objectively so, and 2) creative works are produced by creative people (Runco 2004). The first assumption introduces the criterion problem, a persistent problem in creativity research. When phenomena are subjective, stable and measurable criteria for assessing the phenomena are elusive. Creativity researchers have circumvented this problem by using aggregate discernment to argue that some action or artifact is creative when a majority of knowledgeable observers deem it to be so. Amabile's (1982) Consensual Assessment Test (CAT) popularized this approach. This technique relies on the judgement and consensus of a panel of domain experts to identify creative works, and it has been used extensively throughout creativity research (Kaufman and Sternberg 2010). The second assumption uses the study of creative products as starting point for identifying and investigating eminent creators. This approach uses quantifiable measures of creative output—often raw counts of works produced or awards received—as a means of identifying Big-C creativity—works of genius that have paradigm-altering consequences within or across domains—*ex post facto*.⁹ These studies provide valuable insight into the strategies and processes that eminent creators have used over the course of their careers (Simonton 2003). However, the results of studies of Big-C creativity can

⁹ Kaufman identified four types of creativity: big-C, little-c, mini-c, pro-c. Big-C creativity refers to works of genius that have paradigm-altering consequences within or across domains.

be misleading in that they often confound productivity and creativity and necessarily exclude investigations of creative individuals who do not achieve sufficient notoriety (Kozbelt et al. 2010). Though product research is popular in management research—the creative product is often the dependent variable—most studies focus on the individual and organizational factors related to creative products without consideration of the product itself (Anderson et al. 2014). Table 2.2 provides a description of the four factors of creativity.

Factor	Description
Person	Research focused on understanding what creative people are like. Person research would involve any study of the impact of personality, intelligence, temperament, traits, habits, attitudes, self-concept, behavior or emotion on creativity.
Process	Research encompassing investigations of the stages, strategies and techniques that influence the temporal and cognitive processes of creativity.
Press	Research efforts which probe the interactions between the human and his environment including attempts to measure the congruence and conflict between the two.
Product	Building on the assumption that creative works are produced by unambiguously creative people and creative works can be objectively identified, this research involves the study of outputs and their evolution from idea to artifact.

Systems View

The systems view of creativity represents an evolving trend in the study of creativity. While early studies were reductive in that they focused on the base elements of the various components of creativity—person, place, process, press—modern creativity research is tending toward a more interactive or ecological posture toward the study of creativity (Isaksen et al. 1993). There are many examples of interactive models of creativity (Ford 1996; Isaksen et al. 1993; Woodman and Schoenfeldt 1990), but this trend is best described as a synthesis of Amabile's (1988) model of organizational innovation and Csikszentmihalyi's (1996) systems model. First, the model of organizational innovation illustrates the relationship between organizational innovation

and individual creativity. Amabile does this by arguing that creativity results from the intersection of three components—creative ability, domain knowledge and motivation—such that individuals possessing greater stores of these resources will exhibit more creative behavior. She then maps the componential view to each step in the creative process, explaining how these factors vary in influence at different stages in the process. She concludes by linking each individual-level component to an organizational-level corollary (i.e. motivation to innovate, resources in the task domain and skills in innovation management) to show how factors in the organizational environment or press influence each individual component (Amabile 1988; Amabile and Pratt 2016). In this way, the model of organizational innovation and individual creativity represents an early attempt to infuse creativity research with an interactionist perspective.

Csikszentmihalyi's (1996) systems model of creativity contributes to Amabile's model by arguing that these interactions are situated and thus dependent on the environment from which they emerge. This added perspective begins with the presumption that creativity is enabled and defined by the systems from which it emerges. Specifically, he argues creative works are executed by an individual who works within a field that is a part of a larger domain (e.g. painting, chemistry, business, etc.), and any attempt to understand creativity as a unitary act distinct from the systems from which it emerges is incomplete. This is, individuals who have mastered the language and syntax of a domain engage in an iterative and recursive creative process to develop domain-compatible, field-approved solutions to domain-specific problems. Because this process occurs within a specific field, the traditions and the members of the field influence each

step of the process. Once this process is complete, experts in the field evaluate the resultant contribution according to the current paradigm of the field (Kuhn 1970).

Products that are deemed creative—novel and useful—are incorporated into the field’s schema, thus establishing a reciprocal relationship between creative work within the field and the field itself. For Csikszentmihalyi (1996, 2014), all creative works are situated in sociotechnical systems which influence and are influenced by individual creativity.

A systems view incorporates these perspectives into a hierarchy of systems which exert bidirectional influence on each other and on the creative act itself. In their review of recent trends in creativity research, (Hennessey and Amabile 2010) organize the studies into a model of creativity that includes six systems: neurological, affect and cognition, self¹⁰, group, social, cultural. Though creativity is an individual behavior, it does not occur in a vacuum (Isaksen et al. 1993). An ecological understanding of creativity acknowledges the complexity and sensitivity inherent therein and suggests how factors native to various systems of influence may exert direct or indirect pressure to either facilitate or suppress individual creativity. The systems view has gained support as creativity research has evolved from its early foundations as a decidedly actor-centric phenomenon to a more complex contextually-sensitive activity (Zhou and Hoever 2014). Multi-level perspectives have been common in organizational research where researchers seek to show how the interaction between the employee and their environment influence

¹⁰ (Hennessey and Amabile 2010) refer to this system as ‘Personality.’ We use the term self as it offers a more expansive view of the factors operating within this system of influence while still capturing their original intent.

creativity. Table 2.3 lists the systems of creativity and provides a brief description of each.

Table 2.3: Systems of Creativity	
System	Description
Neurological	The physiological and biological responses which emerge prior to, during or after a creative exercise.
Affect and Cognition	The constellation of cognitive and affectual states which influence an individual's ability or competency in creative endeavors.
Self	The collection of exhibited or believed individual traits which are most likely to enhance or stifle creativity.
Group	Group and team-level factors which influence the creative performance of individual group members or the aggregate performance of the entire group.
Social	Macro level factors occurring within the organization or community which augment an individual's creative potential or ability.
Culture	Consistently held traditions or beliefs which affect the ways in which members of a people group understand or engage in creativity.

Creativity Unified and Decomposed

The prevalence and variety of creativity research across a multitude of disciplines complicates any effort at consolidation. While the breadth and depth of creativity research is an obvious and unqualified benefit, a consequence is that, as some have lamented, studies in one discipline are often unaware of complementary research in another discipline (Hennessey and Amabile 2010; Mumford 2003). When academic fields experience periods of growth, these periods should be followed by periods of constriction during which knowledge is reorganized and reconciled with prior contributions. To position IS creativity research within the broader tradition of creativity research, we will propose two creativity frameworks that serve as models for classifying past contributions to IS research. The first is a unified framework of creativity which integrates insight from stage, factorial and systems views of creativity. The second is a

decomposed activity model of the 5 stages of the creative process. Both will be used to map prior contributions to IS research and to provide direction for future research.

Unified Framework of Creativity

Rhodes proposed the Four P framework as a method for classifying and spurring creativity research. While likening his work to that of Linneaus' development of a taxonomy for naming organisms, Rhodes acknowledges that "students of creativity have not yet taken the time to distinguish the strands of the phenomenon and then carefully to classify new knowledge according to the pertinence thereof to either person, process, press, or product" (Rhodes 1961, p. 310). After nearly six decades, the Four P's framework is the most commonly used method for assessing and ordering creativity research (Glăveanu 2013). While the value of the 4-P's framework is unquestioned, it should be acknowledged that implicit in Rhodes' analogy is the idea that his system may later require further precision.

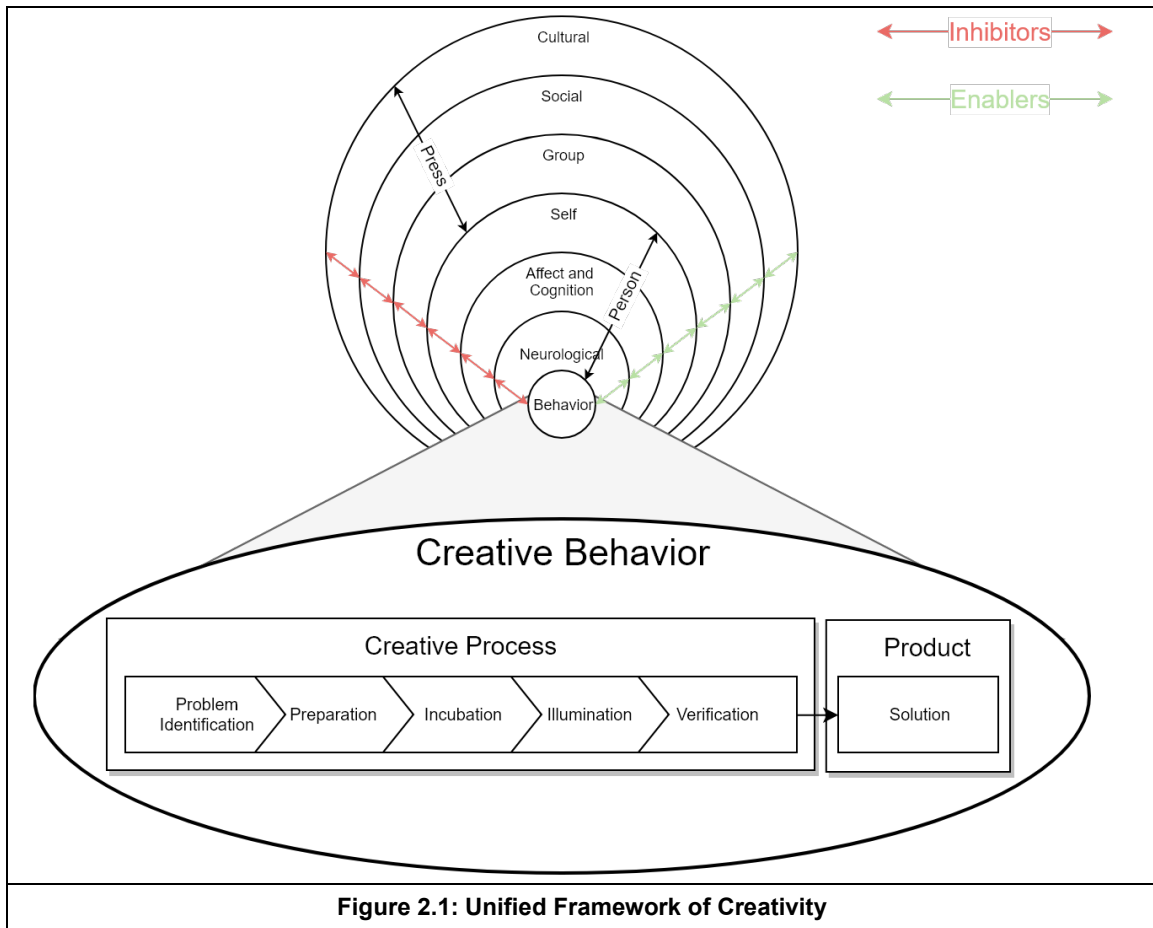


Figure 2.1 represents an update to the Four P's framework which increases the specificity of the original framework and will allow for a more nuanced ordering of creativity research. In accordance with the systems view, the creative press has been expanded to include cultural, social and group systems. These systems represent the universe of cultural, organizational, familial, communal, and team factors which influence individual creativity. The person category has been divided into systems representing the individual's self, cognitive and emotional state and neurological function. Each circle is connected to the others by arrows representing the inhibiting or enabling effects of cross-system factors on the ecological environment. The connective

lines are bi-directional because individual creativity is believed to have reciprocal effects whereby systems influence creative behavior, and creative behavior spills over into other systems, altering the encompassing environment (Csikszentmihalyi 1996; Harrison and Wagner 2016). Finally, the creative process has been segmented into categories representing each stage in the process. This process ultimately gives rise to the creative product which is the novel and useful solution to some environmental problem. This framework integrates insights from three views of creativity into a single unified model and will afford a more precise classification of IS creativity research.

Decomposed Model of Creative Activities

Though this unified framework is useful for establishing an abstract understanding of the various forces at play within the creativity phenomenon, it is silent on the specific ways in which ITs and ISs might interact with the phenomenon. Creativity researchers cope with the abstractness of creativity and the complexity of the creative process by situating empirical studies of creativity within the specific activities occurring in or across stages. For example, a first study investigating creative ideation may be primarily concerned with the factors influencing the raw generation of creative ideas. A second study may be conducted to assess the factors that influence the generation and evaluation of ideas with the intention of explaining how individuals discriminate between good and bad creative ideas. A third study may then consider the factors which influence the evolution of creative ideas in a small group setting. Though each study probes different idea generating activities, all three would be classified as occurring during the Illumination stage of the creative process. As such, a simple stage-view approach to

ordering related research necessarily obscures some of the actions occurring within a stage in favor of a more elegant classification. Additionally, when combined with a systems view of creativity, the stage view creates the impression that all activities occurring within a stage are equally influenced by person and press factors. This approach produces conflicting findings because individual-level factors such as creativity skills or motivation and contextual factors such as organizational support and autonomy may not effect each activity of a given stage to the same extent or in the same direction (Hennessey and Amabile 2010).

These difficulties have led some researchers to decompose the creative process into its core processes or activities (Mumford et al. 1991; Shneiderman 1998, 2000, 2002, 2007) to allow for more focused interventions in creative production. Mumford and colleagues use prior research on stage models of creativity and creative problem solving to identify a general set of core process common to all models (Mumford et al. 1991). The result of their work is a process analytic model of eight creative capacities which include 1) Problem Construction, 2) Information Encoding, 3) Category Search, 4) Specification of Best-Fitting Categories, 5) Combination and Reorganization of Best-Fitting Categories, 6) Idea Evaluation, 7) Implementation, 8) Monitoring. They argue that these eight processes represent the core activities of creative problem solving, and that the relationships among these processes illustrate potential points of intervention where external factors may interact with the creative process and thus creative performance. Similarly, Shneiderman (2000) sought to decompose creativity into a set of component activities which human-computer interface (HCI) developers could use to explicitly

incorporate features that would enhance creative performance. He integrates insights from the inspirationalist, structuralist, and situationalist perspectives on creativity into the four phases of the Genex Framework (Shneiderman 1998) and identifies eight activities that, if integrated properly, “could produce an environment that greatly facilitates creativity” (Shneiderman 2000, p. 135): 1) Searching and browsing digital libraries, 2) Consulting with peers and mentors, 3) Visualizing data and processes, 4) Thinking by free associations, 5) Exploring solutions, 6) Composing artifacts and performances, 7) Reviewing and replaying session histories, 8) Disseminating results. Together, these decompositions of the creative process illustrate how an activity-based approach to creativity can facilitate targeted interventions into the specific activities occurring within each stage of the creative process.

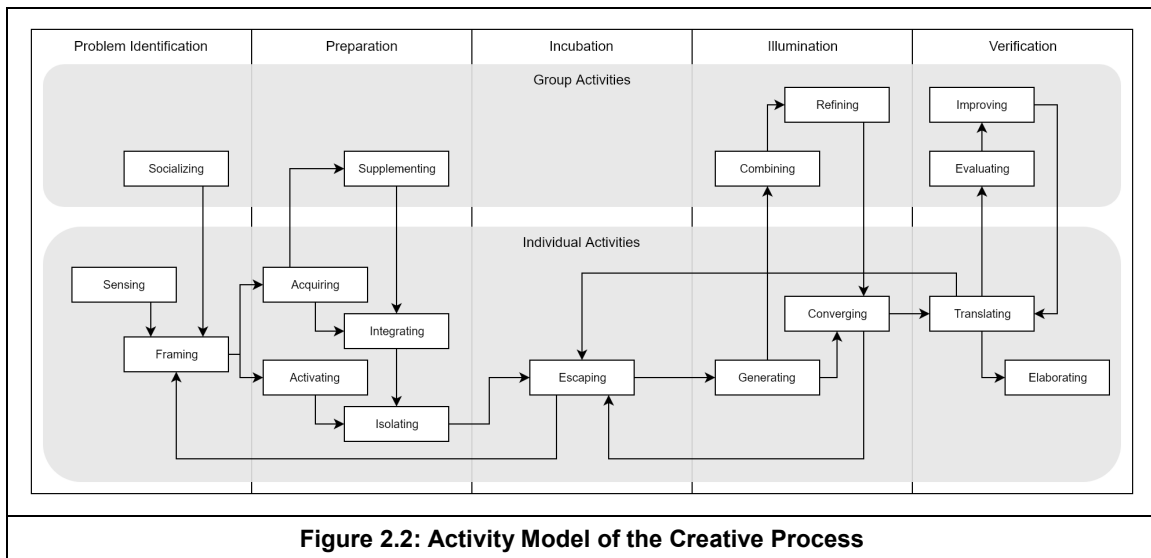


Figure 2.2: Activity Model of the Creative Process

The activity model presented in Figure 2.2 builds on these two earlier efforts and incorporates recent insight from group and team creativity research. In this model, each stage is decomposed into a series of activities that occur within the stage. As the figure

suggests, creativity is primarily an individual process that is enriched by peers and coworkers. Each activity is represented by a box, and directed lines connect activities to subsequent activities thus suggesting the flow within each stage and throughout the creative process. Though the left-to-right order of the stages implies temporality, the activity flow reveals a recursive and iterative process that concludes with the elaboration of a final creative product, and the communication or transfer of the solution to the relevant stakeholders (Csikszentmihalyi 1996; Mumford et al. 1991).

Problems that require creative solutions are often complex, ambiguous and unstructured (Mumford et al. 1996), and require an initial structuring of the problem space. During *problem identification*, employees search for potential problems in the organization's data and social environment. As evidence of a problem mounts, the employee begins to define the essential aspects of the problem and the goals a potential solution would achieve. The initial problem frame will guide *preparation* activities as the employee gathers any potentially relevant resources from their personal repertoire or from the knowledge resources available within the organization. The employee must then engage in a "recombination of familiar elements" (Gerard 1946, p. 482) through which resources are parsed to identify the aspects of each resource that are most relevant to the problem frame. These concepts serve as the soil from which ideas grow during *illumination*. These ideas are wild and varied at first, but gradually converge into a fruitful solution through the conscious work of the individual and the collaboration of knowledgeable peers. Once cultivated, *verification* begins during which the creative idea is translated into the syntax of the domain and communicated to the field, and thus

verified as a potential solution. Periods of *incubation* are interspersed throughout the creative process during which the employee is not actively attentive to the focal problem. Each stage's activities are discussed in greater detail later. See Table 2.4 through Table 2.8 for a description of each activity and an illustrative quote.

As suggested by Mumford et al. (1991) and Shneiderman (2000) earlier decompositions, an activity-centric view of creativity operationalizes an abstract process and affords greater specificity for targeted interventions into the creative process. For our purposes, an activity-centric view offers two additional advantages over more abstract stage models. First, by atomizing each stage, we are better able to classify and order extant research according to the specific focus of each research project. Whereas a stage-based classification would group tangentially related studies under a common heading, an activity model views each stage through a more granular lens and will be better able to differentiate the interests of each study. This will help us diagnose the current state of IS creativity research and identify any trends or biases that may exist. Second, by presenting creativity as a series of actions with unique inputs and outputs, we can begin to imagine the many ways in which ISs interact with individual creativity. As our understanding of inner-workings of each stage improves we are better able to propose targeted investigations of the interplay between the creativity phenomenon and the IS artifact. An activity-centric perspective will allow the field to move beyond general questions of *Can Software Influence Creativity?* (Elam and Mead 1990), to questions of greater specificity that are more cognizant of the many roles ISs serve in modern organizations.

Table 2.4: Problem Identification Activities	
Sensing	Illustrative Quote: "gathering a wide variety of information, including both hard "facts" and also feelings about a situation, and selecting the most pertinent data and questions; it precedes problem definition so that potentially relevant data isn't excluded by a narrow or premature definition of the problem." (Baer 1988)
	Description: Search for or through information which might reveal new problems or new dimensions of existing problems within the environment.
Socializing	Illustrative Quote: "A person with outside connections will not just apply known ideas from other areas to new areas, but these ideas will also expand the way he or she thinks about problems." (Perry-Smith 2006)
	Description: Search for problems or evidence of problems within an employee's social environment.
Framing	Illustrative Quote: "individuals will form ad-hoc categories reflecting crucial elements in the problem, including goals, constraints, outcomes, key steps in problem solution, and essential declarative information." (Mumford et al. 1991)
	Description: Structuring a mental representation of the problem which identifies goals, resources, methods and constraints associated with the problem space.

Table 2.5: Preparation Activities	
Acquiring	Illustrative Quote: "Search for relevant pieces of information that can be used to meet task demands" (Bink and Marsh 2000)
	Description: Collecting broad sets of information or skills which might be useful in addressing the problem as it is currently framed.
Activating	Illustrative Quote: "a knowledge activation phase, in which relevant existing knowledge is activated and retrieved from long-term memory." (Althuizen and Reichel 2016)
	Description: Reactivation of previously learned information, skills or knowledge which might be useful in addressing the problem as it is currently frame.
Supplementing	Illustrative Quote: "the actions of group members by which they share their individual knowledge within the group and combine it to create new knowledge." (Okhuysen and Eisenhardt 2002)
	Description: Receiving problem-relevant instruction, training or information from peers and mentors.
Integrating	Illustrative Quote: "participants actively assess the information and its quality and integrate it into their overall understanding of the situation and their preferences." (Dennis 1996)
	Description: Internalizing new knowledge or skills into existing individual knowledge structures.
Isolating	Illustrative Quote: "identifying or constructing one or more clusters of significant data, which will point to the direction that subsequent problem development or solution efforts might take most fruitfully." (Treffinger 1995)
	Description: Narrowing of the resource pool to only those which are useful for understanding, diagnosing and solving the problem.

Table 2.6: Incubation Activities	
Escaping	Illustrative Quote: “Our respondents unanimously agree that it is important to let problems simmer below the threshold of consciousness for a time.” (Csikszentmihalyi 1996)
	Description: Enabling unconscious processing of problem-relevant information by turning focus away from the present task to engage in some unrelated task.

Table 2.7: Illumination Activities	
Generating	Illustrative Quote: “Generation of potential solutions without evaluation to a presented, predefined problem.” (Basadur et al. 1982)
	Description: Unconstrained idea generation.
Combining	Illustrative Quote: “interacting with a range of diverse others can help to broaden an individual’s way of thinking, loosening previously connected schemas and facilitating his or her making connections among other schemas.” (Perry-Smith and Shalley 2014)
	Description: Enlarging an existing idea by integrating ideas or parts of ideas from members of the social environment.
Refining	Illustrative Quote: “designers proceed to an evaluation of the various design solutions that have been generated...to narrow down the number of design possibilities to a few.” (Zott and Amit 2015)
	Description: Leveraging the knowledge and expertise from members of the social environment to narrow and focus potential ideas as a means of increasing the likelihood of a finding a suitable solution.
Converging	Illustrative Quote: “exploration of the novelty from the point of view of workability, acceptability, or similar criteria to determine if it is effective” (Cropley 2006)
	Description: Bringing an idea to closure in a way that preserves novelty while aligning the potential solution with the defined problem specifications.

Table 2.8: Verification Activities	
Translating	Illustrative Quote: “the creator has to use his or her immense domain knowledge—in particular, how to work using the materials and techniques of the domain—to convert the idea into a finished work.” (Sawyer 2012)
	Description: Using the tools and syntax of the domain to translate an idea into a tangible solution.
Evaluating	Illustrative Quote: “A product or response is creative to the extent that appropriate observers independently agree it is creative. Appropriate observers are those familiar with the domain in which the product was created or the response articulated.”
	Description: Soliciting feedback from relevant stakeholders to assess the extent to which the prototype retains the novelty and usefulness of the creative idea.
Improving	Illustrative Quote: “When a director and producer feel the need of assistance, they convene the group...and show the current version of the work in progress. This is followed by a lively two-hour give-and-take discussion, which is all about making the movie better.” (Catmull 2008)
	Description: Integrating feedback from the field for the purpose of enhancing the novelty or usefulness of the translated artifact.
Elaborating	Illustrative Quote: “problem solutions...must be communicated to potential users...[and]...effective use of appropriate communication channels constitutes an important determinant of dissemination and recognition.” (Mumford and Gustafson 1988)
	Description: Transferring the completed artifact to the relevant stakeholders as a potential solution to the focal problem.

Creativity in IS Research

Before discussing creativity in IS, it is necessary to again acknowledge the confusion surrounding the terms creative and innovative and distinguish their histories in IS research. Though the terms are often used interchangeably, innovation and creativity are distinct phenomena with unique causes and consequences. Within the IS domain, innovation has enjoyed at least three rich streams of research: innovation-as-artifact, innovation-as-process, and innovation-as-attribute. The innovation-as-artifact perspective predates and undergirds the field, as technological innovations have long been of interest to management researchers, and information systems encompass the primary technological innovation of the end of the 20th century (Davis et al. 1989; Downs and Mohr 1976; Moore and Benbasat 1991; Tornatzky and Klein 1982). The organizational

process perspective emerges from the Diffusion of Innovations theory (Rogers 2010) which launched complimentary research into the diffusion of technologies. This stream of research is primarily interested in the process by which organizations and individuals adopt and integrate technological innovations into their routines (Ahuja and Thatcher 2005; Cooper and Zmud 1990; Daft 1978; Kwon and Zmud 1987; Swanson 1994). As with the object perspective, the attribute of innovativeness was gradually imported into IS as the terms ‘innovation’ and ‘technology’ became synonymous. In IS research, innovativeness is a characteristic which is indicative of a willingness to try out new technologies, and as such plays an important role in adoption and use research at both organizational and individual levels (Agarwal and Karahanna 2000; Agarwal and Prasad 1998; Subramanian and Nilakanta 1996). Much of the IS research on innovation focuses on factors leading up to adoption and usage behaviors. Factors studied in innovation (noun. artifact), innovating (verb. process) and innovativeness (adjective. attribute) all have rich histories in IS research and might have some overlap with creativity but are quite different due to their emphasis on organizational behavior and utilitarian outcomes.

Also, we want to acknowledge prior attempts at organizing IS creativity research. Though the topic of creativity is of questionable interest to the field (Couger et al. 1993; Müller and Ulrich 2013; Seidel et al. 2010), there have been at least two prior attempts to organize and classify creativity research in IS. First, Seidel et al. (2010) review research published in the Senior Scholars Basket of Eight journals. They adopt a factorial view of creativity and classify their sample of 27 creativity-relevant articles according to Rhodes’s 4-P’s Framework (Rhodes 1961). The authors assign each article to one or

more of the 4 P's according to the main concepts and constructs discussed in the essay and "their relation to the process, the product, the person, or the press component of creativity" (Seidel et al. 2010, p. 222). They find that creativity research in IS tends to explore individual and group level factors that focus on the Product and Process dimensions of the 4 P's Framework, and encourage future researchers to place a greater emphasis on the socio-technical context (i.e. the Press dimension). A second study by Müller and Ulrich (2013) also uses the 4 P's Framework to classify 88 research articles published in the top 110 journals recognized by the AIS list of MIS journal rankings. They use Couger et al.'s (1993) description of person, process, product and press to develop a keyword-based thematic subdivision of each P, and classify each research project based on the predominant theme of the research. They find that a plurality (47%) of IS creativity research explores the social and technical factors influencing creativity in an information systems context, and they encourage future researchers shift their focus toward the Product and Process components of creativity. Both reviews conclude that creativity is an understudied phenomenon in IS, and more research is needed.

Unfortunately, both reviews suffer from problems stemming from their use of abstract frameworks and the aggregation problems inherent therein. As discussed above, the creative process involves several stages each with distinct activities, and the creative press and person are composed of multiple interacting systems. So, when Seidel et al. (2010) call for a shift away from Process research and *toward* research into the interactions between the IS and the creative Press and Müller and Ulrich (2013) call for a shift *away* from research into socio-technical interactions and toward research on the

creative Process, these calls, in addition to being contradictory, may be too ambiguous to be actionable. Because the Process, Press and Person are composite components of creativity, any classification according to one of Rhodes's higher-level P's sacrifices some precision as the idiosyncrasies of each study are subsumed for the sake of order. This is necessarily true of any classification system which, to be useful, must successfully balance the competing requirements of order and specificity. In his proposing of the 4-P's framework, Rhodes intimated that a classification system was needed in creativity because absent an organized effort to "distinguish the strands of the phenomenon and then carefully to classify new knowledge according to the pertinence thereof to either person, process, press, or product" (Rhodes 1961, p. 310) creativity as a phenomena and topic of research would continue to flounder. Once stabilized by an organizing principle, Rhodes suspected that creativity research would eventually reach "the stage of advancement which botany reached when Linneaus organized flora into phyla and into classes," (Rhodes 1961, p. 310) and thus require a more discriminating means of organizing research. In our ordering of creativity research, we seek to build on and extend their work by further clarifying the internal dimensions of the press, person and process, with the hope that a granular view of the creativity phenomenon will serve as a spark for more nuanced and varied investigations of the interactions between IS and creativity.

Sample

To conduct a systematic review of creativity research in IS, we started our sample with the 49 articles identified in the two prior reviews.¹¹ We then added to this sample by using the “creativ*” search term to identify potential articles published in the IS Scholar’s basket of 8 journals—*Management Information Systems Quarterly* (MISQ), *Information Systems Research* (ISR), *Journal of Management Information Systems* (JMIS), *European Journal of Information Systems* (EJIS), *Journal of the Association for Information Systems* (JAIS), *Journal of Strategic Information Systems* (JSIS), *Journal of Information Technology* (JIT), *Information Systems Journal* (ISJ)—from the journal’s inception through 2018. We chose to focus on IS journals because our primary goal is to understand the role of the IT artifact in affecting creativity, and a more diverse selection of journals (e.g., management- or creativity-centric journals) would have been less likely to provide insight into the central role of the IT artifact. Additionally, we chose to sample articles from basket journals because our secondary goal is to understand how the field of IS studies the creativity phenomenon and the basket journals provide a representative sample of high-quality research covering a variety of topics within the IS domain. A Web of Science search of titles, abstracts, author-generated keywords and system-generated keywords revealed 58 additional articles. We used a checklist to determine the extent to which each article was relevant to the study of creativity. First, we read the abstract, introduction and conclusion of each article. If the authors suggest that their work makes a

¹¹ Though Müller and Ulrich (2013) coded 19 articles from basket journals and Seidel et al. (2010) coded 43, an intersection of both studies produced an initial sample of 49 articles.

contribution to creativity research, the paper was included in the sample. Articles that were not explicitly relevant were submitted to a second check. If the article was a conceptual or design paper, we searched its theoretical development for links to creativity research. If the article was an empirical paper we scanned the methodology for operationalizations of a creativity variable. If we found links to creativity research or a creativity construct, the article was included. If no links were found, we performed a final textual search for matches to the term “creativ*” to assess whether the authors refer to creativity in a scientific or euphemistic manner. Articles which fail all three tests were excluded from the sample. The final sample contained 59 articles.

Measures

We employ four measures which help expose the ways in which IS researchers investigate the interplay between the IS artifact and the creativity phenomenon. The first two measures assess the researcher(s)’s view of the role the IS plays, and its effect. The next two measures explore the specific aspects of the creativity phenomenon that are under investigation. We coded every article in our sample on each of the four variables: IS Conceptualization, IS Effect, Creativity System, Creativity Activity. Table 2.9 provides a description and summary of each measure discussed below.

Table 2.9: Measures and Descriptions		
Measure	Description	Source
Information System	IS Conceptualization	The treatment of the IS in the research project
		Values: Tool, Proxy, Ensemble, Computational, Nominal
Information System	IS Effect	The valence of the proposed effect of the IS in the research project
		Values: Inhibitor, Enabler, Both
Creativity Phenomenon	Creativity System	The ecological systems which are studied in the research project
		Values: Behavior, Neurological, Cognitive and Affect, Self, Group, Social, Cultural
Creativity Phenomenon	Creativity Activity	The creative activities explored in the research project
		Values: Sensing, Socializing, Framing, Acquiring, Activating, Supplementing, Integrating, Isolating, Escaping, Generating, Combining, Refining, Converging, Translating, Evaluating, Improving, Elaborating

IS Conceptualization: Orlikowski and Iacono (2001) developed a framework for classifying conceptualizations of the IT artifact. Their five-level schema is often used as a means of understanding how and to what extent IS researchers theoretically engage the idiosyncrasies of the IT artifact. Four of the levels represent different instantiations of the artifact in a research setting. The *tool* view conceptualizes the role of technology as that of a “piece of equipment, application or technique which provides specifiable information processing capabilities” (Orlikowski and Iacono 2001, p. 123). The *proxy* view represents an attempt by the researcher to incorporate some surrogate variable such as IT spending as an operationalization of an attribute of the technology itself. The *ensemble* view imagines the role of an IT to be that of one machine within a “system of alliances” (Latour 1987) whereby an assembled network of actors and machines interact in the

performance of a common task. Finally, the *computational* view probes the “capabilities of the technology to represent, manipulate, store, retrieve, and transmit information” (Orlikowski and Iacono 2001, p. 127). The fifth conceptualization is the *nominal* view in which the technology serves as the backdrop for the research project but remains untheorized and inconsequential. Creativity is an individual cognitive and behavioral activity that is socially and environmentally contingent. As such, information technology may play a variety of roles in influencing individual creativity. This measure will help identify the prevailing perspectives researchers have taken in conceptualizing an ITs role in individual creativity (Grover and Lyytinen 2015).

IS Effect: IS researchers have long acknowledged that information systems use does not always have a direct, positive effect on performance (Cenfetelli 2004; Orlikowski 1992). As a tool, an IS is imbued with the preferences of the system’s developers and is thus not neutral to the task process or its execution (Orlikowski and Iacono 2001; Sun 2012). Any conflict resulting from the user’s perceptions of the IS’s capabilities may inhibit rather than enable system usage, task performance or both. Likewise, organizational creativity researchers, aware that employee creativity is fragile and must be nurtured and protected, have sought to define the organizational characteristics that either facilitate or constrain creativity (Ford 1996). Therefore, a comprehensive body of research into the impact of IS on creativity must allow for and theorize the valence of information technology tools. To assess the extent to which both roles are represented in extant research, we coded each conceptualization as potentially enabling or inhibiting creativity. For empirical research projects, we coded the article as

representing an enabler perspective if the IT is believed to have a positive effect on creativity, and as an inhibitor if the hypothesized or posited relationship is negative. For conceptual and design papers, we used the author(s)'s description of the possible impact of IS use on creativity as an indicator of the enabling or inhibiting effects. Additionally, we coded an instantiation as representing both if the author(s) acknowledge that a system may have either an enabling or inhibiting effect which is temporally or contextually dependent.

Creativity System: The first two measures illuminate the ways in which the IT artifact is conceptualized. This measure and the next probe the article's engagement with the creativity phenomenon. First, we coded each article to identify the creative systems at play within the research project. Figure 2.1 above illustrates the six systems which influence the creative process. This measure introduces greater specificity into the analysis than is typically present in an aggregate-level classification such as the 4 P's Framework. A systems view subdivides the person factor into three systems: neurological, cognitive and emotional, and self. Likewise, the press factor is divided into group, social and cultural systems. A seventh behavioral 'system' was added to our classification. While not a system in the sense that the other systems constitute a hierarchy of increasingly external ecological influences, a behavioral system is necessary to discriminate between studies that predict creative perceptions (e.g. creative self-efficacy, creative intention) and creative performance. In addition to providing a more granular organization of creativity research, this method is also more cognizant of the varying effects that constructs may have within and across systems. Articles were coded

according to the constructs or concepts discussed within the article. For example, Hildebrand et al. (2013) investigate the impact of feedback on creativity. In their study, subjects are asked to submit the design of a creative product (i.e. jewelry). They are then provided feedback on their design and given an opportunity to revise their original submission. They theorize that community feedback induces the need to conform which causes the participant to modify their original designs. As such, the study is concerned with factors within the *Social, Cognitive and Emotional* and *Behavioral* systems.

Creativity Activity: As a second measure of engagement, we will identify the specific creative activities that are discussed within each research project. As discussed above, Figure 2.2 presents a collection of 17 activities spread over the five stages of the creative process. We read each article to identify which of the 17 activities the authors investigate. For example, (Blohm et al. 2016) sought to understand how the representation of a decision-making task influences a user's ability to evaluate creative ideas. In their study, each participant was given a collection of ideas and they were asked to identify the best ideas. Because their study is only considering the factors related to the elevation of good ideas, it and was coded to reflect their interest in the *Elevating* activity. A second project conducted by (Althuizen and Wierenga 2014) investigated how the type and amount of information available in a knowledge repositories influence the development of a creative product (i.e. a marketing campaign). In two studies, subjects are asked to use a knowledge base containing potentially relevant information to develop a creative marketing campaign which solves a business problem. The authors manipulate the participants' access to relevant information to assess the role that information

resources play in the generation and translation of creative ideas. Based on their description of the research setting and experimental tasks, their study was coded as representing *Integrating*, *Isolating*, *Generating* and *Translating* activities (the *Escaping* and *Elevating* activities may have occurred during the experiment, but the authors do not mention their influence on the creative process). For more information on the coding process, see Appendix A.

Results

In the following sections we will discuss the results of our analysis. First, we present descriptive statistics of our sample. These statistics will help identify publication trends across the basket journals throughout the history of the field. Next, we present the results of our coding of the two IT artifact measures (i.e., IS Conceptualization and IS Effect). This section will provide a general understanding how IS researchers conceive the role that the IS plays in affecting creativity. Next, we present the results of our coding of the two measures of the creativity phenomenon (i.e., Creativity Systems and Creativity Activities). This section will illustrate the specific creativity topics that are of interest to IS researchers and are likely affected by IT artifacts.

Descriptives

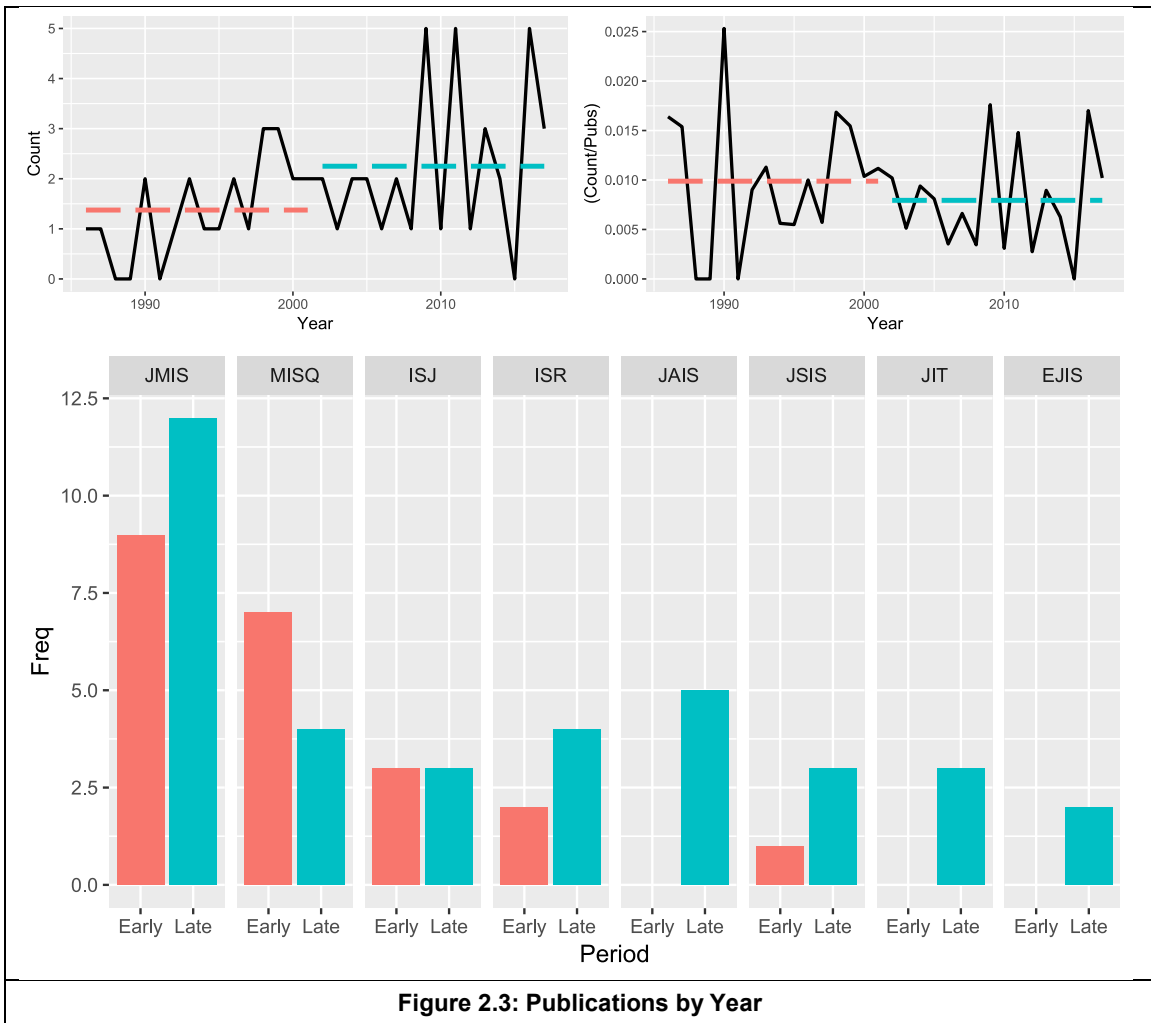
Table 2.10 summarizes the publication counts for each journal. Though several journals began publishing peer-reviewed research prior to 1986, the first article explicitly considering the creativity phenomena was published in JMIS in 1986 (Weber 1986). Other than the four gap years of 1988, 1989, 1991 and 2015, at least one creativity article was published in each year through 2018. Because this stream of research spans more

than three decades, it is useful to divide the sample into eras of research to better understand how journal interest changes over time. After segmenting research into early (16 years; 1986-2001) and late periods (16 years; 2002-2018), we can see that the raw number of creativity articles increases for all journals except MISQ and ISJ. Because raw counts can be misleading, a relative measure is included to provide additional perspective that will aid in understanding general trends in creativity research. The number of published creativity articles as a proportion of all articles published is listed in parentheses. Figure 2.3 illustrates that despite an increasing interest in creativity across most journals, the creativity topic's share of the overall space within the discipline's eight leading journals has decreased.

Table 2.10. Creativity Research Published in IS Journals

Era	Year	EJIS	ISJ	ISR	JIT	JMIS	JSIS	J AIS	MISQ	Grand Total
Early	1986					1 (3.13%)				1 (1.64%)
	1987					1 (3.45%)				1 (1.54%)
	1988									0 (0.00%)
	1989									0 (0.00%)
	1990			1 (5.26%)		1 (3.23%)				2 (2.53%)
	1991									0 (0.00%)
	1992		1 (4.55%)							1 (0.90%)
	1993					1 (2.44%)			1 (3.13%)	2 (1.13%)
	1994					1 (2.38%)				1 (0.56%)
	1995					1 (2.44%)				1 (0.55%)
	1996			1 (4.76%)					1 (3.85%)	2 (1.00%)
	1997								1 (4.17%)	1 (0.57%)
	1998						2 (5.56%)		1 (3.85%)	3 (1.69%)
	1999						1 (4.55%)	1 (3.03%)	1 (3.03%)	3 (1.55%)
	2000			1 (5.56%)					1 (3.57%)	2 (1.04%)
	2001				1 (4.17%)				1 (4.76%)	2 (1.12%)
Early Total		0 (0.00%)	3 (1.32%)	2 (0.79%)	0 (0.00%)	9 (1.57%)	1 (0.67%)	0 (0.00%)	7 (1.46%)	22 (1.00%)

Late	2002					1 (2.17%)	1 (6.25%)			2 (1.02%)
	2003					1 (2.50%)				1 (0.51%)
	2004	1 (3.57%)				1 (2.44%)				2 (0.94%)
	2005					1 (2.13%)			1 (2.94%)	2 (0.81%)
	2006							1 (2.94%)		1 (0.35%)
	2007						1 (4.55%)	1 (2.78%)		2 (0.66%)
	2008	1 (1.72%)								1 (0.34%)
	2009		2 (6.67%)			2 (4.55%)	1 (5.56%)			5 (1.76%)
	2010					1 (2.13%)				1 (0.31%)
	2011					2 (4.26%)		1 (3.23%)	2 (3.51%)	5 (1.48%)
	2012								1 (1.49%)	1 (0.28%)
	2013			1 (1.49%)		1 (2.17%)		1 (3.45%)		3 (0.90%)
	2014					1 (2.04%)		1 (2.70%)		2 (0.63%)
	2015									0 (0.00%)
	2016		1 (3.13%)	3 (5.88%)		1 (2.17%)				5 (1.70%)
	2017				3 (13.04%)					3 (0.99%)
	2018	1 (2.63%)								1 (0.29%)
	Late Total	3 (0.39%)	3 (0.63%)	4 (0.56%)	3 (0.61%)	12 (1.50%)	3 (0.77%)	5 (0.98%)	4 (0.50%)	37 (0.75%)
Total	3 (0.31%)	6 (0.92%)	6 (0.66%)	3 (0.41%)	21 (1.58%)	4 (0.78%)	5 (1.04%)	11 (0.90%)	59 (0.87%)	



Combined, these results suggest that the field has a complex relationship with IS creativity research. On the one hand, it is encouraging to see the increasing interest in the topic of creativity depicted in Figure 2.3. These charts indicate vigorous growth across all journals with very few plateaus. Also, Figure 2.4 shows an encouraging diversity across journals with most journals publishing both qualitative and quantitative investigations into the creativity phenomenon. Finally, though empirical studies are most common, the field has clearly adopted a multi-front approach to exploring creativity within the IS context, in response to which journal editors have “chosen a strategy to let many flowers bloom”

(Robey 1996, p. 402). On the other hand, however, the creativity phenomenon's proportional share of published IS research appears to have stagnated over time. This is discouraging because it suggests that, at least on this topic, the field's interests are diverging from that of IS professionals and organizational leaders who see "technology as an enabler of collaboration and relationships—those essential connections that fuel creativity and innovation" (Kappelman et al. 2018, 2019; Korsten and Berman 2013, pp. 47–48). Also worrisome is that more than one-third (37%) of all creativity research was published in a single journal: JMIS. If this journal is excluded from our sample, creativity research would have accounted for slightly more than one-half of one percent (0.6%) of all published research in the field's top journals. Given the general increases in interest in other academic fields and the business community's growing acknowledgement that creativity is an essential organizational outcome, this abdication of creativity as an IS phenomenon is disheartening.

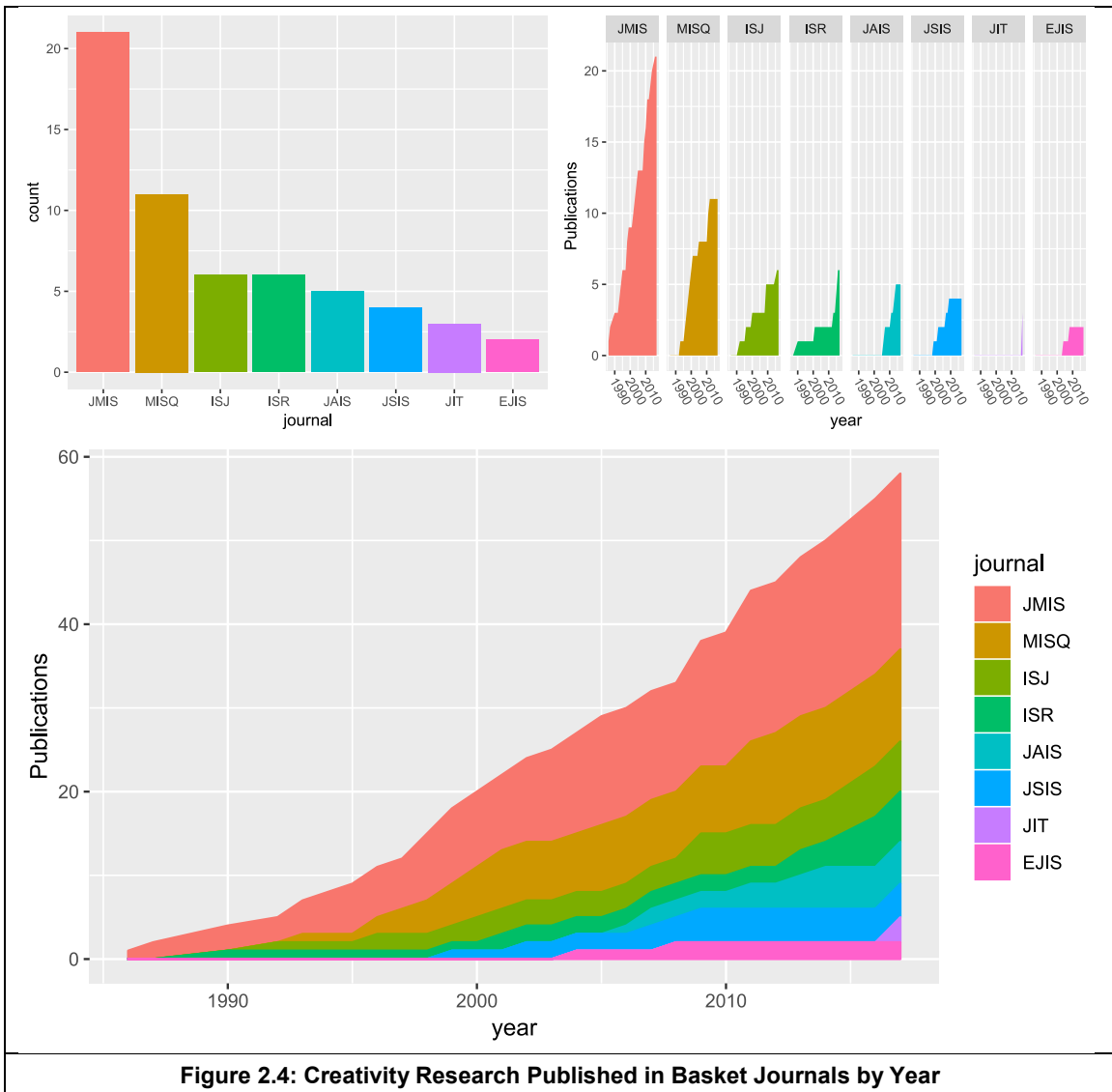


Figure 2.4: Creativity Research Published in Basket Journals by Year

Though the descriptive statistics above reinforce the impression that creativity is an understudied phenomenon in IS, they do not suggest possible explanation for the lack of interest. To dig deeper into the IS research community’s treatment of the creativity phenomenon, we will now turn to an investigation of the (1) role (IS Conceptualization) and effect (IS Effect) of the IT artifact in influencing the (2) systems (Creativity Systems) and activities (Creativity Activities) of the creativity phenomenon.

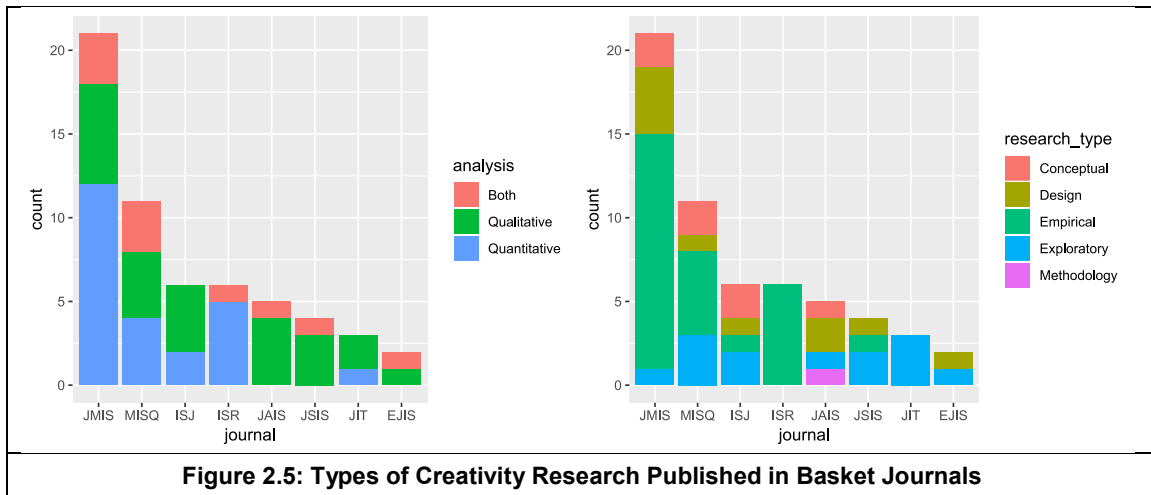
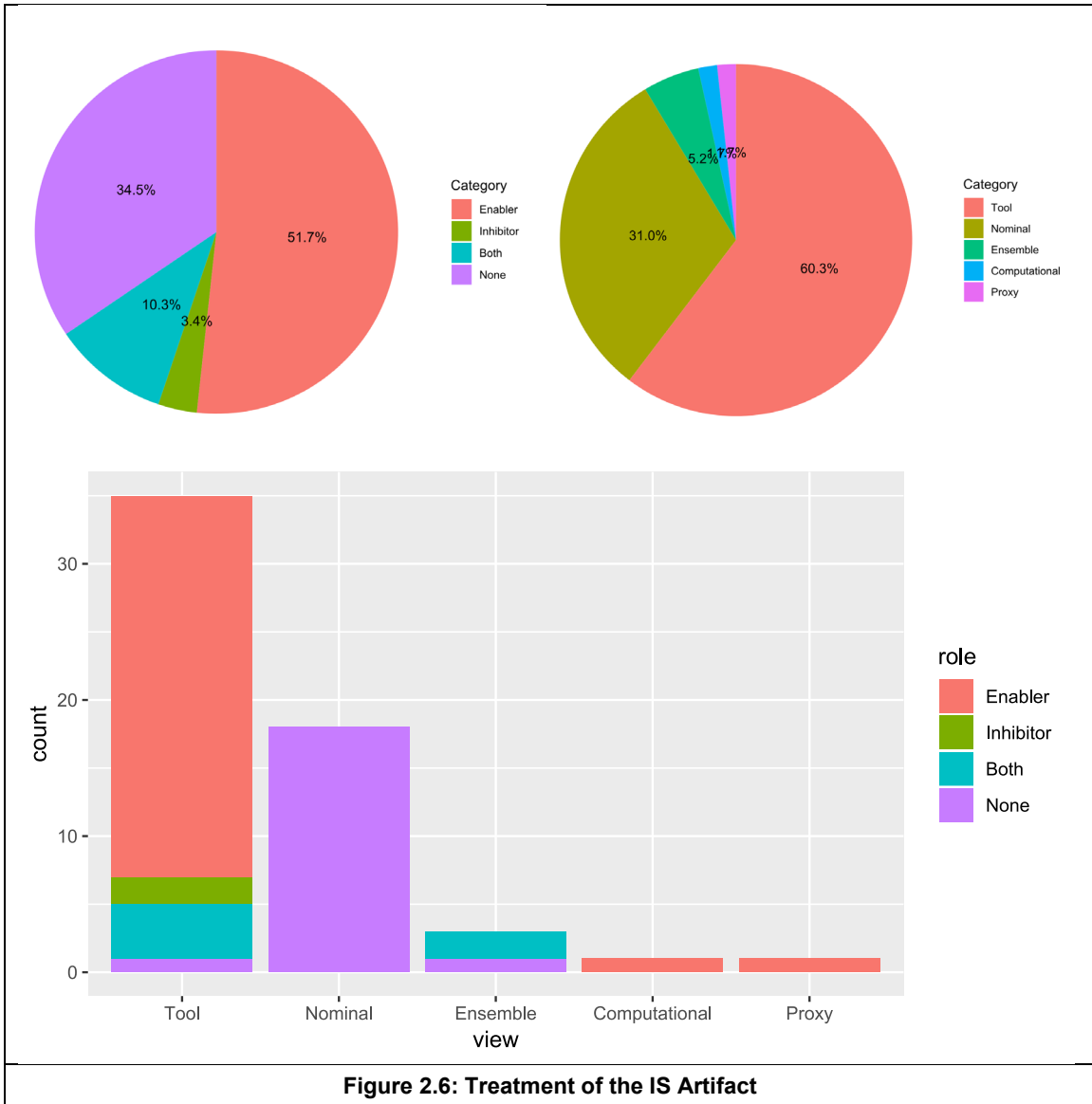


Figure 2.5: Types of Creativity Research Published in Basket Journals

IS Artifact

Creativity is a behavioral outcome that organizational researchers often classify as a performance indicator (Amabile 1996; Lee and Choi 2003). As such, ISs straddle the phenomenon, influencing it as an antecedent on the front-end and being influenced by it as a consequent on the back-end. As an antecedent, the IS may guide the creative process (Marakas and Elam 1997), encourage divergent thinking (Althuizen and Reichel 2016) or facilitate creative expression (Hildebrand et al. 2013). As a consequent, the design (Aaen 2008) and development (Gupta et al. 2009; Tiwana and McLean 2005) of an IS artifact may benefit from creativity. To better understand the many ways ISs are represented in creativity research, we will employ Orlikowski and Iacono's (2001) IS View typology as an indicator of the IS's intended role and Cenfetelli (2004) notion of IS enablers and inhibitors to assess the hypothesized valence of that role. Figure 2.6 provides a summary and integration of these two classification schemes.



The Tool view is the most common conceptualization within IS creativity research (n=35). This view supposes the IS to be external to, but supportive of the creative task. That is, the IS is supplementary to the creative performance in that it serves as a tool for organizing or facilitating aspects of the task, but it is not the means by which individual creativity is expressed. For example, in three typical studies researchers investigate the ways in which an IS might stimulate creativity on some primary, non-IS-

dependent task. In the first study Althuizen and Wierenga (2014) show that a large and diverse repository of cases in a case-based reasoning tool is helpful in moving individuals toward more creative marketing campaigns. In the second study, Althuizen and Reichel (2016) find that electronic brainstorming systems can help individuals generate more novel and useful ideas for reinvigorating a failing business (MacCrimmon and Wagner 1994) by pushing them to make remote associations between a stimulus and a problem condition. In a third study, Massetti (1996) shows that while the type of CSS did not have an effect, subjects aided by one of three different CSSs generate a greater quantity of creative ideas for addressing homelessness problems in urban areas than do individuals using pen and paper. These studies are representative of the most common conceptualization of the IT artifact whereby the IS serves as a tool for managing an aspect of the creative process (i.e. as a digital scratchpad during idea generation) or implementing some strategy for enhancing creativity (i.e. as a guide for brainstorming or divergent thinking).

Unfortunately, the *Nominal* view is the second most commonly occurring view of the IS. Studies employing a nominal view often conceptualize the IS as incidental to the creative behavior in that the IS is present—typically as a means of representing a task—but inconsequential to an individual’s creative performance. For example, Dennis et al. (2013) conducted an experiment to show that individuals who played a game designed to prime them toward an achievement orientation generated more ideas and more creative ideas than neutral-primed subjects. In their study, the IS served as the mechanism by which the treatment was delivered and was not hypothesized to affect performance.

Additionally, two studies investigating the role of feedback in creativity show that while community feedback can have a homogenizing effect on ideas which stifles individual creativity (Hildebrand et al. 2013), ideas emerging from particular feedback trajectories (i.e. paradox-framed) exhibit higher degrees of novelty and usefulness¹² (Majchrzak and Malhotra 2016). In these studies, the IT artifact is incidental to the creativity phenomenon and lies untheorized in the background of the investigation. Table 2.11 summarizes our findings with regard to the treatment of the IS artifact in creativity research.

Table 2.11: View and Role of the IS in Creativity Research

	Tool	Nominal	Ensemble	Computational	Proxy¹³	Total
Enabler	28	0	0	1	1	30
None	1	18	1	0	0	20
Both	4	0	2	0	0	6
Inhibitor	2	0	0	0	0	2
Total	35	18	3	1	1	58

In IS creativity research, the IS is most often hypothesized to have an enabling effect on creativity. Whether the research is empirical, theoretical or design oriented, most researchers describe the IS as having a potentially positive effect on creativity. For example, Ebel et al. (2016), Knoll and Horton (2011), and Müller-Wienbergen et al. (2011), use creativity theory to guide the design of an IT artifact. They posit that the use

¹² The authors use the term *Innovativeness* to refer to ideas that are novel and useful.

¹³ Though the proxy view is common throughout IS research (Orlikowski and Iacono 2001) we found this view to be largely absent in creativity research within IS. This is partly due to conceptual overlap between Tool and Proxy views, and to the types of studies creativity researchers conduct. First, though many studies include individual perceptions of the technology none include *only* individual perceptions. For example, Blohm et al. (2016) hypothesize both perceived ease of use (individual perception) and task representation (technology feature) to be predictive of decision performance. In this case and others, we coded the focal article as adopting a Tool view of the technology. Second, creativity research tends toward experimental designs with the IT artifact presented as a treatment effect, thus suggesting the design or capabilities of the tool are at least partly responsible for task performance.

of the proposed technology will improve creative performance on some focal task. Specifically, Ebel et al. (2016), use insights from business model development research and creative process research to design a system which manages the business model development process by incorporating features for sharing material, communicating with peers, analyzing the business environment, and designing, implementing and managing the business model. Business models generated with the system were rated as more creative than prior models. Knoll and Horton (2011) conceptualize creative ideation as a cognitive manufacturing process and design thinkLets—the “smallest unit of intellectual capital required to create one repeatable, predictable pattern of collaboration among people working toward a goal” (Briggs et al. 2003, p. 46)—to help group members engage in idea jumping (i.e. analogical thinking), dumping (i.e. set breaking) and pumping (i.e. knowledge priming). Finally, Müller-Wienbergen et al. (2011) identify the design requirements and develop a prototype for a system which supports creative problem solving by encouraging both divergent and convergent thinking. These three design studies are typical of an enabler-focused conceptualization whereby use of an IT will have a direct positive influence on creativity.

Though only two studies explicitly theorize an inhibiting role for the IS, it was more common for researchers to acknowledge that the characteristics of the IS may both facilitate and constrain creative performance, depending on the context. For example Blohm et al. (2016) find that the ways in which ideas are presented influences an individual’s ability to correctly identify creative ideas. Using an experimental design, the authors tasked subjects with using an IS for either rating ideas for their novelty, value,

feasibility, and specificity, or purchasing ideas in a preference market. They found users were better able to correctly *rate* ideas as creative than they were able to correctly *purchase* creative ideas in the idea-market condition, and conclude that while complex systems have an impairing effect on performance, an easy to use system frees “cognitive resources and allows users to make more accurate idea evaluation decisions” (Blohm et al. 2016, p. 45).

Creativity

Creativity is a complex phenomenon that is influenced by a host of individual, social and contextual factors (Rhodes 1961). To better understand how creativity is treated in IS research we first consider the creativity systems (Hennessey and Amabile 2010) represented in our sample studies. The systems will illustrate the person and press factors that are most influential in an IS context. Then, we present data illustrating the various creative activities investigated in these studies. The activities will identify the specific creative behaviors that are the focus of each research project and most likely to affect or be affected by the focal IS. Finally, we integrate these views to develop a holistic understanding of the creativity phenomenon in IS research.

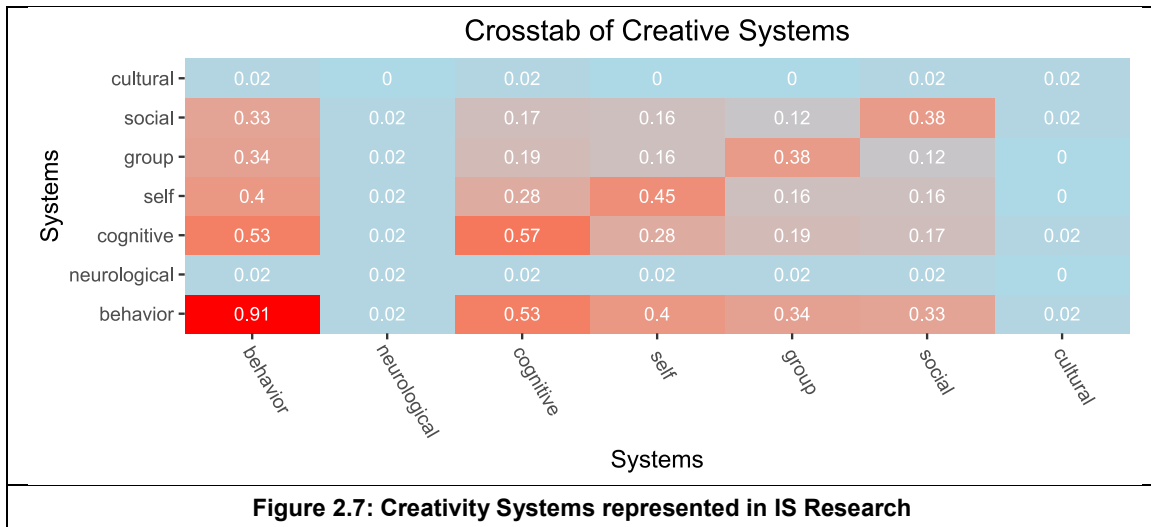
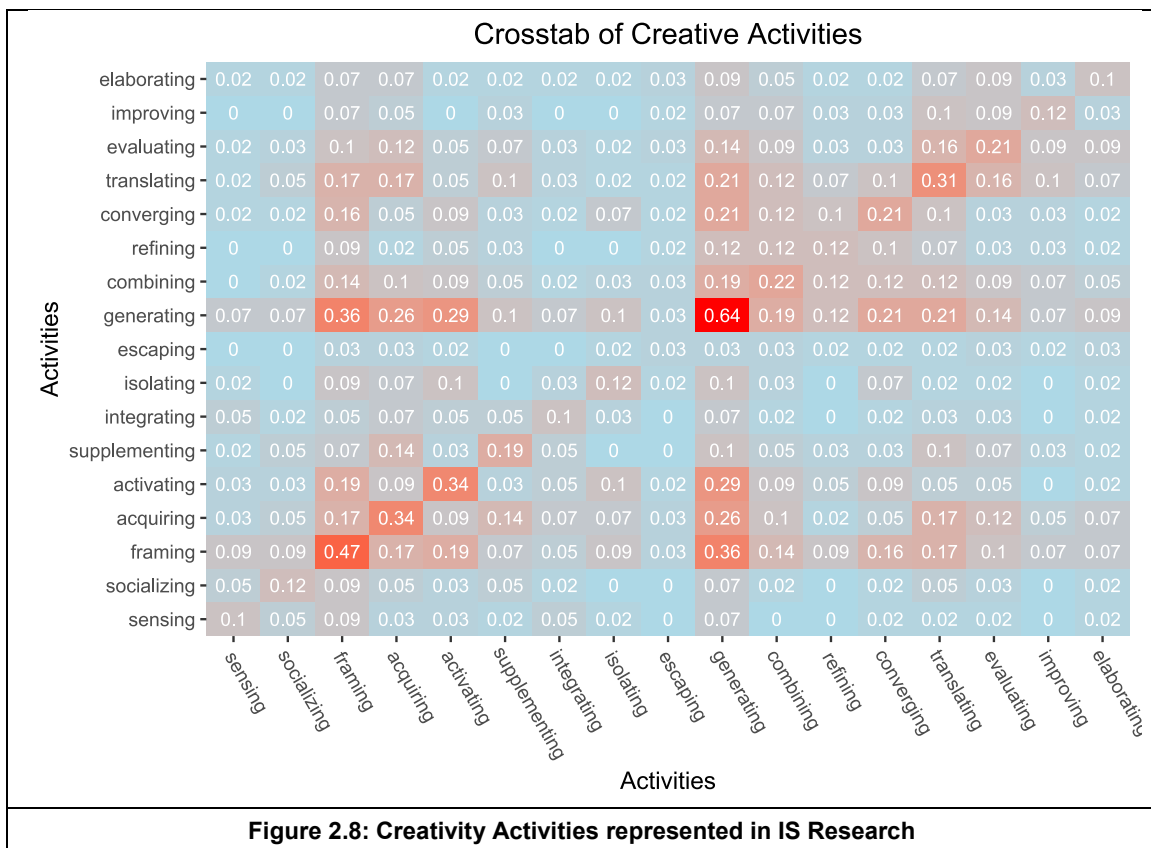


Figure 2.7 shows a crosstab of the creative systems investigated in our sample. The crosstab can be read as a correlation table where the number on the diagonal represents the percent of our sample that investigates that system, and the off-diagonal values represent co-representation of the systems in a single study. For example, creative Behavior is the most commonly researched systems such that 91% of the creativity research projects published in Basket journals investigate the causes of creative behavior, the consequences of creative behavior, or have subjects perform some creative act. Consistent with trends in creativity research from reference disciplines, IS studies typically hypothesize an indirect relationship between the IS and performance in which the IS affects creative behavior by first augmenting an individual's mental state (e.g. Cognitive and Affect System: 53%), skill set (Self system: 40%), team dynamics (Group system: 34%) or work environment (e.g. Social System: 33%). For example, in a study concerning a CSS's ability to enhance innate creative skill, Massetti (1996) shows that while the type of CSS did not have an effect, subjects aided by a CSSs generate a greater quantity of creative ideas for addressing homelessness problems in urban areas than do

individuals using pen and paper. Easton et al. (1990) explore the ways in which an IS might be able to increase decision quality in a group brainstorming session and find that a single IS designed to perform a specific task is more likely to enhance the overall creativity of the group's solution, than a conglomerate of tools which each offer unique features that may be useful for a task. Also, Gray et al. (2011) investigates the relationship between the social environment and creative behavior by studying social bookmarking services. They show that those individuals who interact with and maintain a more diverse social network tend to exhibit more creative behavior, as designated by their peers. Finally, of the many studies that explore how use of an IS affects cognition, Lilley's (1992) work stands out as a lone contrarian voice. He expresses concern that use of an IS may encourage single-loop cognitive processes in that the system provides a view of a problem that establishes a conventional understanding of the potential solutions, thus constraining an executive's ability to frame the problem and solve it in a more creative way. In each of these studies, the authors seek to understand how an IS might alter the user or their environment to enhance creative behavior.

A less common approach is to incorporate creative behavior as an independent variable that effects other creativity systems. Though researchers and executives believe creativity to have valuable downstream benefits for individuals, teams and organizations, only 2 studies explicitly explored these relationships. First, Füller et al. (2009) argue that creative consumers are more likely to feel that they have more control over design and decision process when participating in an online co-creation platform. Second, Lee and Choi (Lee and Choi 2003) posit that organizational performance is enhanced by

organizational creativity, and thereby offers an explanation for the relationship between knowledge management enablers (i.e., culture, structure, people, and IT) organizational performance. Though few, these creativity-as-cause studies hint at the potential benefits of creative behavior, and when considered in conjunction with the creativity-as-consequence studies, offer support for the bidirectional effect of creativity systems.



A breakdown of the predominant creativity activities sheds further light on the state of IS creativity research. Figure 2.8 shows that much of the focus has been on Framing (47%), Acquiring (34%), Activating (34%) and Generating (67%) activities. Framing studies tend to emphasize the importance of gaining an understanding (or shared understanding, in group settings) of the problem and how this affects the final creative

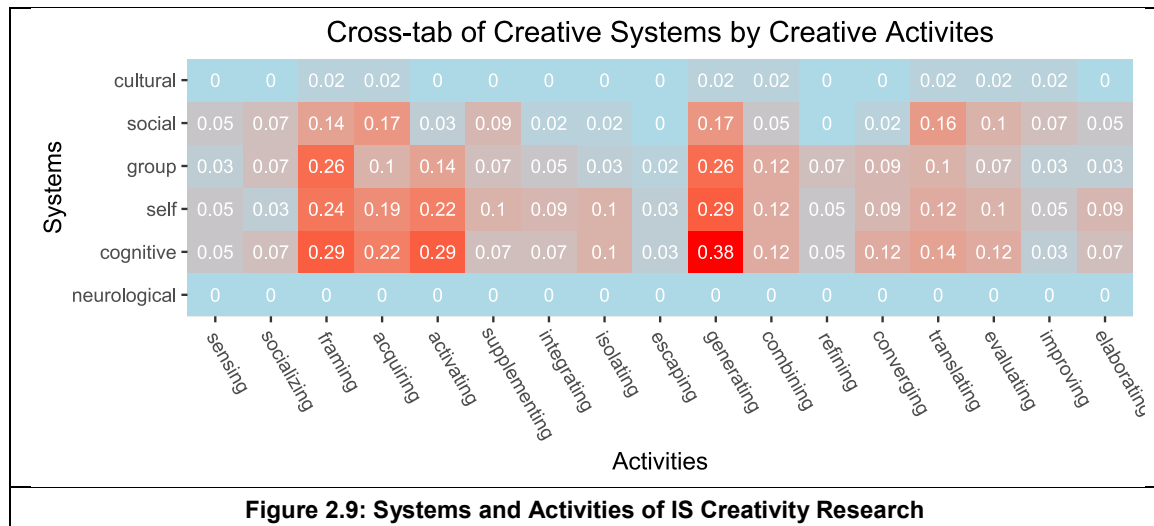
product or idea. This is a central theme in Malhotra et al.'s (2001) retelling of the successful completion of a Boeing-Rocketdyne innovation initiative. They argue that, in the case of Virtual Cross-value-chain Collaborative Creative teams, success was made possible by an IS that established a shared understanding of the creative project by allowing team members access to tools for sharing artifacts, interacting frequently and creating and storing ad-hoc, context-specific knowledge. Studies exploring the Activating activity typically argue that because creativity emerges from the recombination of extant knowledge (Campbell 1960; Koestler 1964; Mednick et al. 1964; Mednick 1962), technologies can enhance creativity by focusing the user's attention on thoughts or memories that are conceptually distant from some focal concept. This concept of spreading activation (Collins and Loftus 1975) is foundational to Santanen et al.'s (2004) Cognitive Network Model of creativity in which creativity can be enhanced by technologies that encourage the discovery of "new associations among frames from previously disparate areas of knowledge networks within the context of the problem at hand" (Santanen et al. 2004, p. 176). Whereas Activating studies are interested in stimulating creativity activating old knowledge, Acquiring studies are concerned with the stimulating of creativity through the gaining of new knowledge. For example, in a field study of executive information systems, Vandenbosch and Huff (1997) find that systems that allow executives to flexibly manipulate and scan data resources encourage more creative solutions to organizational problems. Studies investigating the Generating activity are focused on the act of idea generation. As shown by the heat map in Figure 2.8, studies looking at Framing, Activating and Acquiring activities, typically do so in the

context of idea generation. For example, Briggs and Reinig (2010) Bounded Ideation Theory suggests how technologies can help users improve creative ideation by helping them frame and reframe existing problems through the acquisition of new information, activation of distant relationships in their extant knowledge network.

Figure 2.9 presents a crosstab of creative systems and activities¹⁴ which illustrates the most common approaches to framing creativity research in IS. This figure suggests that researchers typically seek to explore how an IS's effect on the Cognitive system influences Framing (29%), Activating (22%), Acquiring (29%) or Generating (38%) activities. As discussed above, Generating is often the focal creative activity with the Framing, Activating and Acquiring activities serving as the mechanisms by which Generating is affected. More simply put, this figure suggests that IS creativity research tends to focus on the cognitive factors that affect creative ideation. This perspective is well illustrated by Weber's (1986) early contribution to DSS research in which she argues for a reevaluation of the role of an IS in the decision-making process. She calls for systems that extend the traditional DSS by offering managers support in solving "wicked" problems—unstructured problems in which the nature of the problem as well as any goals or strategies for attaining those goals may be unknown (Mason and Mitroff 1973). She argues that the potential inherent in systems that offer a variety of strategies for "fostering human learning and subsequent creativity is as limitless as the human mind" (Weber 1986, p. 86). In this way, she frames the creativity phenomenon as one

¹⁴ The Behavior system was removed from this figure because the activities are behaviors and the intention of this figure is to tease out the relationships between the systems of creativity and the specific activities involved in creative behavior.

occurring in the mind, and one moderated to the extent that an individual’s cognitive faculties are directed toward more efficient and effective ideation.



Discussion

Together, the measures of IS Conceptualization and IS Effect illustrate that a majority of IS creativity research conceptualizes the IT artifact as a *supplemental tool capable of enabling* creativity. This perspective is illustrated in Figure 2.6 where the tool view dominates other IS conceptualizations, and the enabling role is employed in a clear majority of IS creativity studies. While these studies provide valuable insight for managers interested in using supplementary tools to improve employee creativity, this would represent a narrow view of the role ISs play in influencing other forms of individual productivity. Notably, the proxy and ensemble view are largely absent from extant IS creativity research but may offer valuable insight into the interaction between IS and creativity. For example, the proxy view of an IS has been used elsewhere in IS research to investigate how IS expenditures influence the organizational climate (Weill

1992) and employee perceptions (Lapointe and Rivard 2005). This approach could be used to illustrate how the adoption of enterprise systems or bring-your-own-device (BYOD) policies affect employee perceptions of organizational support or individual creative identities, both factors that have been shown to influence creative behavior (Amabile et al. 1996; Farmer et al. 2003). Likewise, an ensemble view could be used to investigate how the organizational systems spill over into other functions of the work environment. For example, enterprise social media have been shown to alter individual knowledge hierarchies (Leonardi 2015) which may inhibit an employee's creativity as their social network becomes more or less homogenized.

Our analyses of the creativity phenomenon suggest that IS creativity research has emphasized investigations of the *cognitive factors which influence idea generation*. The results reveal several gaps or biases in the field's understanding of the relationships between IS and creativity. First, at the systems level, investigations of cultural and neurological phenomena are nearly absent. While the interactions between the IS and these systems may be less obvious, reference discipline research has found each level to play a unique role in creativity. For example, the *International Handbook of Creativity* is an edited collection of research articles devoted to cultural differences and creativity (Kaufman and Sternberg 2006). That creativity is viewed and valued differently across cultures may have consequences for organizations relying on globally dispersed teams. How these employees think about creativity and respond to implicit and explicit expectations for creativity, and how they use and understand technology as a support and conduit for performing creative tasks may vary across cultural divides and thus lead to

inconsistent performance. Second, most IS research has focused on a small subset of activities occurring in the early stages of the creative process. While these stages offer transparently valuable insight into the generation of creative ideas, they tend to ignore the reality that creative works are rarely fully-formed at conception (Götz 1981). As discussed above, creative ideas must be translated into the syntax of the domain (Csikszentmihalyi 1996). As more domains incorporate digital technologies (e.g., 3D printing, Virtual Reality, Artificial Intelligence), there are opportunities for ISs to be enablers of and collaborators in the translation of ideas into creative artifacts. A final concern is the lack of precision with which creative activities are studied in IS. Studies on ideation in groups typically discuss generating, combining, refining and elevating activities as if each is equally influenced by the IS or IS-relevant factors. Thus, studies may offer conflicting explanations for their findings. For example, Nunamaker et al. (1987) suggest that anonymity reduces inhibition and encourages participation while Gupta et al. (2009) argue that close personal relationships with group members reduce inhibition and encourage creativity. It is possible that the IS's effect on inhibition—the underlying impediment to idea generation in both studies—is sensitive to the specific activities of ideation, whether generating, combining, refining or converging. A more precise conceptualization of the creative activity might reduce these conflicts.

When the results of the predominant conceptualizations of the IT artifact and the creativity phenomenon are considered together, we see that IS creativity research is primarily concerned with *supplemental tools capable of enabling creativity by interacting with an individual's cognition and social environment to enhance idea generation*. This

perspective is narrow with regards to both the IT artifact and the creativity phenomenon. In the following sections, we address these twin issues independently and discuss the theoretical implications of a more expansive view of both the IS and the creativity phenomenon.

Implications

Our review suggests that the field's predominant view of the IS-Creativity interaction is one in which the IS operates in a stand-alone manner, external to but supportive of individual creativity. That is, the IS is a tool one picks up if they want to be more creative; it is not a tool one uses to perform some task that may or may not require a creative solution. Also, our review shows the field has neglected creativity as a research topic and has tended toward a narrow view of the phenomenon. This leaves a key question that we address in this section: How might the field develop a more comprehensive program of creativity research? Specifically, how might IS researchers more thoroughly explore the bi-directional, cross-systems effects that emerging technologies have on the various activities contained within the creative process? We take two tacks to approach these questions. First, we offer ideas on expanding predominant view of the IS. We do this by profiling two emerging perspectives—IS as work systems and IS spillover—in IS research and show how these perspectives on the nature of the IT artifact might be used to develop a more comprehensive view of the relationship between ITs and Creativity. Second, we use an activity view of creativity to explore the potential touch-points within the creative process where an IS might interact

with creativity. We then offer illustrations of the varied research questions that are likely to emerge from this more expansive view of creativity.

Information Systems in IS Creativity

A narrow view of the IS reveals at least two opportunities for new avenues of research in IS creativity. The first uses a work system view of the IS as a means of expanding the notion of what it means to support creativity. The second challenges the notion that either ISs or creative work stand-alone in modern organizations by adopting a spillover lens to explore the expected and unexpected ways in which ISs interact with creative work.

IS Work Systems and Creativity

To date, IS researcher have adopted a narrow view of creativity and what it means to support it. In many organizational tasks, generating ideas only represents a component of the overall work task that must be worked out in some organizational system (Mumford and Gustafson 1988). In IS research, creativity studies overwhelmingly conceptualize the tool as distinct from the creative behavior. From this perspective the tool is limited to a supplementary role in that it is only intended to support creative ideation. The IS plays no role in the remainder of the creative process. While this segregation may have been necessary during an era in which research, communication, learning and creation occur in a more physical, tangible context, trends toward greater digitization demand a reevaluation of the necessity and appropriateness of this division (Nambisan et al. 2017; Orlikowski and Scott 2008).

As the manufacturing economy of much of the 20th century gave way to the information economy of the early 21st century work and work outputs shed many of the tangible qualities that were essential to a theoretical lens which viewed user, task and tool as discrete entities. When productivity tools are imagined to be external to the task, their effect on productivity is deterministic to the extent that the tool ‘supports’ the task. Where the distinction between tool and task is appropriate, the impact of the tool on productivity is arithmetic and predictable. As the distinction becomes less tenable, the role of the tool shifts from ‘impact’ to ‘interact’ whereby productivity gains are achieved through the exploitation of affordances rather than through installation and use (Orlikowski and Scott 2008). Such is the case with digitization and creative work. The segregation of tool from task ignores the primacy of the information system as the means by which individuals translate their ideas into creative outputs. In modern organizations ISs serve less as a support for work and more as a conduit through which work is enabled. From this perspective, the employee’s relationship with and mastery of the tools are essential to any understanding of the presence (or absence) of productivity and creativity gains afforded by digital technologies. Just as it would be insufficient to investigate the painter, paints, canvas and brushes in isolation, so too is it inappropriate to view the IS as distinct from and external to the creative task.

Of the studies in our sample, only Ebel et al. (2016) and Schlagwein and Bjørn-Andersen (2014) diverge from the compartmentalized view of creative work. In both studies, the IS serves as the medium of creation, and in both studies the authors find that the working out of a creative artifact—business models in Ebel et al. (2016) and LEGO

designs Schlagwein and Bjørn-Andersen (2014)—within the technology environment leads to further revision and evolution of the original idea. These findings comport with Alter's (2008, 2013) view of the IS as work system where inputs such as creative ideas must be transformed into creative outputs within the IS. Increasingly enterprise and cloud technologies serve as the backdrop for a greater diversity of organizational activities ranging from gathering information to transferring knowledge to creating new artifacts. In this digitized setting where employees must use the IS as a means of giving life to their ideas, a work system approach suggests a new role for the IS in supporting creativity (Alter 2013). Viewing the IS as a conduit for translating creative ideas could lead to avenues of research that investigate the individual, tool and task factors that influence the evolution of creative ideas as they are worked out in a digital environment, and the creativity of the final product.

IS Spillover and Creativity

A second consequence of the tendency to view the IS as a support tool is that it limits the investigation of the impact of the IS on creativity to contexts in which IS has been designed to support (i.e. enhance) creativity. While these studies provide valuable insight into the efficacy of specific ISs as creativity support tools, they are silent on the effects of a pervasive IS environment. For much of the field's history, researchers have been searching for an explanation for the predicted but absent productivity gains (Brynjolfsson 1993). Case studies on system implementation efforts indicate that the relationship between system adoption and organizational productivity may be complicated by the unintended consequences—changes in power structures (Markus

1983) or role perception (Lapointe and Rivard 2005; Rivard and Lapointe 2012)—that accompany wide-scale implementations. These studies hint at the IS’s ability to interact with and alter the social and structural aspects of an organization, thereby leading to unexpected system-user interactions. As discussed above, information and communication technologies are not external to the work performed in modern organizations but are ingrained in the fabric of both the organization and work. As this perspective of ISs and their role in modern organizations becomes more widespread researchers are beginning to investigate the potential for system impacts to spill over into unexpected functions in unexpected ways (Jones and Karsten 2008).

Spillover is a concept that is used colloquially in a variety of disciplines. Early research into spillover effects conceptualized spillover as “a phenomenon in which one party benefits from the actions of another party without incurring significant costs” (Han et al. 2012, p. 294). Initially proposed as an economic phenomenon in which one organization or industry benefits from the capital expenditures of an third party—as is the case when organizations benefit from the research and development (R&D) expenditures of technology companies (Griliches 1992)—spillover gradually morphed into a more general phenomenon in which the actions of one entity are believed to have indirect consequences on other entities in the actor’s network. In addition to R&D spillovers, researchers have investigated the role of knowledge spillovers in organizational innovation (Owen-Smith and Powell 2004) and entrepreneurship (Block et al. 2013). More recently, researchers have begun to investigate psychological spillover effects in which cognitive or psychological resource expenditures in one domain have

consequences for the individual in a seemingly unrelated domain (ten Brummelhuis and Bakker 2012). This perspective is increasingly common in research exploring the work-home or work-family interface. Researchers adopting an ecological view of the relationship between worker and work argue that skills developed or resources expended in one context (e.g. at work) are not constrained to that context, but instead spill over into other settings (e.g. home), and vice versa. Additionally, these spillover effects may be positive or negative depending on the depleting or fortifying nature of the activity (Grzywacz and Marks 2000; Harrison and Wagner 2016; Tang et al. 2017).

Spillover is important to IS creativity research because individual creativity is highly sensitive to external forces, and these forces are increasingly mediated through ever more ubiquitous ITs and ISs. To understand the effects of digitized work environments, IS researchers are embracing a more situated view of employees and tasks such that performance is contingent upon a web of interrelated and overlapping systems which enable the worker-tool-task interface. These interlocking systems comprise a digitized work environment where primary and supplementary systems interact to support work. In this setting, performance will depend on the extent to which these systems have been designed to work synergistically with one another. Orlikowski (1992) argues that in this type of IS environment, it is possible that the effects of use might spillover in unexpected ways into both essential and peripheral aspects of the employee's role. That is, employees who find that the various systems supporting their work were designed with different and potentially competing assumptions regarding the role of the IS and the extent to which it is integrated into the task may experience degraded performance as

they navigate the competing demands of the systems comprising the IS environment. As management research has shown, synergy among the factors that make up the work environment is essential to encouraging and maintaining individual creativity (Amabile et al. 1996; Anderson et al. 2014; Zhou and Hoever 2014). As ISs are more enmeshed in the work environment and employees are increasingly reliant on multiple systems to support their work, managers need more insight into how these systems interact to influence work performance and creativity.

Creative Activities in IS Creativity

In the following sections, we will illustrate how future researchers might use an activity-centric view of creativity as an inspiration for new investigations into the interplay between IS and creativity. Each section focuses on a single stage in the creative process and, in describing the activities that comprise the stage, will discuss the ways in which an IS might influence the stage's activities, and how those effects cascade throughout the creative process.

IS and Problem Identification Activities

The problem identification stage of the creative process is the stage during which an employee becomes aware of an organizational problem and begins to structure the problem with the intention of solving it. The activities of this stage are highlighted in Figure 2.10. Sometimes referred to as problem construction (Reiter-Palmon et al. 1997) or problem finding (Getzels 1979, 1982), this stage is concerned with structuring a mental representation of the problem such that the employee seeks to identify the “crucial elements in the problem, including goals, constraints, outcomes, key steps in problem

solution” (Mumford et al. 1991). The variety and scope of the problem representations will constitute a problem space from which the solution space will be structured (Dorst and Cross 2001). A problem space that is narrowly framed necessarily constrains the potential solution space. Thus, the goal of the problem identification stage is to identify important problems and to frame those problems so as to allow for the widest possible set of solutions.

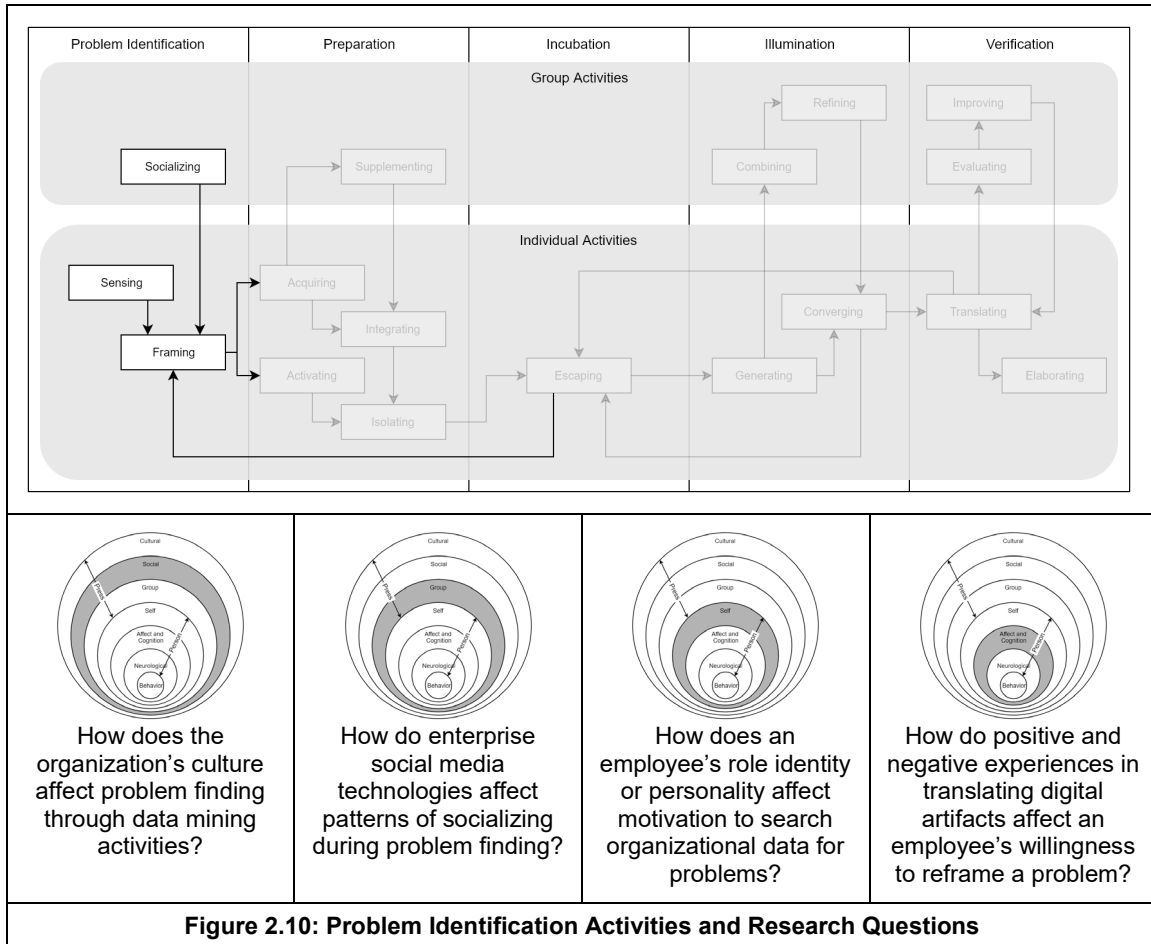
The key activities of this phase are focused on finding and framing organizational problems. Though organizational leaders sometimes find and assign problems to employees, the problem oftentimes lacks specificity and in some cases, may be a symptom and not the problem itself (i.e. the “problem” of low customer loyalty is likely only a symptom of several organizational problems) (Getzels 1982). Thus, employees are to engage in internal and external problem finding. Internal problem finding represented by the sensing activity is a process in which an individual employee searches organizational resources for data or information which may reveal a problem or evidence of a problem. Socializing represents an external search for organizational problems within the employee’s social environment. ISs may be particularly influential in the internal and external finding activities as these are largely information search and communication activities. These are rich areas in IS research, and future research could consider how an explicit goal of finding a creative solution to unstructured and ambiguous problems influences search processes or communication patterns.

Once a problem or potential problem is identified, the employee constructs a representation of the problem (i.e., framing) that determines the desired outcome(s),

information and resources needed to solve the problem, and any constraints associated with solving the problem. This representation necessarily establishes the initial boundaries for a potential solution (Dorst and Cross 2001). Because novelty is a key component of creativity and novelty is bred in variation (Campbell 1960), the mental representation of the problem space must be sufficiently broad so as to allow the greatest possible variety of potential solutions. Thus, the challenge inherent in framing a problem is balancing the need to narrow the problem space to an extent that the objectives of the problem are clear while leaving the problem space wide enough to allow for novel solutions. ISs may be used to stimulate remote associations or prime employees to think about problems differently (Althuizen and Reichel 2016; Dennis et al. 2013). Also, exposure to new technologies or training initiatives may be used to stretch an employee's understanding of what is possible, thereby expanding the solution space (Nambisan et al. 1999)

As an employee progresses through the creative process, they may return to the problem identification stage as they reflect on the resources and information that will inform their work, or as they work through translating their ideas into a workable solution. During these iterations, the employee's understanding of the goals, resources, methods and constraints will evolve and thus alter their initial framing of the problem. In a demanding and fast-paced work environment, the features of an IS may tailor search activities and search results in a way that discourages these loopbacks, resulting in premature closure of the problem frame (Lilley 1992). Creativity research would suggest that this form of satisficing is primarily a problem of motivation that limits the novelty

and usefulness of any potential solution. Future researchers could consider how development techniques, policies or requirements affect one's willingness to revisit their framing of a problem or how communication technologies encourage the reframing or problems.



IS and Preparation Activities

The preparation stage of the creative process is the stage during which the employee engages in a process of acquiring information and isolating problem-relevant knowledge structures. The activities of this stage and sample research questions are

presented in Figure 2.11. This stage is largely concerned with the processes by which the problem frame directs resource (i.e., knowledge, skills, abilities) search, acquisition, retention and activation. During this stage, problem-relevant resources such as prior experience, technical skill and domain knowledge among others are identified and assessed for their applicability to the present problem. As the employee's framing of the problem and their awareness of resource gaps evolve, further preparation will ensue (Dorst and Cross 2001). Therefore, the goal of the preparation stage is to identify and activate a subset of resources that will be useful in the development a creative solution.

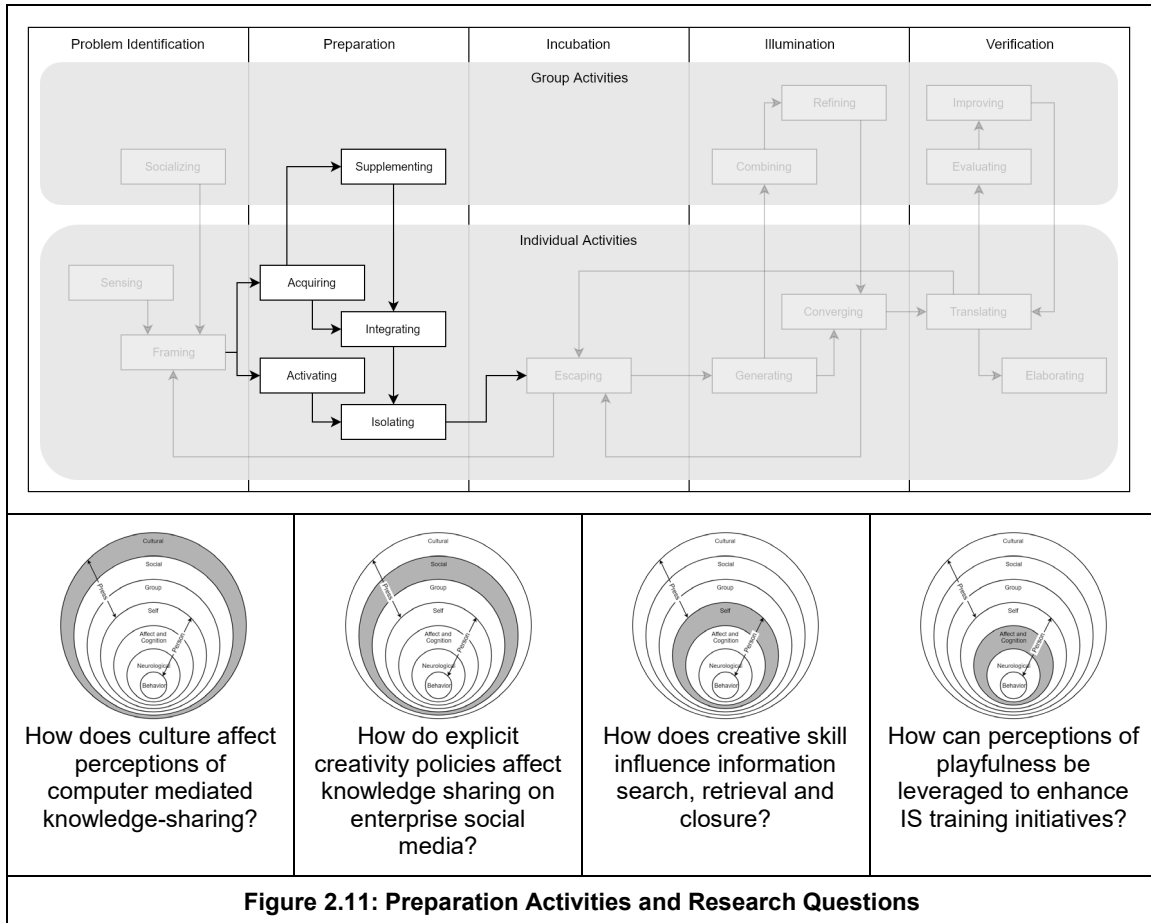
Preparation activities comprise a two-step process of first activating resources and then isolating those resources which are relevant to the problem frame. In situations in which the employee is particularly skilled and has a wealth of prior experience and knowledge, activation is primarily a cognitive process of extracting potentially relevant—as determined by the problem space—information from long-term memory (Amabile and Pratt 2016). When activating resources from long-term memory, employees should resist habitual or routinized responses. Though prior knowledge and skill are essential components of creativity, it is not the deployment of practiced skill *per se* that enhances creativity, but the employee's ability to combine and adapt prior skill to fit the present problem (Ericsson 1999; Glăveanu 2012). Therefore, ISs may be useful as memory aids or as trainers that employees may use to continue to hone or sharpen their skills in anticipation of a future opportunity to perform.

When faced with a broadly framed or unique problem, employees may find they lack the resources needed to achieve a creative outcome. If additional resources are

needed, the employee must then engage in a secondary process of learning. During the learning process new resources are acquired via information search or imputed by experienced peers (Sawyer 2012). Depending on size of the knowledge gap, this phase may last an extended period of time. For example, a development team seeking to take advantage of the capabilities of a new technology may spend weeks learning about new features and how best to incorporate them into their current project. The focus of these learning exercises should be on developing expert knowledge (Dreyfus and Dreyfus 1980) as temporary or superficial acquisition will be of no use in the later stages of the creative process (Bink and Marsh 2000). Therefore, ISs may support these activities in a variety of ways: documentation systems could be used to create a catalog of project notes and outcomes; communication technologies may create new opportunities for employees to identify and reach out to experts inside and outside the organization; training technologies may guide the employee through sessions which emphasize experimentation as opposed to memorization and repetition.

For any given problem, an employee will only use a subset of their knowledge and skills to develop a solution. It seems counter-intuitive, but creativity suffers in conditions of both want and excess. Thus the winnowing of superfluous or unhelpful resources plays an important role in establishing a foundation from which to develop a creative solution. Whereas the other activities in the preparation stage were focused on acquiring an expansive set of resources, the isolating activity is concerned with the methods by which employees isolate the subset of information that will guide future illumination and verification activities. Therefore, memory aids and documentation tools

might be useful for helping employees consciously define the types of resources that are beyond the scope of the focal problem should improve focus and creativity in the later stages. Also, decision tools could be used to direct an employee’s attention toward the resources likely to lead to a creative solution.



IS and Incubation Activities

The incubation stage of the creative process occurs entirely in the unconscious mind of the individual. Figure 2.12 illustrates how the incubation activity (i.e., Escaping) connects to other activities in the creative process, and offers potential research questions for this stage. Though labeled unconscious, this form of goal-directed processing is

believed to occur any time an individual's attention is turned from the focal task to some other activity (Madjar and Shalley 2008). A goal—such as being creative—makes the task sticky throughout the mind whereby any interruption that turns consciousness toward a new task frees the mind to engage in the unconscious processing of the original goal-directed task (Dijksterhuis and Nordgren 2006). When the individual's attention is directed elsewhere, unconscious thought continues to evaluate, weight and relate problem-relevant information (Dijksterhuis et al. 2006). As such, this stage is entirely dependent upon information and stimuli that were learned or activated prior to the period of unconscious processing. That is to say, the unconscious mind must be primed with problem-relevant information so that it has something to process. As the creative process unfolds and new information or problems are added to the task, processing during the incubation stage may lead forward to new ideas, necessitate a restructuring of an individual's understanding of the problem or reveal the need for new rounds of knowledge or skill acquisition. Thus the creative process iterates between conscious and unconscious processing of the task as conscious work supports and stimulates unconscious processing which then directs the individual's attention to subsequent action and thought (Csikszentmihalyi 1996).

Though unconscious processing is often associated with “sleeping on it,” research has shown that simple distractions or breaks from a complex task can improve decision-making (Jett and George 2003; Madjar and Shalley 2008). Thus, any time spent away from a task is believed to trigger unconscious processing during which the employee's creativity stands to benefit from the escape. As organizations are tending toward a more

virtual and distributed structure, information systems may increasingly serve as mediators for more traditional interruptions such as impromptu co-worker interactions or incoming phone calls. Additionally, employees have greater access to non-workplace interruptions through information systems as smartphones that provide a platform for engaging in activities that blur the line between work and home. Prior research has shown that the characteristics of ISs can simultaneously induce a sense of autonomy and feelings of dependence (Jarvenpaa and Lang 2005), and managers need to better understand how this paradox impacts creative performance. Future researchers should consider how ISs can serve to both encourage, discourage and interrupt incubating during a creative task.

Research on creativity suggest that incubation is a stage that serves as a central hub for the creative process in that new information gathered throughout enhances the creative output when it intermingles with other resources during unconscious thought (Dijksterhuis and Strick 2016). The acts of converging on creative ideas during illumination and translating ideas into artifacts often introduce new problems into the creative act. As the complexity and difficulty of the problem increases, so too does the need to step away from a task and divert attention to some other activity, thus enabling unconscious processing of the new information. However, not all breaks are equal (Jett and George 2003). When the employee has no control over the distraction, the break may increase the employee's stress. Also, distractions that are overly engaging may require so much conscious processing that the break becomes no break at all. These factors will determine the extent to which the distraction serves as an escape or simple a distraction. Increasingly, information technologies are providing that escape and future researchers

should consider how an IS-mediated distraction might differ from a more material disruption.

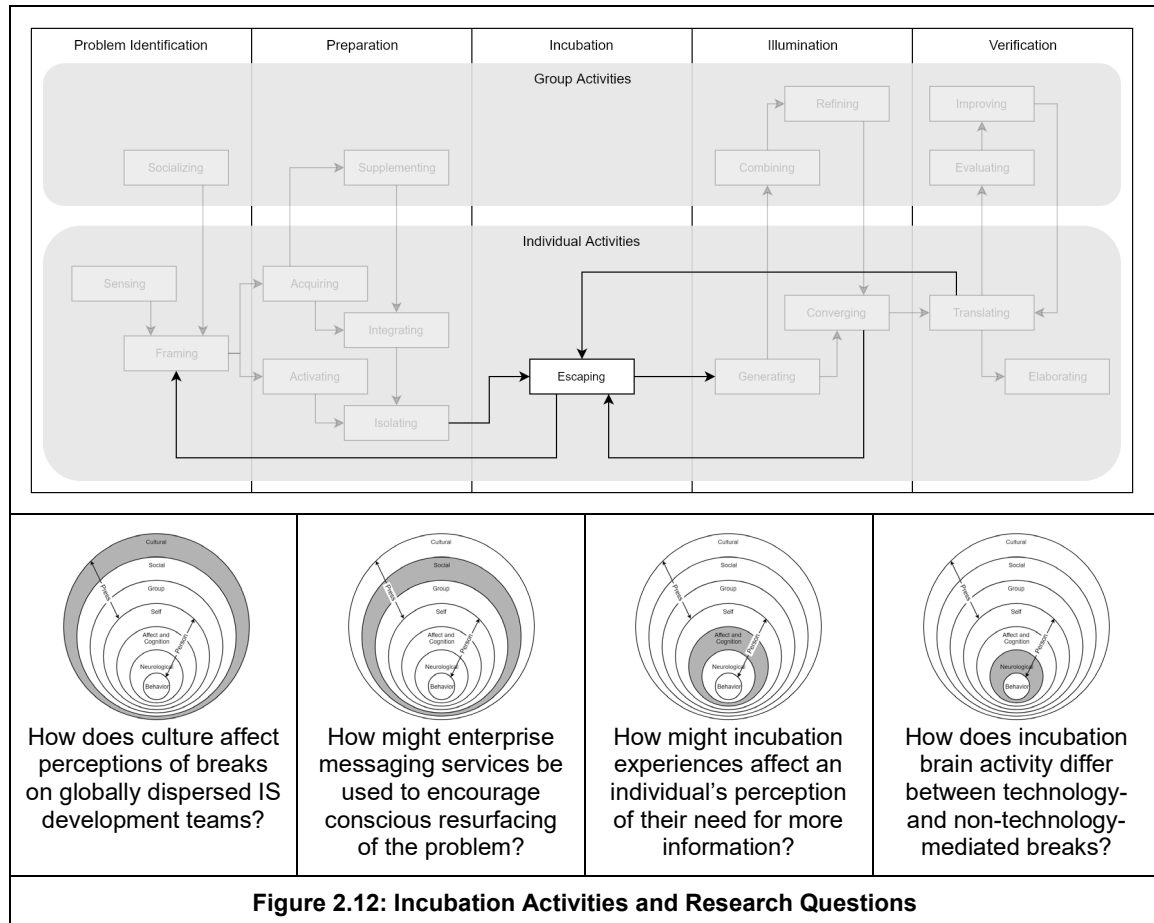


Figure 2.12: Incubation Activities and Research Questions

IS and Illumination Activities

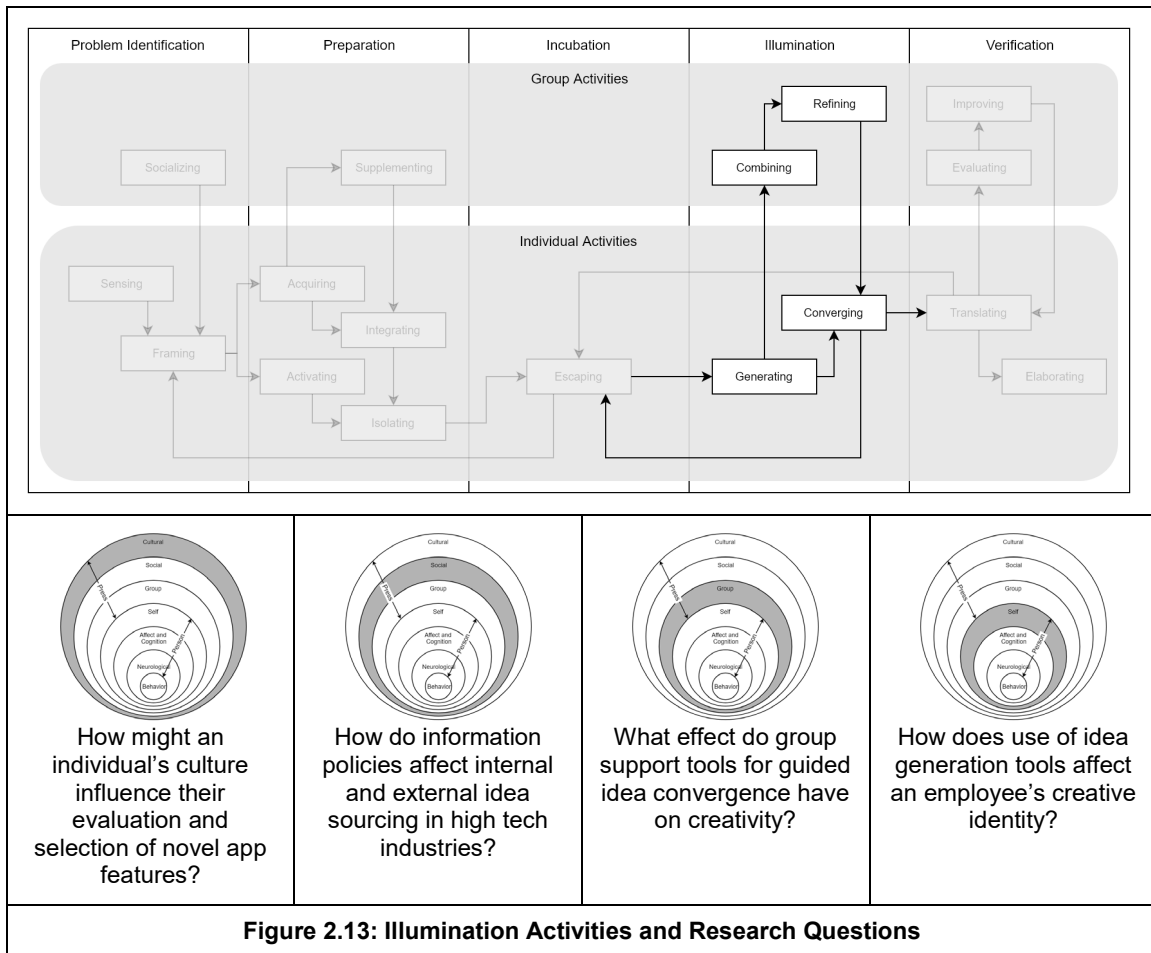
The illumination stage of the creative process is the stage concerned with the generation of creative ideas. Figure 2.13 illustrates the activities in this stage and their role within the larger creative process. While this stage is often associated with simply suggesting new ideas, research suggests that this stage involves a two-step process of generating new ideas and then converging on useful ideas. That is, to be creative an idea must be both novel and useful and the two activities of Generating and Converging

illustrate how new ideas are molded into good ideas. First ideas are generated without evaluation and then ideas are assessed and conformed to the specific problem condition (Basadur et al. 1982, 2000). Groups and teams are sometimes integrated into the illumination process to support ideation and evaluation activities. Though organizations often formalize group support into brainstorming sessions (Litchfield 2008; Osborn 1957), they should also encourage ad hoc interactions in which an employee solicits input from co-workers or peers (Catmull and Wallace 2014). Incorporating skilled and knowledgeable outsiders into the illumination process may improve convergence, though their contribution to the process may be limited by their familiarity with the problem domain. Typically, the suggestions of those who are well-versed in the domain will be of greatest value, while those who are novices in the domain will be limited in their ability to improve ideas (Sawyer 2012).

Both individuals and groups participate in the two-step process of divergent and convergent thinking. During the Generating activity, individuals should consciously and intentionally delay evaluation of new ideas. The goal of delayed evaluation is to reduce inhibition and increase the quantity and diversity of possible solutions. Similarly, groups engage in divergent thinking when they institute mechanisms to dissuade idea judgement. Though ideas are individual, members of a team benefit from the proffering of new ideas when any portion of an idea is combined with their own ideas for solving the problem. ISs may be instrumental in diverging activities by expanding the employee's breadth of ideas. For an individual, this might include mental stimulation tasks, games or prompts which encourage uninhibited ideation (Althuizen and Reichel 2016; Dennis et al. 2013;

Nunamaker et al. 1987; Santanen et al. 2004). ISs may expand idea breadth by facilitating access to peers or experts, by structuring group interactions to discourage pre-mature evaluation or closure (Dennis et al. 1996) or by using artificial intelligence to generate novel combinations of topics (Amabile 2019).

During the converging phase, the ideas are evaluated according to the parameters of the problem frame. Whereas the emphasis of the first phase was on new ideas, the goal of this phase is to cull the bad ideas from the good ideas. To do this, individuals use their framing of the problem and their access to problem-relevant resources as guides for molding their ideas into potential solutions. Groups also aid in the converging process when individual members use their own understanding of the problem and prior experience to suggest refinements or identify limitations in a potential solution. ISs may aid individuals and groups in converging on useful ideas by guiding idea evaluation through a process of assessing ideas for risk, uncertainty, costs, complexity, and technical feasibility (Cropley 2006).



IS and Verification Activities

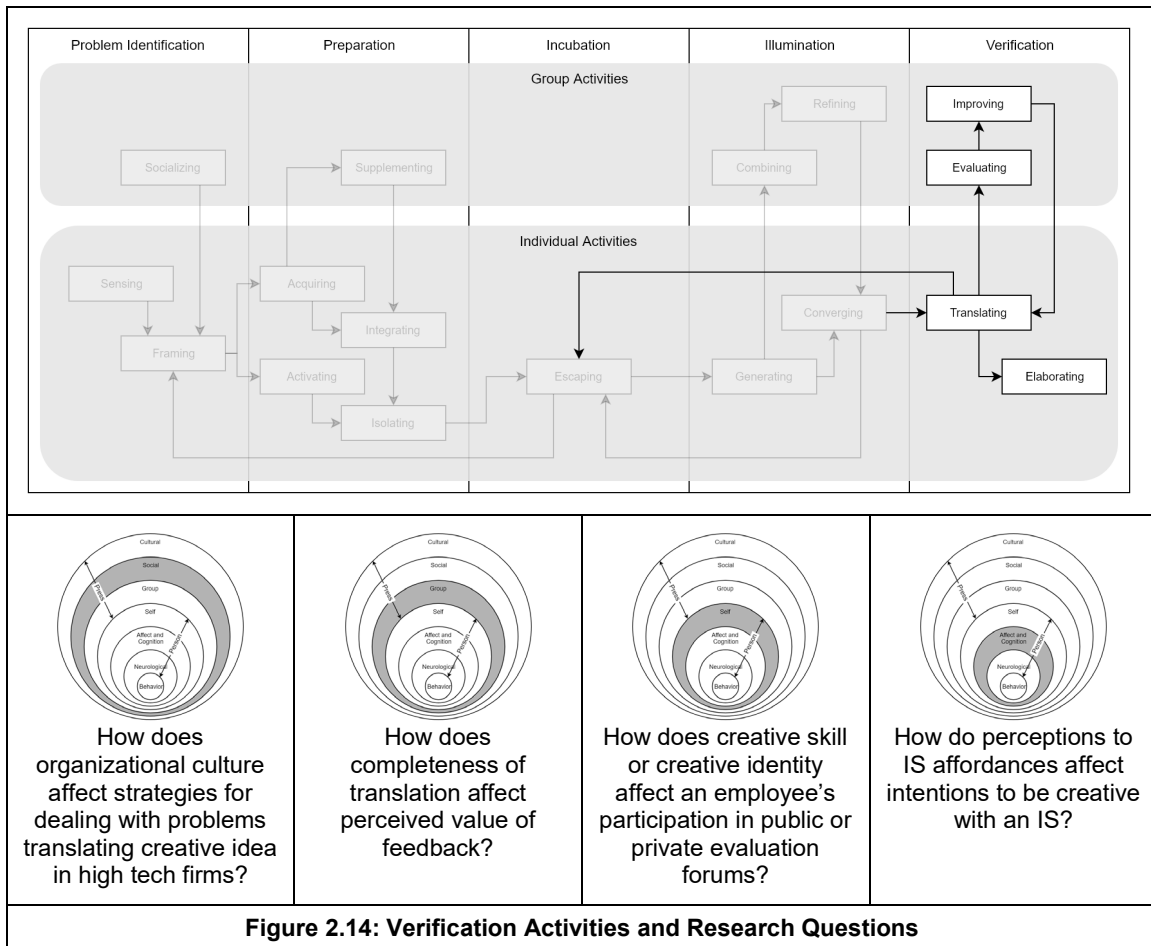
The verification stage of the creative process deals with the translation of creative ideas into creative artifacts. Figure 2.14 illustrates the activities in this stage and suggests some potential research questions. Though some models of the creative process conclude with the selection of creative ideas, there is anecdotal (Poincaré 1910) and scientific evidence (Patrick 1937, 1938) that the working out of creative ideas is nontrivial and essential to the creative process. During the verification stage, ideas are made tangible through the application of the syntax of the domain (Csikszentmihalyi 1996).

Incompatibilities between the idea and the tools, talent and material which are to give it life will trigger further iterations of the creative process as the employee reconsiders the problem and the potential solution (Amabile 1988; Amabile and Pratt 2016). Peers and coworkers may evaluate early prototypes of the artifact and may offer their expertise to aid in the translation process. Once complete, the artifact is then communicated and distributed as a creative solution to a particular problem and potential innovation to a wider acceptance within the organization (Mumford et al. 1991). Thus, the goal of this stage is to convert an idea into a workable solution.

Initially, verification involves an iterative process of conversion and evaluation whereby an individual or team manipulate the tools and material of the domain (Translating) and consult peers for guidance (Evaluating) and advice (Improving) as they seek to construct a faithful representation of the seed idea. As organizational artifacts gradually shift toward the digital, information systems will begin to play a much larger role in the translation process. In a digital work environment, systems serve as digital substitutes for tangible tools and materials. When new systems are implemented, prior expertise with analog tools or with prior systems may be lost or compromised, thus limiting an employee's creative output (Glăveanu 2012). Future researchers should investigate the effect that technical expertise has on creativity and how systems implementations and conversions influence creativity and creative intention.

Elaboration refers to the political act of communicating a creative solution to a wider audience (Csikszentmihalyi 1996; Mumford et al. 1991). In some domains such as the fine arts, this may be a formalized process of presenting work to a body of experts

and peers who will explicitly assess the work's creativity. In an organizational setting, it is more typical that this activity consists of concluding the development phase of a project and moving toward implementation. The artifact may be assessed, but it is rare that creativity would be explicitly considered. As organizational artifacts move toward digitization, this activity is increasingly a problem of systems implementation whereby a new digital artifact must be fit into an existing systems framework. When creativity is an explicit goal for the artifact, this process may be complicated by the inherent difficulty of describing and integrating systems that are, by definition, new. Future ISD research could investigate the political challenges associated with elaborating radically (or incrementally) novel artifacts into a wider system infrastructure.



Setting the Research Agenda for IS and Creativity

In Table 2.12 we summarize these implications by contrasting the IS Perspective against the Creativity Perspective for each of the topics discussed above. For the IS perspective, we offer a brief description of how the given topic has been or might be explored in IS research. The creativity perspective is intended to shed light on the ways in which creative performance would differ from other measures of performance for the given topic. We present these perspectives in this way to highlight the immense opportunities for adapting existing streams of research to a new and important context; because though all topics already have a footprint within the field, few have been

explored in the context of creativity. Also, Table 2.13 highlights prior approaches to studying creativity in IS and proposes new directions for future research. As discussed above, IS researchers have tended toward a narrow view of both the IS and Creativity, and these views have necessarily constrained the types of investigations IS researchers conduct. This table offers insight into how new conceptualizations may similarly inform future explorations of the creativity phenomenon in IS.

Table 2.12. Opportunities for Creativity Research in IS				
		IS Perspective	Creativity Perspective	
Information System	Work System	The IS is not supplemental, but rather instrumental to the completion of the work task.	There are no creative tasks, only problems that require a creative solution. Employees should be encouraged to pursue creative solutions across all work tasks.	
	Spillover	The IS is not isolated, but integrated into a larger network of technologies, all of which interact with task performance.	Employees should use organizational resources synergistically and resources should be aligned to encourage and enable creativity.	
Creative Activities	Problem Identification	Sensing	Data mining solutions help organizations more quickly identify problems/opportunities inside and outside of the organization.	“Wicked” problems are most amenable to and in need of creative solutions.
		Socializing	Enterprise social media help create near experiences for employees who are geographically dispersed.	Interactions among people with diverse backgrounds and experiences are valuable resources for developing creative solutions.
		Framing	Project management tools are useful for defining and managing project scope (i.e., requirements, resources, expectations, goals)	Creativity is encouraged when problems are framed precisely (i.e., clear expectations) and broadly (i.e., indifference regarding how objectives are achieved).
	Preparation	Acquiring	ISs are instrumental in storing existing information and enabling searches for new information.	New knowledge creates new capacities for expressing creative solutions.
		Activating	Knowledgebases serve as organizational memories of past initiatives and are used to define resource requirements for future projects.	Searching memories for distal connection will generate novel ideas because the greater the conceptual distance between ideas, the more likely the linkages will be novel.
		Supplementing	MOOC technologies can be used to connect employees with expert trainers or mentors who are geographically dispersed throughout the organization.	Experts and knowledgeable outsiders aid in skill acquisition and help individuals see their skills as applicable to a greater diversity of problems.
		Integrating	Organizations regularly use online training modules to ensure competency and to encourage continuing education.	To stimulate creativity, new knowledge must be practiced in increasingly novel and difficult simulations, ensuring greater integration with existing knowledge.
		Isolating	Decision support technologies help users organize information and weigh alternatives to improve decision-making.	Narrowing to a specific skillset or knowledgebase will provide a foundation for focused solutions during illumination.
	Incubation	Escaping	Organizations use ITs to introduce do-not-disturb routines and to encourage employees to take breaks at regular intervals.	Conscious processing is often linear and taking a break can allow remote associations to intermingle with the focal problem.
	Illumination	Generating	Artificial intelligence technologies are used to generate new ideas based on combinations of former solutions.	Generating ideas without concern for feasibility ensures the widest possible gamut of potential solutions.

		Combining	Interactive group support systems encourage the uninhibited sharing of ideas.	As individuals share ideas with one another, new ideas in part or in whole may be integrated into the creative solution.
		Refining	Collaboration systems offer tools for allowing outsiders to comment on prototypes and upcoming products.	Peers and experts in the domain are best suited to identify unworkable aspects of an idea.
		Converging	Recommendation systems and artificial intelligence technologies used to help users narrow down viable solutions. solutions to the problems they face.	Sampling from all possible ideas to converge on a solution that ensures appropriateness while maintaining novelty.
	Verification	Translating	Increasingly, information systems are the primary conduit for most modern work tasks.	The creative idea is skillfully worked out in the language and syntax of the domain.
		Evaluating	Telepresence systems give remote employees rich tools for engaging with and monitoring projects.	Peers monitor progress to ensure the artifact is faithful to the creative idea.
		Improving	Open-source technologies and standards give outsiders access to developing applications and offer them opportunities to propose new features or capabilities	Domain experts may identify new opportunities for enhancing the novelty or usefulness of the solution.
		Elaborating	Crowdfunding technologies create platforms where users can pitch ideas and garner support for projects	The finished artifact is communicated to a body of experts and presented as a solution to the initial problem.

Table 2.13. Future Directions for Creativity Research in IS			
		Prior Approaches	Future Directions
Conceptualization	Creativity	Creativity is primarily a process of generating novel and useful ideas.	Creativity should be treated as a multi-stage process with each stage comprised of multiple activities. Because the stages are distinct, each has unique inputs and outputs that will affect creativity. Further, researchers should be aware that micro- (individual) and macro- (environment) level factors affect the process throughout, but not necessarily in an equivalent manner across stages and activities.
	Information Technology	ITs are useful for managing the ideation process and helping users generate larger quantities of creative ideas.	ITs should be viewed as having internal and external effects on creativity. Researchers should continue to explore the supplemental role ITs play, but they should also recognize that ITs have instrumental (i.e., work system) and intersectional (i.e., ensemble/spillover) effects on modern work.
Research Design	Creativity	Heuristic problems are used to prompt subjects for potential solutions (ideas). Studies are typically conducted using experimental designs, and subject responses are assessed using measures of volume (number of ideas) and quality (creativity of ideas).	It is legitimate to study creativity as a function of problematization, knowledge, rest/distraction, ideation and translation. As such researchers might consider survey designs that assess perceptions of creative tasks and problems, field studies of the evolution of creative artifacts, event studies that explore the impact of an organizational change (i.e., new technology adoption) on beliefs about the creative environment, the spread of creative ideas across social network and longitudinal studies of the effects of learning on creative and/or domain skills. Further, because each stage has distinct goals, researchers may consider developing proxy measures for creativity that assess creative performance in each stage or for individual activities in addition to the commonly used self-report and expert judgement measures of creativity.
	Information Technology	The experimental prompt rarely requires a technology. Instead, the IT serves as a treatment condition that is added to the task as a supplement for some aspect of the idea generation process. Thus, the technology is hypothesized to affect creativity by enhancing communication, memory, organization, etc.	In addition to investigating supplementary roles, IS researchers should explore creativity when the IS is instrumental to the task or when the IS is intersectional with the task. For instrumental tasks, it is important that researchers study the IS as a full rather than a partial mediator of the task. For example, researchers could consider the effect that the user's knowledge of the IS or the corpus of available features has on the user's ability to produce creative artifacts with such a tool. Researchers should also explore the intersectional role of information technologies as modern life is replete with technology systems that regularly intersect with work tasks, for good and ill. For example, researchers could explore the distracting—a type of incubation—effect that ITs have and how different distractions might improve creativity.

Conclusion

Creativity research has a long and rich history in many academic fields; however, our field has, at best, expressed inconsistent interest in the creativity phenomenon. To better understand the field's posture toward creativity, and to identify potential opportunities for future IS creativity research, this essay begins by synthesizing three predominant conceptualizations of the creativity phenomenon (i.e. as a series of stages, collection of factors, or hierarchy of systems) and decomposing creative behavior into an iterative and recursive process model of creative activities. These models are then used to map extant IS creativity research. Our classification reveals a common view of the relationship between ISs and creativity whereby the IS serves as a supplemental tool capable of interacting with an individual's cognition to enhance creative ideation. This view is narrow with respect to an historical view of the creativity phenomenon and narrow with respect to prevailing perspectives on the role of an IS. To expand these views, we first consider two emerging perspectives on the role of an IS in modern, digitized organizations. Then, we illustrate how an activity-centric view of creativity can serve as a stimulant for future investigations of the interplay between creativity and IS phenomena. Together, these perspectives help to enlarge our understanding of the ways in which creativity is expressed through an IS or affected by the presence of ISs. Our hope is that this research encourages wider and deeper explorations of creativity in IS research.

CHAPTER THREE

3. CREATIVITY WITH IS: A CONSERVATION OF RESOURCES PERSPECTIVE

Abstract

As more creative work tasks are mediated through information technologies, it is important to understand how the user and the technology interact during the creative task, and the consequences of that interaction on creativity. In this study, we explore this question by showing how a user's relationship with technology influences creative performance. We employ a conservation of resources lens through which we envision creativity to be an effortful working out of creative ideas and argue that the user's technology-specific resources (i.e., IS Mastery and Creative IT Identity) will supplement their resource pool prior to the creative task. During the task, these resources will affect the extent to which users are capable of efficiently redirecting cognitive resources away from interacting with the technology and toward managing the creative task. Those who are more efficient in allocating resources will more successfully stave off depletion effects and will achieve higher levels of creative performance. We test our hypotheses with data collected from an observational study of 213 undergraduate business students. The results largely confirm our hypotheses and show that the user's mastery of an IS and the extent to which they identify as a creative user of IT will affect the ways in which they use the technology to perform creative tasks, and these usage patterns will influence the user's commitment to and effort required by the task. Surprisingly, we found no link between IS Mastery and Task-Technology Fit (TTF) and a negative relationship between

TTF and Creative Performance. We discuss these findings and others and offer suggestions for researchers and practitioners.

Introduction

“When authors wrote stories with quill pens, no one thought that the pen was a collaborator in the author’s creativity; it was just a tool. When typewriters became widespread, they too were considered to be passive, transparent tools. But a software package like Dramatica somehow seems to be more than just a tool; it seems to cross a line into being a virtual collaborator. To explain this sort of computer-assisted creativity, we need to know a lot about the software, and we need to know a lot about the step-by-step creative process. We can’t explain this creativity just by looking inside the writer’s head.” (Sawyer 2012, p. 329)

Creativity is a kinetic activity. While the inspiration for creative products and processes is born in the mind, the manifestation of these outputs is borne through the active conversion of ideas into artifacts (Götz 1981). That is, a good idea is a necessary but insufficient component of the creative process. In fact, Thomas Edison argues that inspiration accounts for a mere 2 percent of the overall process, with the remainder being composed of the ‘perspiration’ or hard work (Couger 1995) of translating creative ideas into the symbolic language of the domain (e.g. music, physics or advertising) (Csikszentmihalyi 1996). As such, the knowledge and skills that were essential to creative ideation may give way to more functional skills as the creative task transitions from thinking to doing. This may be especially true as the tools of creation become more complex, as is the case with digital tools.

In modern organizations, employees are increasingly reliant upon information systems (IS) as the primary conduit through which they express creative solutions to work tasks. Though employees may have the knowledge, skill and motivation to

conceptualize creative ideas (Amabile 1983), they may still struggle to concretize their ideas as digital artifact. That is, in the context of IS-enabled work tasks, the creative idea is separate from creative expression, and the fidelity of the conversion and the efficacy of the solution will depend upon the user's mastery of the digital tools of creation. As these tools become more complex and the digitization of work tasks and work products continues, employees will need to leverage new technology-centric skills and abilities that are distinct from those that gave rise to the creative idea.

The notion that creative elaboration is effortful and requires a mastery of the tools and medium of translation is common in many fields but is absent in IS research. Instead, IS creativity researchers prefer an idea-centric view of the creative task that positions the IS as a tool that supports creative ideation (Avital and Te'eni 2009). This perspective unnecessarily limits the scope of creative work and the role that technologies play in modern creative tasks. First, by limiting the scope of creative performance to idea generation, this perspective ignores the difficult and, oftentimes, fruitful work of translating creative ideas into creative products. Second, in modern work environments, an IS is increasingly the primary conduit through which employees perform creative tasks, and viewing the IS as supplement rather than essential to the creative task overlooks many of the ways in which an IS might affect creative performance. Just as artisans must develop a deep and rich relationship with the tools of their craft (e.g. brush techniques, brush function, mixing colors, etc.) to fully realize their vision (Glăveanu 2012), modern workers need a knowledge of the system's features and the ability to exploit them. In a digitized workplace, ISs will play an ever-important role as a medium

for creative expression as new technologies with new capabilities continue to introduce new opportunities for being creative in a digital world and IS researchers should seek to understand how ISs affect the translation of creative ideas into creative (digital) artifacts.

The quote at the beginning of this essay illustrates how ISs have evolved as tools of creative expression. Early ISs were inflexible and indifferent to the tasks they supported (Hirschheim and Klein 2012), and were often designed to support and automate specific parts of tasks. Over time, these technologies grew from supporting portions of a task to facilitating all aspects of the task. To encourage this evolution, system designers added a dizzying array of extensible features and functionalities that would allow users to quickly and flexibly respond to changing task demands. These new affordances have introduced new ways of using ISs and expanded the diversity of tasks ISs might perform. In the context of creative tasks, the IS may be an impediment to or a collaborator with the user throughout the creative process; however, the role the technology plays will depend on employee's ability to efficiently and effectively wield the digital tool in service to the creative task. As organizations simultaneously move toward greater digitalization and greater demand for employee creativity, there is great need to understand how individuals might use an IS to develop creative solutions in a digital environment. Specifically, this research aims answer the following research question: **How does a user's mastery of an IS affect their ability to use the IS as a medium for producing creative solutions to work tasks?**

Theoretical Development

The theoretical foundation for this study derives from a linking of the componential view of creativity (Figure 3.1) (Amabile 1983) to a conservation of resources view of individual performance (Hobfoll et al. 1990). We discuss these links in the following sections. First, we discuss the tangible process of translating creative ideas into creative artifacts and the role that domain-specific skills and motivation play in achieving a creative outcome. Specifically, we contend that act of creating digital artifacts in an IS is influenced by IS-specific skills (i.e., IS Mastery) and motivations (i.e., Creative IT Identity) and that users who possess such resources will be better situated to perform creatively. Then we turn to the Conservation of Resources (COR) Theory to help explain how IS-specific skills and motivations might improve creative performance. First, IS-specific skills and motivations are resources that alter a user's perception of the creative task and technology they must use to complete it. Second, the acquisition of these resources affords users exploitable opportunities during the task that conserve resources for other aspects of the task. Those users who most capable of conserving resources will be able to avoid the negative consequences of resource exhaustion—reduced commitment and increased difficulty—and will be more likely to achieve higher levels of creative performance. Within each section we tie the general ideas of creativity and resource acquisition, allocation and depletion to IS specific concepts that would be essential for any user tasked with using an IS to develop a creative solution to some business problem.

Creativity

Creare, the Latin root from which creativity is derived, suggests an act of *making*, *producing*, *generating* or *giving birth to* some observable outcome (Götz 1981). Thus, creativity is an intentional act performed by an individual to bring about some observable outcome that is novel and useful within some specific context (Rhodes 1961). Stein (1975) integrates these ideas in what has come to be known as the standard definition of creativity (Runco and Jaeger 2012): “a process that results in a novel product or idea that is accepted as useful, tenable or satisfying by a significant group of people at some point in time” (Stein 1975, p. 253). As the definition suggests, creativity differs from other forms of creating in that the creative products are both novel and useful. Because creativity is contextual and socially determined (Amabile 1982), outcomes need not be novel *per se*, but simply novel *in situ*. Likewise, the usefulness of a creative work is subjective and sensitive to the problem for which it was derived and the audience to whom it is communicated (Stein 1953).

Implicit in Stein’s definition (1975) and explicit elsewhere (Rhodes 1961) is the notion that the creative product is both an idea and an “observable outcome or response” (Amabile 1983, p. 358). That is, “when an idea becomes embodied into tangible form it is called a product” (Rhodes 1961, p. 309). In organizational research, this two-step process of translating ideas into artifacts is often referred to as a process of innovation where the first steps is responsible for generating creative ideas and the second step is responsible for converting those ideas into organizational resources (Amabile and Pratt 2016; Mohr 1969; Zhou and Hoever 2014). Over time, the nature of creative products in

organizational research has drifted toward the ephemeral such that the creative idea is now considered to be of central concern to managers and researchers alike (Anderson et al. 2014). Thus, it is now common for definitions of creativity to focus on the generation of novel and useful ideas (Amabile and Pratt 2016; George 2007; Zhou and Hoever 2014) that are later implemented by other groups within the organization.

In IS research, as in much management research, the creative idea remains of utmost concern (Avital and Te'eni 2009; Dean et al. 2006; Müller and Ulrich 2013; Seidel et al. 2010). This focus on creative ideas stems from the larger trends in organizational research discussed above and from a preference within the field of IS for conceptualizing the IS's role as one of support. That is, the IS is typically presented as supplementary rather than essential to the creative task. This is illustrated in the findings from two reviews of creativity research in IS (Müller and Ulrich 2013; Seidel et al. 2010). First, Seidel et al. (2010) found that in a majority of studies researchers investigate the ways in which decision support systems (DSS), creativity support systems (CSS) and group support systems (GSS) manage and improve creative processing for the purpose of enhancing idea generation. In a second review, Müller and Ulrich (2013) find that in IS research these systems—DSSs, CSSs and GSSs—are primarily used to “provide environments that lead to more novel and useful ideas” (2013, p. 182). As organizations move toward greater digitization, this focus overlooks the role systems may play as individuals pursue creative solutions to digital work tasks. Further, prior research offers little guidance for managers and researchers concerned with the role of an IS as a conduit for translating creative ideas into creative, albeit digital, work outputs. Despite its

popularity in IS and other management disciplines, the elevation of the idea as the primary creative artifact is admittedly narrow—Amabile (1983) states that the term *product* is inherently broad—and perhaps detrimentally so.

Many creativity researchers who prefer a process-centric view of individual creativity similarly separate the stages of ideation and creation (Mumford et al. 1991; Sawyer 2012; Wallas 1926); however they do so for different reasons. While organizational researchers separate the creative idea from its implementation because these stages are necessarily spread across teams or functional areas, researchers focused on individual creativity separate the idea from its concretization because ideas are often incomplete precursors to solutions. In fact, researchers who focus on individual creativity have found that the work to “put in shape the results of this inspiration” (Poincaré 1910, p. 329) may introduce new ideas, uncover new problems or reveal incompatibilities between the idea and its representation (Csikszentmihalyi 1996). When the idea is elevated to a preeminent position, it is assumed that the working out of an idea is inconsequential and that fidelity is easy to achieve. This is rarely the case for individual tasks. In fact, there has long been anecdotal (Ghiselin 1952; Poincaré 1910) and scientific evidence (Patrick 1937, 1938) that the working out of creative ideas is a nontrivial and essential component of creativity. That is, while the creative idea provides the germ from which the product grows, the creativity of the idea is ultimately determined by the creativity of the product that emerges from the work of externalizing the idea.

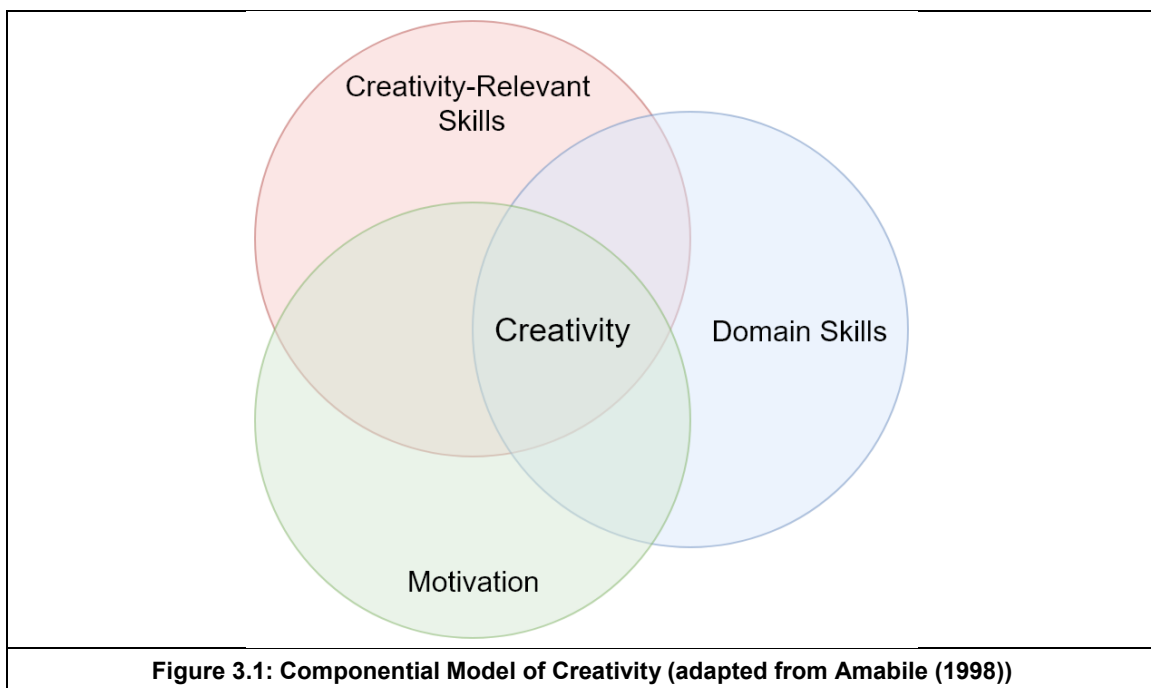
In summary, individual creativity is an intentional process through which a person brings to life their ideas as observable solutions to specific tasks. To be creative, the

resultant product, process or service (Amabile 1988) must be both novel within the task environment and useful for addressing the focal problem of the task. Unlike innovation processes where creative ideas are often generated and implemented by different groups of people, individual creativity is focused on the processes by which a person responds to some focal problem by generating ideas for solving the problem and then translating those ideas into an observable artifact. As more work tasks are digitized, ISs will increasingly serve as conduits through which employees translate creative ideas into creative artifacts. In this context, the act of externalizing an idea will be driven by the user's skill with the IS and their motivation to persevere any difficulties they may face performing the task (Amabile 1983). In the following sections we discuss how an individual's skill (i.e., IS Mastery) and motivation (i.e., Creative IT Identity) affect creative outputs and propose two IS-specific competencies that users may leverage to improve creativity.

Domain Skill and IS Mastery

The creativity of a product will be influenced by an individual's ability to translate their ideas into the symbolic language of the domain. Sawyer (2012) offers the following example to illustrate the importance of skill in the translation of one's ideas: "Monet had the idea to paint a haystack in a field at different times of the day and the year; but his idea wouldn't have gone anywhere unless he also had the painting skills to mix the right colors, to hold and to move the brush to make the right strokes, and to compose the overall image to get the desired effect" (Sawyer 2012, p. 134). During the externalization of creative insight, individuals interact with the tools and medium of the

domain to give life to their ideas, and in doing so they may encounter new insights, reveal deficiencies in either the idea or its translation, uncover new problems, or even reformulate their understanding of the focal problem (Csikszentmihalyi 1996; Sawyer 2012). Thus, skill with the medium of creation is needed to guide translation in a way that ensures the greatest fidelity between creative idea and creative artifact, and to afford an individual the poise needed to exploit new opportunities as they arise.



Researchers have identified two classes of skills that are important when externalizing ideas: creativity-relevant skills and domain-relevant skills (Amabile 1988; Amabile and Pratt 2016). Creativity-relevant skills consist of the knowledge of creativity techniques, processes and heuristics for solving complex problems in novel ways.¹⁵

¹⁵ Creativity-relevant skills are, to a large extent, independent of the creative task. These are general skills for generating creative solutions problems and include mental exercises such as attribute association, brainwriting, manipulative verbs, among others. Though creativity-relevant skills are important they are

Domain-relevant skills consist of the technical expertise or factual knowledge one employs in performing a given task, and may include “technical skills that may be required by a given domain, such as laboratory techniques or techniques for making etchings, and special domain-relevant talents that may contribute to creative productivity” (Amabile 1983, p. 363). Amabile and Pratt (2016) contend that success during the verification and externalization “stage depends most heavily on the individual’s skills in the task domain” (2016, p. 164). Thus, those who lack the domain skills needed to manipulate the appropriate tools for the creative task would be ill-equipped to identify and correct discrepancies between the idea and the emerging product, and would thus be limited in their ability to fully and faithfully give life to their ideas (Csikszentmihalyi 1996; Lubart 2001; Sawyer 2012).

The importance of domain skills is premised on the belief that creativity emerges from the intentional deployment of actions and responses perfected prior to the creative task (Glăveanu 2012). Studies of eminent artists consistently describe the artist as one who invests many hours in the perfection of tools and techniques (Csikszentmihalyi 1996; Ericsson 1999; Sawyer 2012). For example, Jackson Pollack, whose work appears random and accidental, spent many hours perfecting the “drip” technique before employing it as a tool of creative expression (Lake et al. 2004). Scholars have shown that a period of intense study and intentional practice of techniques intended to improve performance, sometimes referred to as the ten-year-rule (Gardner 1993) or the 10,000-

unlikely to be tied to a single IS. To keep our focus on technology-specific factors, we exclude these skills from our analysis and focus instead on IS-specific domain skills. For a review of creativity techniques see Couger et al. (1993) and Couger (1995).

hour rule (Gladwell 2011), typically precedes expert performance within a domain (Ericsson 1999; Ericsson et al. 1993). While practicing, individuals are encoding actions and techniques into ever larger mental “chunks” which form the basis of mental representations of and responses to domain tasks (Ericsson and Lehmann 1996). As experts acquire a more varied repertoire of mental representations and skills they become better able to exploit those resources as a means of acquiring a high level of control over relevant aspects of performance while also maintaining the flexibility requisite of a creative task (Ericsson 1998). Glăveanu (2012) argues that these habitualized automatic responses during creative tasks free “mental resources and helps us focus on other aspects of the task while performing it” (2012, p. 80). Thus, mastering the tools and techniques of the domain serves as a lubricant during creative tasks that reduces the resistance an individual may encounter during the concretization of ideas by increasing the number of potential responses to any given task, and by decreasing the cognitive costs of exploiting well-encoded responses.

Increasing digitization has ushered in a new era of work, and with it a new constellation of domain skills. Over time, the IS’s role has grown from one of external support and automation to one that is, in many instances inseparable from the task it animates. This trend is recognized by the work system (Alter 2004) view whereby the IS is a system in “which human participants and/or machines perform work (processes and activities) using information, technology, and other resources to produce informational products and/or services for internal or external customers” (Alter 2008, p. 451). This view contrasts with the conceptualization of the IS as a tool (Orlikowski and Iacono

2001) in that tools are used by individuals to perform a task, while work systems create an ensemble environment in which individuals participate with technologies in transforming organizational resources into products or services (Alter 2008, 2013; Jaspersen et al. 2005). As more organizational inputs and outputs are digitized, more organizational work is encompassed within the context of a sociotechnical work system. This necessitates a reevaluation of the relationship between employees and the technological resources that are entangled in their work processes. When the technology serves as a conduit rather than a support for work, the primary driver of performance gains shifts from whether the technology is used to whether the user is capable of appropriating and exploiting the technology's affordances—the set of action potentials inherent in an IS (Majchrzak and Markus 2012; Orlikowski and Scott 2008). Thus, to develop creative solutions to organizational problems in a more digitized work environment, users must acquire a mastery over the technologies that enable their work tasks.

Creative ideas must be worked out, and the faithfulness of the solution to the animating idea will be influenced by the extent to which the IS serves as an extension of or impediment to the user. Individuals who have mastered an IS will not struggle to translate their ideas and may be able to exploit certain affordances inherent in the technology to achieve a level of creativity commensurate with or in excess of the original idea. Therefore, we propose the concept of *IS Mastery* as a precursor to creative expression. We base our conceptualization of IS mastery on a skills acquisition model of superior performance whereby performance gains on complex tasks are the result of

increasingly sophisticated use of task instruments (Dreyfus and Dreyfus 2005, 1980). This view contends that users who have mastered an IS are aware of the action potentials afforded by the IS, have effortless access to those features and are capable of adapting their use to the various requirements of the task. These individuals would be least encumbered by use of the IS because they would most capable of wielding the IS in service of the creative task. In the follow paragraphs we first establish a link between IS Mastery and creative performance, and then we identify the three characteristics that define IS Mastery.

Essential to an understanding of mastery is the concept of deliberate practice. Deliberate practice is a special type of training which consists of a regimen of effortful activities designed to optimize improvement (Ericsson et al. 1993) by “constantly raising the difficulty of the exercise and thus engaging in activities that require incremental development” (Glăveanu 2012, p. 79). Over time, through repetition and incremental improvement, ever more complex mental representations of the task are encoded in long-term memory. These representations create a web of interconnected and overlapping, context-sensitive, domain-specific skills (physical or mental) which serve as the foundation for future performance. As more skills are acquired, the density of the web increases, affording experts a larger repertoire of situational contingencies to exploit during the execution of the task. For example, Bryan and Harter (1899) found that the primary difference in performance for novice and expert telegraphers lays in the expert’s ability to prepare for and link successive keystrokes by overlapping movements versus the novice’s treatment of each keystroke as a single act. Similar results have been found

in domains ranging from medical diagnosis to sports to music (Ericsson and Lehmann 1996), all suggesting that, more than innate talent, extended periods of deliberate practice are most responsible for performance differences between experts and novices (Gladwell 2011). The skills acquired during periods of deliberate practice help experts “generate and select the better products and better actions under conditions requiring flexibility and creativity” (Ericsson 1999, p. 332). In this way, creativity is the repurposing of knowledge and skills already mastered. Glăveanu (2012) goes on to argue that the habits developed during the pursuit of mastery constitute a collection of skills which an individual may then exploit in the face of novel problems that demand creative solutions.

Table 3.1: Dimensions of IS Mastery	
IS Competence	Extent to which individuals possess broad and deep knowledge of the features of an IS.
IS Knowledge Depth	Completeness of an individual’s knowledge of the feature sets available within an IS.
IS Knowledge Breadth	Variety of an individual’s knowledge of the feature sets available within an IS.
IS Improvisation	Extent to which the user is capable of adapting the features of an IS to serve a variety of purposes in the performance of a task
IS Routinization	Extent to which a user has internalized the features of an IS such that the features are easily accessible and can be used without much effort

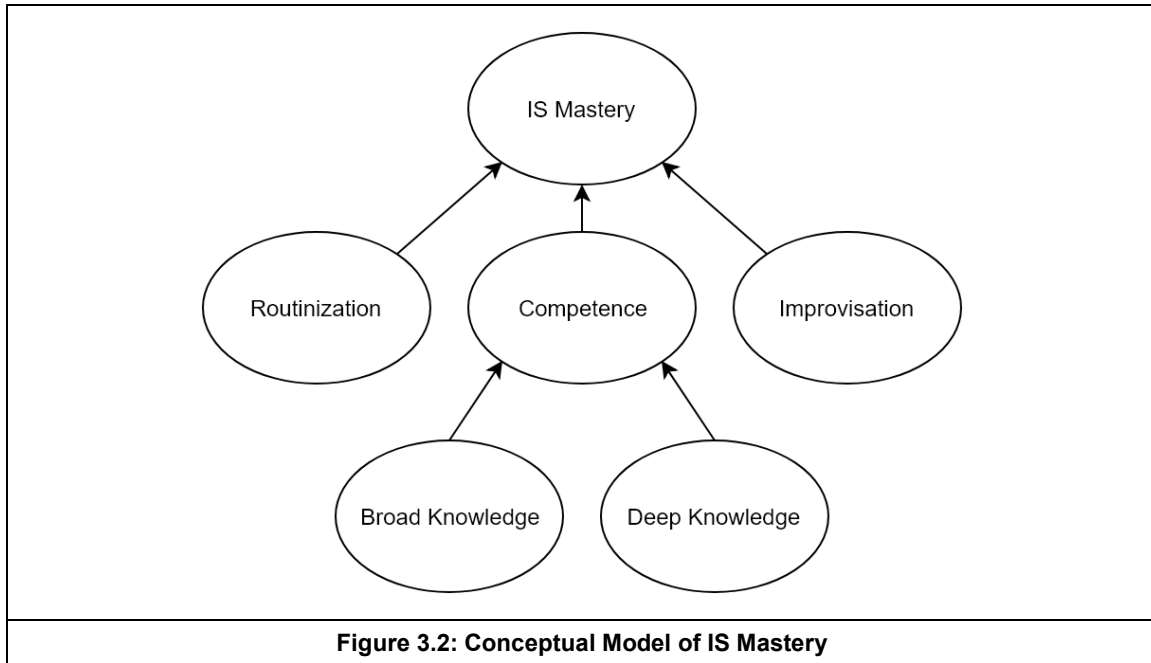
This view of mastery borrows from the fine arts where expert performance is conceived as the extent to which encoded mental representations of the tool are accessible to the artist during the creative task (Ericsson and Lehmann 1996). Therefore, we define IS Mastery as *the extent to which individuals possess competence, improvisational skill and routinized knowledge with an IS*. In line with the expert performance view of mastery, this definition acknowledges that mastery cannot be measured by quantity of experience or feature knowledge. Instead, IS Mastery is conceptualized as having the three feature-centric components: IS Competence, IS

Routinization and IS Improvisation (Figure 3.2). Competence represents an individual's broad and deep knowledge of the features of an IS (Benlian 2015; Munro et al. 1997). Broad knowledge refers to the variety of known features which a user may employ for the completion of a task. Broad knowledge is important because it serves as a foundation for making sense of a tool's purpose, capabilities and limitations. Users with a broad knowledge of an IS will be better able to stretch their usage of the tool into unintended or unexpected (by the tool's developers) domains, regardless of the spirit of the feature (Griffith 1999). Deep knowledge refers to a user's proficiency with a set of already known features. Whereas broad knowledge is concerned with whether or not a group of features is *known*, deep knowledge is concerned with whether or not a group of features is *known well*. Users with a deep knowledge of a set of features achieve a greater degree of control through familiarity such that the user has adequate foreknowledge of what a feature does and how it will affect their task, making the user's work more efficient. When combined, these two characteristics of IS Mastery increase a user's capability with an IS and the facility with which users deploy those capabilities during the task.

To graduate from competence to mastery, a user's knowledge of the IS must be accompanied by an ability to deploy their skill with minimal effort, and an intuition about how their skills should be applied to new problems (Dreyfus and Dreyfus 1980). We term these feature-centric supplementary skills IS Routinization and IS Improvisation. First, IS Routinization refers to the *extent to which a user has internalized the features of an IS such that the features are easily accessible and can be used without much effort*. Feature routinization contributes to performance by automating actions within the IS so that the

user's attention might be consumed by the task (Aarts and Dijksterhuis 2000; Ericsson 1998; Ericsson et al. 1993). Just as the typists described above link consecutive letters together with overlapping finger positions (Bryan and Harter 1899), master users of an IS can effortlessly chain together actions because the user has routinized each feature in the chain to such a degree that they can sense that the output of one action will be the precise input of the subsequent action without stopping to consider each action independently. While routinization makes use more efficient, it can, as other researchers have indicated, lead to inflexibility (Leonardi 2011) or entrenchment (Dane 2010) and limited creativity. For this reason, IS Improvisation is essential to IS Mastery. IS Improvisation, defined as *the extent to which the user is capable of adapting the features of an IS to serve a variety of purposes in the performance of a task*, ensures that the user's knowledge of an IS remains dynamic and applicable across contexts. Users whose knowledge of an IS maintains a level of plasticity will be better able to adapt to changing conditions within the task (Ericsson 1998). For example, expert pianists who excel at sight-reading tasks, an improvisational skill, tend to have learned this skill independent of traditional forms of practice. Instead, sight-reading performance is acquired through deliberate practice of tasks with varying levels of complexity (Lehmann and Ericsson 1996). Similarly, users who have only used a technology to perform a specific task (e.g., using Microsoft PowerPoint to create slideshows) will struggle to adapt their knowledge of the technology to a related but different task (e.g., using Microsoft PowerPoint to create a poster), and will produce solutions that are anchored to their conceptualization of the technology rather than the task (e.g., producing a poster that has a landscape orientation and uses

bullets to demarcate key details). Together, IS Routinization and IS Improvisation allow users to move beyond competence and into mastery of an IS.¹⁶ The dimensions of IS Mastery are defined in Table 3.1 and illustrated in Figure 3.2.



Motivation and Creative IT Identity

A second component of creativity is motivation, or the will of the individual to persevere. Motivation is a complement to skill in that it serves to bolster individuals throughout the hard work of creating something new and valuable (Amabile 1983). Motivated individuals will endure the task without giving up or satisficing, and will produce artifacts that exhibit higher levels of creativity than would similarly skilled

¹⁶ IS Mastery, as we have described it above, has much in common with Computer Self-Efficacy. However, researchers have long distinguished between one's ability to perform and one's confidences in their ability to perform with the former enhancing to the latter, and both playing an important role in performance (Bandura 1982). For a discussion of the similarities and differences, see Appendix C.

individuals who lack motivation (Csikszentmihalyi 1996). Intrinsic motivation—the desire to persist in one’s work for the sake of the work itself (Amabile 1996; George 2007)—was first posited to have an influential role in creativity by Crutchfield (1962) who describes the creative man as one who engages in a difficult task because they are “‘caught’ by [a problem] and compelled to be immersed in it, and with achievement of a solution the creator is ‘by joy possessed’” (1962, p. 122). Thus, the role of intrinsic motivation in creativity is straightforward: “People will be most creative when they are primarily intrinsically motivated, by the interest, enjoyment, satisfaction, and challenge of the work itself” (Amabile et al. 1996, p. 1158). It is believed that this internal drive toward completion is essential to creative work because creative problems are ambiguous and the externalization of a creative solution is arduous. The variety of potential solutions inherent in creative problems increases the complexity and uncertainty of formulating a creative solution, thus increasing both the requisite effort to complete the task and the risk of failure. Intrinsic motivation provides individuals with the initial interest to engage in a difficult task, and the perseverance to see it through to completion (Csikszentmihalyi 1988; Lawler and Hall 1970). The positive impact of intrinsic motivation has been well-established in organizational research (Anderson et al. 2014) and is incorporated into the most influential theories of organizational innovation and employee creativity (Amabile 1988; Ford 1996; Scott and Bruce 1994; Unsworth 2001; Woodman et al. 1993).

Though intrinsic motivation stems from an individual’s inherent interest in an activity, the interest may derive from a variety of underlying psychological factors. *Identity* is one such factor that has received attention in creativity (Petkus 1996),

psychology (Markus and Wurf 1987) and management (Farmer et al. 2003) research. The concept of identity—meanings a person attributes to the self (Burke 1980) or one’s answer to the question “who am I?” (Carter and Grover 2015)—emerges from two differing perspectives on how meanings are derived (Stets and Burke 2000; Tierney 2015). The social psychology perspective (Turner et al. 1987), referred to as Social Identity Theory, operates at the collective level such that individuals derive meaning from their associations and group memberships. This perspective posits that individuals respond to the identity interrogative with the statement “I am where I belong,” and that their behavior is dictated by group norms and traditions. The sociology perspective (McCall and Simmons 1966; Stryker 1980), known as Identity Theory or Role Identity Theory, argues that individuals derive meaning from their roles: “I am what I do.” This perspective suggests that one’s view of their role(s) in a given setting determines their self-concept, and subsequently their behavior. Though these perspectives differ on the underlying mechanism by which individuals define themselves, they agree that identity is both a determinant of behavior—individuals act in accordance with who they believe themselves to be—and a source of motivation—individuals strive to limit discrepancies between how they act and who they are (Markus and Wurf 1987; Stets and Burke 2000). Building from Role Identity Theory, Petkus (1996) developed the notion of a creative identity which he describes as an “individual liking to see him/herself, and be seen by others, as someone who is creative” (1996, p. 192). According to role identity theory, individuals who adopt a creative identity are motivated to legitimate this identity by

performing their role in a way that is congruent with their concept of what it means to be creative.

Identity is an emerging and potentially powerful concept in IS research. Recent work by Carter and Grover (2015) argues that prior conceptualizations of ITs as material objects that serve only to reinforce extant social identities ignore the social, relational and representational ways in which modern systems are used to construct and express identity. In response to these evolutions of system use, they propose the concept of IT Identity, which they define as “the extent to which a person views use of an IT as integral to his or her sense of self” (Carter and Grover 2015, p. 938). Consistent with prior identity theories, they propose a recursive view of IT Identity whereby experiences influence identity, identity influences behavior and behaviors alter experiences such that the features of an IS and a user’s experience of those features will, through usage, lead to the formation of an IT identity—exhibited by the emotional energy drawn from use of the IT, the user’s dependence on the IT and their relatedness to the IT. Once established, an individual’s IT Identity will alter their usage behavior and their experience of usage. By way of example, they offer the following: “someone who views Adobe Photoshop® as integral to the self, verifies the identity when images that result from interacting with the software’s feature set match the level of personal creativity s/he claims as an individual” (Carter and Grover 2015, pp. 933–934).

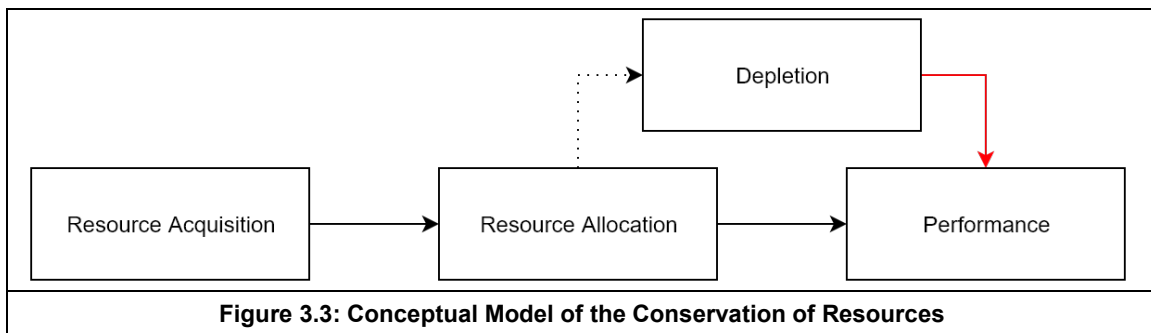
As an extension of their logic and integration of research on Creative Identities, we propose the concept of Creative IT Identity which we define as *the extent to which an individual views creative expression with an IT as integral to his or her sense of self*.

Individuals with a Creative IT Identity would find enjoyment in using ITs to perform creative tasks. Because this identity may also have social components, these users may be driven to both use ITs for creative tasks and use ITs in a way that may be seen as creative. For example, a user with a Creative IT Identity who is using Adobe Photoshop® to design marketing material will be motivated by a need to verify their identity but this drive may result in either the achievement of a creative outcome or usage patterns (i.e., use of certain features or techniques) that the user's peers may deem creative, or both. Thus, the concept of a Creative IT Identity is intended to capture the evolving role technologies play not only as tools for engaging in creative tasks but also as an extension of the user's creative identity. In this way, the use of an IT as an extension and expression of an individual's identity will motivate the user to persevere through difficulties they may encounter during the externalization of their ideas as they strive to resolve discrepancies that arise between their experience with the IS and their chosen identity.

Conservation of Resources

In the above sections, we argue that the externalization of creative ideas is an uncertain and effortful task, and that individuals who enter this phase of the creative process with the requisite resources (i.e., skill and will) are better able to manage any difficulties they may face and better able to exploit whatever creative prompts may arise. Though Amabile's componential model of creativity predicts that motivation and skill will enhance creative output, it is agnostic about the mechanisms by which these resources prepare users for the hard work of creativity (Amabile 1988). To explain the link between creative performance and these resources we turn to psychological theories

of effort-contingent behavior. Specifically, we adopt a conservation of resources perspective to show how IT-specific resources such as IS Mastery and Creative IT Identity prepare users for the task and improve resource conservation during the task, thus ensuring the successful marshalling of cognitive resources toward creative ends. This perspective, illustrated in Figure 3.4, provides a framework for understanding how the acquisition of technology-specific resources (i.e., IS Mastery, Creative IT Identity) enhances resource allocation and delays depletion, thus improving creative performance.



COR Theory is a motivation theory of resource management, cognitive impairment and performance (Hobfoll 1989, 2002). COR contends that cognitive function and well-being are dependent upon a finite supply of psychological resources. These resources may include anything of value that helps a person achieve their goals (Halbesleben et al. 2014). Resources are typically categorized as object (i.e., tangible goods such as homes or automobiles), condition (i.e., states of being such as married or employed), personal (i.e., individual characteristics including skills and abilities) or energy resources (i.e., leverageable endowments such as time or money) (Hobfoll et al. 2018). Resources may play a fortifying (Sonenshein and Dholakia 2011) or optimizing (ten Brummelhuis and Bakker 2012; Grawitch et al. 2010) role. That is, users who have

acquired an abundance of resources are better prepared for tasks that might consume resources; however, abundance alone does not guard against excessive resource loss because “it is not necessarily the one with the most resources that thrives but the one that is best able to allocate those resources” who is most capable of navigating demanding tasks (Halbesleben et al. 2014, p. 1339). In this way, COR shows how performance is driven by the need to conserve resources. Just as organizations make decisions based on a finite supply of resources (March 1991; Wernerfelt 1984), individuals choose to engage in or avoid behaviors according to the availability of resources needed to perform the task. Thus, a COR perspective on creative performance suggests that performance on a creative task depends on an individual’s reservoir of creative resources (acquisition) and their ability to efficiently deploy those resources (allocation) in a way that both avoids exhaustion (depletion) and ensures sufficient resources are devoted to the creative task (performance). These relationships are illustrated in Figure 3.3.

A key corollary of COR is that those who have acquired more resources are less vulnerable to resource loss and better positioned to exploit those resources in service to the creative task (Hobfoll et al. 2018). Two important assumptions of COR theory support this: “if people who possess resources do encounter stressful situations, then they are better equipped to deal with stressors” and “people with more resources are less negatively affected when they face resource drains because they possess substitute resources” (ten Brummelhuis and Bakker 2012, p. 547). As stated above, COR maintains that the loss—actual or perceived—of resources is inherently stressful. To avoid this condition, individuals can acquire resources that prevent or delay depletion. Those who

have a wealth of task-relevant resources are fortified for the task in that they simply have more resources available to devote to the task and to stave off the effects of resource depletion. Specifically, individuals are fortified against depletion when they acquire new skills, enhance existing skills and develop confidence in their ability to perform various tasks (ten Brummelhuis and Bakker 2012; Hobfoll et al. 1990, 2018; Kanfer et al. 2017; Muraven and Baumeister 2000). For example, a meta-analysis of core self-evaluations (CSE), a composite factor of self-reported self-esteem, locus of control and emotional stability, found that high levels of CSE are related to lower levels of avoidance and higher levels of problem-solving coping (Kammeyer-Mueller et al. 2009). Thus, those who have acquired IT-centric resources such as IS Mastery and Creative IT Identity will be better equipped to meet the demands of IS-mediated creative tasks.

Despite the value of acquired resources, the finite nature of those resources suggests that resource loss is unlikely to be uniform, and that those who are more efficient or effective in their allocation of resources will be best positioned to achieve their goals. Because cognitive resources are consumed during demanding tasks, individuals endeavor to guard against resource loss by employing conservation strategies (Hobfoll 2001, 2002). Two common strategies are avoidance and automaticity. Avoidance strategies adopt a cost-benefit approach to a task such that decisions or actions deemed too costly are avoided (Payne 1982). Baumeister et al. (Baumeister et al. 2000) liken this phenomenon to that of a fatigued athlete who no longer chases balls they believe to be out of reach. This tradeoff between effort and performance helps individuals achieve an acceptable level of performance while avoiding the unpleasant experience of

depletion. Alternatively, an individual may rely on automatic processing as a means of conserving resources (Bargh 1989). For example, individuals may exploit domain skills such as goal-directed cognitive scripts and/or routinized behavior to automate well-practiced portions of a creative task thereby conserving resources for other more demanding portions of the exercise (Ericsson et al. 1993). Users who have access to knowledge, abilities or strategies that enhance resource efficiency or effectiveness will be better able to avoid depletion by more efficiently allocating resources during the task. Conversely, individuals who lack these resources are more likely to experience resource exhaustion.

Finally, a key principle of COR theory is that individuals enter a defensive posture when their resources are exhausted (Hobfoll et al. 2018). Like physical effort that saps energy, mental effort is believed to consume cognitive resources and to gradually lead to a form of depletion (Baumeister et al. 1998) or psychic impairment (Hobfoll 2002). Researchers have found that tasks which require focus, emotional energy and time consume resources more quickly than less engaging work (Halbesleben et al. 2014), and creativity researchers have found that creative tasks are resource-hungry in that individuals depleted prior to the task tend to be less creative and those depleted by the creative task tend to exhibit lower levels of performance on subsequent tasks (Harrison and Wagner 2016; Tang et al. 2017). Though there are no direct indicators of depletion, it has been associated with a variety of maladaptive behaviors such as lack of self-control (Baumeister et al. 1998) and poor motivation (Kanfer et al. 2017). In the context of creativity, depletion effects are likely to present in the form of depletable indicators of

motivation and domain skill (Amabile 1988, 1998). Creativity researchers have identified two such indicators—goal commitment and perceived cognitive effort—that are important predictors of performance on creative tasks (Shalley et al. 1987). COR researchers have shown that these factors are sensitive to depletion effects. In fact, Walsh (2014) found that individuals depleted by a task tend to show lower levels of commitment to their work. Also, Johnson (2008) has found that as cognitive resources become exhausted, individuals tend to find their work more difficult. These studies show that indicators of motivation (i.e., goal commitment) and domain skill (i.e., perceived cognitive effort) are both predictive of creative performance and adversely affected by resource exhaustion, suggesting that as cognitive resources are used up during a creative task, individuals are likely to find the task more difficult and to be less committed to the goal of creativity than would be those who avoid depletion through the efficient allocation of resources.

Conservation of Resources in Information Systems

As ISs have become increasingly common mediators for information processing and communication tasks, evidence has emerged that the use of an IS will affect an individual's store of resources available during a task. First, using an IS may consume resources if the IS acts as an impediment between the user and the task. Recent research by Ayyagari et al. (2011) shows that when the characteristics of a technology and the demands of a job are in misalignment, employees experience resource depletion through a form of strain called technostress. Technostress is a “state of mental and physiological arousal observed in certain employees who are heavily dependent on computers in their

work” (Arnetz and Wiholm 1997, p. 36) that results from an individual’s inability to cope with the use of constantly evolving technologies (Ragu-Nathan et al. 2008). To deal with these stressors, employees consume cognitive resources which would have otherwise been directed to performance of the work task. Second, when a tool is properly aligned with the intended task, or the user is skilled in the application of the technology, the user will feel that they have more resources at their disposal for the task (Benlian 2015; Goodhue 1995). Thus, acquiring mastery of an IS prepares users for tasks that require those resources. Finally, users may develop IS-centric skills that improve their allocation of resources during a task. For example, Cognitive Absorption refers to a state of deep engagement with an IS that is exhibited by a feeling of being in control of the technology (Agarwal and Karahanna 2000). Users who experience Cognitive Absorption during a task will find that the “lower cognitive burden imposed by a technology frees up attentional resources to focus on other [aspects of the task]” (Agarwal and Karahanna 2000, p. 675). In this way, the technology and the user’s relationship with the technology may serve to fortify, conserve or consume an individual’s cognitive resources, and thus influence their ability to successfully externalize their creative ideas through an IS.

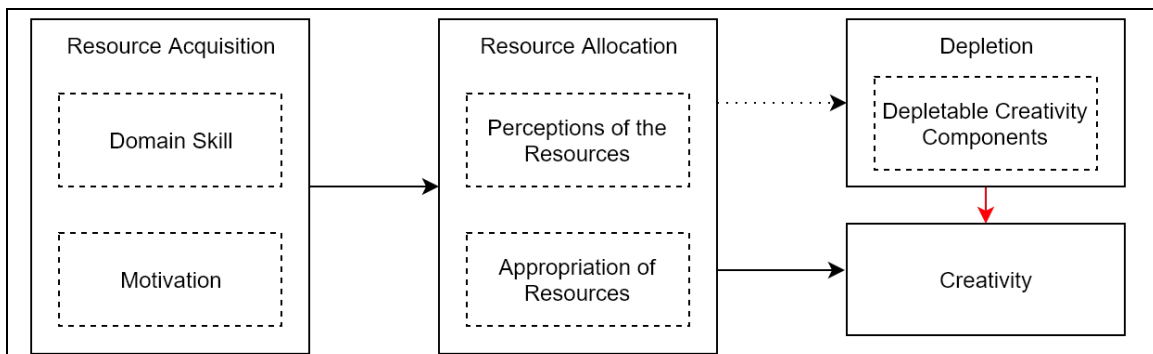


Figure 3.4: Conceptual Model of Creativity and the Conservation of Resources

In summary, individual creativity—the production of novel and useful solutions to organizational problems—is a complex process of concretizing creative ideas into creative artifacts. This elaboration of ideas requires motivation and skill as individual employees struggle to work out their ideas in the syntax of their domain. Increasingly, these tasks require technology tools that are essential conduits of creative work. Thus, creativity will be determined by the employee’s store of creativity-relevant IS-centric resources (i.e., IS Mastery and Creative IT Identity) and the efficiency with which they deploy those resources during the creative task. Employees who develop a mastery of these tools will not only face fewer challenges in faithfully representing their ideas in a digital space but will also have opportunities to exploit the affordances these tools offer and move beyond their prototypic concept. Likewise, users who develop a synergistic relationship with their tools such that performing creative tasks with the IS becomes a means for verifying their identity, will be better motivated to persevere through any difficulties they may encounter during the task. Table 3.2 further summarizes an integration of the Componential View of Creativity and the Conservation of Resources Theory.

Table 3.2: Integrating a Componential View with Conservation of Resources			
	Acquisition	Allocation	Depletion
Motivation	Users with a Creative IT Identity will be eager to engage in opportunities to verify their identity.	Motivated users will find the creative task enjoyable, conserving resources that would otherwise be consumed by frustration with the task or technology.	As resources are exhausted, users will seek to avoid the stress of depletion by limiting their commitment to the goal of creativity.
Domain Skill	Users with IS Mastery will have greater access to the knowledge and skills needed to perform creative tasks with the IS.	Skilled users will conserve resources by using well-known time- and energy-saving technology features/routines.	As resources are exhausted, users will feel the lack the skill to perform creatively and will find the task more demanding

Research Model and Hypotheses

To structure our investigation of the acquisition, allocation and conservation of IS-centric resources in service to individual creativity, we develop a research model (Figure 3.5) which integrates these concepts into a task-technology-fit (TTF) perspective on system use and performance (Goodhue and Thompson 1995). This model allows us to investigate the influence IS-centric resources have on the development of creative artifacts. From this perspective, we hypothesize that the extent to which an individual will achieve creative performance will be determined by their acquisition of resources prior to the creative task, and their efficient allocation of those resources during the execution of the task.

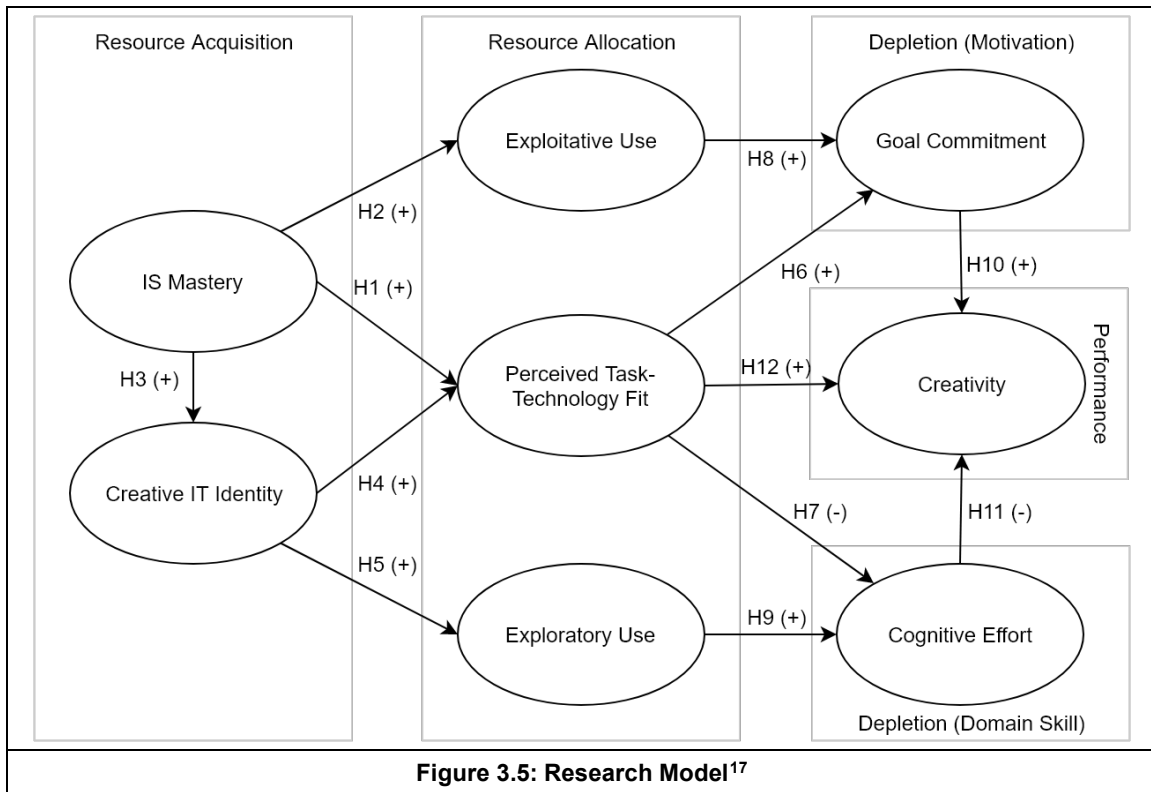


Figure 3.5: Research Model¹⁷

In the following sections, we explore how the acquisition of IS-specific domain-skill (IS Mastery) and motivation (Creative IT Identity) affect the allocation of resources as exhibited by the exploitation (Exploitative Use) and/or exploration (Exploratory Use) of IS features and the perception of fit between the technology and the creative task (Perceived TTF). Because these factors exemplify different levels of resource expenditure with exploitative behaviors and fit perceptions pointing to conservation, and exploratory behaviors indicating consumption, we then turn our focus to the ways in

¹⁷ In the research model, Exploratory Use is illustrated as representing a mechanism for allocating resources. This is appropriate in the context of this study where Exploratory Use is conceptualized as a resource allocation strategy. However, we wish to note that exploratory activities, both in system use and organizational strategy are knowledge building activities and are therefore likely to generate additional resources. Thus, in real-world settings, Exploratory Use is likely to serve as both resource allocation strategy and mechanism for resource acquisition with the effects of allocation occurring in the near-term and the effects of acquisition occurring at a more remote point (Gupta et al. 2006; March 1991)

which each manifest in depletion as suggested by either reduced commitment to being creative (Goal Commitment) or increased perceptions of task difficulty (Perceived Cognitive Effort). Though we have included depletion factors in our model, depletion is not guaranteed. Instead, depletion effects should only be apparent in the worsening of the componential indicators—perceived cognitive effort and goal commitment—as resources are consumed. That is, as users exhaust their store of resources, they will begin to experience the depletion effects of waning commitment and finding the task increasingly difficult. Finally, we discuss how allocation and depletion culminate in performance on the creative task (Creativity). Definitions for model constructs are presented in Table 3.3.

Table 3.3: Constructs and Definitions	
Construct	Definition
Creativity	Extent to which a solution to a task is novel and appropriate.
Perceived Task-Technology Fit	Extent to which the user perceives the system's capabilities to match the demands of a task.
Goal Commitment	Extent to which an individual is determined to try for a goal.
Perceived Cognitive Effort	Extent to which individuals perceive the task to be cognitively demanding.
Exploitative Use	Extent to which an individual uses a well-known set of features of an IT to perform his or her task.
Exploratory Use	Extent to which a user uses new system features to support his or her task.
IS Mastery	Extent to which individuals possess competence, improvisational skill and routinized knowledge with an IS.
Creative IT Identity	Extent to which an individual views creative expression with IT as integral to his or her sense of self.

Acquisition of IS-Specific Resources

Based on our review of the literature, we identified IS Mastery and Creative IT Identity as IS-centric resources will that fortify individuals for creative tasks. In the sections below, we explain how the acquisition of IS Mastery and Creative IT Identity affect the allocation of resources during a creative task.

IS Mastery

IS Mastery is an IS-specific skill that stretches a user's understanding of the capabilities of a technology. As ISs move away from simple task replication and automation and toward modular, extensible, flexible instantiations, a user's depth of knowledge can take many different forms (Burton-Jones and Grange 2013). For example, an employee who regularly uses Microsoft Excel to import data from a database, transpose rows and columns and then use lookup functions to import values from another worksheet, may have extensive knowledge of these features while having limited or non-existent knowledge of the full universe of Excel's capabilities. Another employee who, convinced of Excel's power and flexibility, may use it for a variety of work tasks ranging from simple (basic data collection) to complex (dynamic report generation) to unexpected (project management). Both users may report similar levels of expertise, experience and usage history while exhibiting different capabilities and usage patterns with Excel.

A consequence of the evolving and dynamic nature of ISs is that users may come to see the IS as applicable to a wider diversity of tasks. Just as a chef's knife has more uses in a professional's kitchen than in an amateur's, users who have mastered an IS will have developed a more robust understanding of the tool's capabilities and will likewise use the tool to perform tasks that novices deem to be incompatible. Because mastery is developed through the intentional practice of varied and increasingly difficult tasks within the IS (Ericsson et al. 1993), the user's view of the action potentials and appropriate applications of a given technology will expand in accordance with their mastery of a technology (Majchrzak and Markus 2012). Thus, users who have a higher

degree of IS Mastery are more likely to see the technology as a good fit for a wider diversity of tasks. Therefore, we hypothesize:

Hypothesis 1: The user's IS Mastery is positively related to the user's perception of fit between the creative task and the technology.

Mastery is a skill developed through deliberate practice that allows for the efficient deployment of actions in response to task stimuli. Researchers have shown that pianists achieve high levels of musical performance during novel (sight-reading) and creative (improvisation) scenarios by intentionally deploying routinized responses to specific prompts during the performance (Ericsson and Lehmann 1996; Sawyer 2012). That is, the pianist is able to play expertly *and* creatively because they have routinized portions of their performance, freeing their attention to scan for opportunities for creative expression (Aarts and Dijksterhuis 2000; Ericsson 1998). The novice lacks these practiced skills and must remain focused on their management of the instrument to the detriment of the creative task (Glăveanu 2012). These effects have been seen across a number of domains (Ericsson and Lehmann 1996), and they suggest that deliberate practice endows the expert with a set of competencies that, when exploited, automate the routine aspects of the task, freeing the performer to focus on the fidelity and creativity of their work.

A user who has mastered an IS will have a more diverse repertoire of exploitable routines to draw from during the performance of a creative task. As users attend training sessions or practice using an IS, they will develop a deeper understanding for how various features can be used and combined to accomplish different tasks. As actions

within the IS become ingrained, the user will be able to exploit these routines and perform their tasks more efficiently (Bala and Venkatesh 2016). This exploitation of a user's ingrained knowledge of an IS is known as exploitative use, and is defined as *the extent to which an individual uses a well-known set of features of an IT to perform his or her task* (Bala and Venkatesh 2016; Burton-Jones and Straub 2006). Users who have mastered an IS have ingrained knowledge of the technology's features, their function and how to use them to address a variety of task problems. During a creative task, these users will thus have ready access to a set of routinized and exploitable competencies (i.e., features) that automate portions of the task. As mastery increases, it is more likely that the user will exploit these routinized actions. Therefore, we hypothesize:

Hypothesis 2: The user's IS Mastery is positively related to the user's exploitative use of an IS

IS Mastery is developed through the deliberate practice of varied and increasingly difficult tasks with an IS. As users achieve competence in one aspect of the IS, they must move to ever more complex tasks in order to both deepen their competence with the IS and routinize its features (Ericsson et al. 1993). Also, to lessen the likelihood of entrenchment (Dane 2010), users must continue to apply their knowledge to increasingly diverse tasks (Ericsson 1998). Throughout the training, success and failure play important roles as successful applications of the IS indicate the need for more difficult tasks and failures indicate the need for greater refinement of skills. Over time, users develop an ingrained knowledge of the IS, its capabilities and the extent of their ability to successfully adapt the IS to a variety of tasks.

Creative identities follow a similar trajectory in that individuals who successfully perform creative acts gradually come to see themselves as creative individuals (Farmer et al. 2003; Petkus 1996; Tierney 2015). Though there is little direct evidence mastery-focused training enhances one's creative identity, there is tangential evidence that suggests the likelihood of the two developing in concert. For example, research on self-efficacy—a known correlate of identity (Stets and Burke 2000)—has shown that across a variety of disciplines, successfully completing increasingly difficult tasks has a strong positive relationship on both specific and general self-efficacy (Bandura 1982; Gist 1987; Gist et al. 1989; Marakas et al. 1998). Also research on creative self-efficacy indicates that improvements in task-relevant skills are associated with higher levels of creative self-efficacy suggesting that users who have spent time developing a greater aptitude with an IS (Compeau and Higgins 1995) would begin to see themselves as more capable of being creative with the IS. Also, leaders who see themselves as having a greater competency for leadership and have invested more time into the practice of leadership see themselves as having a more salient identity as a leader and as being more creative in their role as a leader (Lord and Hall 2005). Thus, we expect that as the user grows in mastery of an IS by successfully applying their skill to a wider array of problems, we expect they will increasingly see themselves as creative users of IT. Therefore, we hypothesize:

Hypothesis 3: The user's IS Mastery is positively related to the user's Creative IT Identity.

Creative IT Identity

Creative IT identity is a type of identity that is activated when individuals engage in creative tasks with IT. Identity is increasingly seen as an important factor in predicting performance on tasks. One's identities emerge from a reciprocal relationship between perceptions and behaviors called enactment, a concept central to an understanding of how identities, roles and behaviors interrelate and evolve over time (Stets and Burke 2000; Stryker and Serpe 1982). Identities are enacted (i.e., acted out) from definitions that an individual assigns to their role, their relationship with others and their environment (Stryker and Serpe 1982). Though identities are most commonly structured in relation to one's role, they also emerge from one's interaction with other actors—any person or object that is essential to the enactment of one's identity (Stryker and Serpe 1982). Behaviors flow from the definitions one assigns to the self and the other, and these emergent actions are “the product of a role-making process, initiated by expectations invoked in the process of defining situations but developing through a tentative, sometimes extremely subtle, probing interchange among actors that can reshape the form and content of the interaction” (Stryker and Serpe 1982, p. 204). That is, interactions between the self (i.e., the user) and the other (i.e., the IS) add new information that will influence an individual's identity, thereby altering subsequent interactions.

As definitions change, so to do expectations for the self *and* for the other (i.e., what they are capable of, how they should respond, etc.) (Carter and Grover 2015; Stryker and Serpe 1982). According to an object-based view of IT-centric identities (Carter and Grover 2015), individuals who view IT as an essential conduit of their

creativity will develop expectations for the technology that conform to this definition. That is, someone with a strong Creative IT Identity, would have gradually developed this identity through repeated enactment. A consequence of this gradual strengthening of one's Creative IT Identity is that they would come to see the material object by which they enact their identity—various ITs—as a functional, malleable and portable conduit of creativity that is well matched for the task of translating creative ideas into creative works. Therefore, we hypothesize:

Hypothesis 4: The user's Creative IT Identity is positively related to the user's perception of fit between the creative task and the technology.

Individuals who have a salient Creative IT Identity will engage in creative tasks differently from their peers, because they will feel a greater need to perform the task in a way that accords with and verifies their identity. Identities are enacted and verified over time and each subsequent successful creative endeavor further fortifies the creative identity (Carter and Grover 2015). As the identity becomes more salient, future opportunities to enact one's identity become an increasingly valuable source of self-esteem, self-efficacy and enjoyment (Stets and Burke 2000; Stryker and Serpe 1982); however, these opportunities are also endowed with internal and external expectations that dictate how the creative task is acted out. Though identities are individual, they are socially constructed. That is, the individual experiences the identity, but the identity is informed by the people and objects associated with the identity. These designations are reflexively applied to the person claiming the identity, creating behavioral expectations that drive action (Stryker and Serpe 1982). Thus, individuals with a Creative IT Identity

likely enjoy using IT to perform creative tasks while also feeling a need to perform tasks in ways that are congruent with their identity (i.e., creatively).

For those who see themselves as creative users of IT, their beliefs about how they should interact with an IS while performing a creative task will drive their actions during the task. One way in which users express their creativity while using an IS is through exploration. Exploratory use, defined here as *the extent to which a user uses new system features to support his or her task* (Ke et al. 2012), is an extra role behavior in which users try new features that may be unrelated to the focal task. Exploratory behaviors are uncertain, costly and are intrinsically motivated. That is, exploratory behaviors are undertaken for the benefit of the user (i.e., to improve knowledge or mastery of an IS) and may not necessarily improve performance on a given task. Ke et al. (2012) have shown that users who explore the features of an IS do so for normative and hedonic reasons. The culture of an organization or the internal values of a user can create normative pressures that encourage users to behave in a way that is consistent with those norms (Ke et al. 2012). For users with a Creative IT identity, they would see the task as an opportunity to verify their identity and would be motivated to use technology innovatively, exploring new features and testing the capabilities of the technology. Also, users who enjoy using ITs are more likely to explore the technology (Ke et al. 2012). Thus, users with a Creative IT Identity are more likely to derive enjoyment and confirmation from exploring the features of a technology. Therefore, we hypothesize:

Hypothesis 5: The user's Creative IT Identity is positively related to the user's exploratory use of an IS.

Allocation of IS-Specific Resources

Resource allocation is likely to have both indirect and direct effects on performance where the performance effects of allocation strategies will be mediated by increased/decreased depletion and the effect of a well-matched technology will directly affect creative performance. In the following sections we discuss these relationships and explain how the user's perception of TTF and their employment of Exploitative or Exploratory usage strategies might affect the extent to which they experience depletion effects—reduced commitment and increased difficulty—and their creative performance.

Task-Technology Fit

Individuals who perceive a match between their resources and the demands of a task are better able to conserve resources and are less likely to experience the strain of depletion. This contingency effect is commonly referred to as 'fit' and has been studied in the context of person-environment (P-E) fit (Edwards 1996), person-organization (PO) fit (Chatman 1989), cognitive fit (Vessey 1991; Vessey and Galletta 1991), strategic fit (Venkatraman and Camillus 1984) or task-technology fit (Goodhue 1995; Goodhue and Thompson 1995). Though fit has been defined in many ways (Drazin and Van de Ven 1985; Venkatraman 1989), COR researchers tend to define it as a match between resources and goals (Halbesleben et al. 2014). When there is a match between one's resources and goals, they are more efficient or face fewer difficulties in using their resources to achieve their goals. When fit is lacking, or misfit is high, individuals must expend additional resources to compensate for the incongruencies between resources and task demands (Goodhue 1995).

As users work within an IS to develop creative solutions, an on-going perceived match between one's technological tools and one's task requirements will conserve resources by making the task seem easier and more efficient. IS fit research in the context of individual use of an IS began with the work of Vessey and Galletta (1991) who found that individual performance on an IS-mediated task depends upon the IS's ability to produce outputs consistent with user's needs. Later researchers posited a more general effect whereby task performance depended on the extent to which the IS provides features that are supportive of the task goals (Goodhue and Thompson 1995; Zigurs and Buckland 1998). This theory, formalized as TTF theory, posits that a match between the characteristics of a technology and the requirements of a task improves task performance by making the task seem easier or more efficient (Goodhue and Thompson 1995). Though TTF Theory would suggest a direct effect on creativity (discussed below), a COR perspective would suggest that the perception of TTF, defined as *the extent to which the user perceives the system's capabilities to match the demands of a task* (Goodhue 1995; Jarupathirun and Zahedi 2007), conserves resources and delays resource exhaustion by reducing the need to allocate resources to resolving the misfit between the technology's capabilities and demands of the creative task (Edwards 1996). Thus, users who perceive a high level TTF would be more effective in their allocation of resources, staving off the adverse effects of resource depletion.

Users who avoid resource depletion tend to exhibit higher levels of commitment to task goals and tend to find the assigned tasks easier than those who have exhausted their available resources. First, goal commitment, defined as *the extent to which an*

individual is determined to try for a goal (Hollenbeck et al. 1989; Presslee et al. 2013), is likely to benefit from the perception of fit. In an organizational context, the perception of fit has been shown to lead to improved commitment to the organization and its goals. Greguras and Diefendorff (2009) found that individuals who feel they have the requisite resources for successfully performing their tasks indicate higher levels of commitment to the goals of their organization. Similarly, Cable and Judge (1996) found that employees who sense a congruence between their own personalities and the characteristics of their organization are more committed to it. In a technology context, TTF has been shown to moderate the relationship between computer self-efficacy and performance (Strong et al. 2006). This suggests that TTF increases the perception of the likelihood of attaining a successful outcome with the IS, an antecedent of goal commitment (Locke et al. 1988). Second, TTF is likely to decrease the perception that the task requires much cognitive effort, here defined as the *extent to which individuals perceive the task to be cognitively demanding* (Perera 2000; Todd and Benbasat 1999; Wang and Benbasat 2009). Goodhue explicitly links TTF and the effort-accuracy framework (Payne 1982) arguing that “task-technology fit and cognitive cost/benefit perspectives are both based on the same basic propositions” and that users “will be frustrated in their efforts” when fit is lacking (1995, pp. 1830–1831). Similarly, Todd and Benbasat (1999) argue that in the context of decision support systems (DSS), a misfit between the task and the capabilities of the DSS makes the decision task more seem restrictive and difficult. Thus, we expect that users who perceive a fit between the technology and the creative task will exhibit a greater

commitment to the goals of the task and will find the task less difficult than their peers who find the technology to be a poor match for the task. Therefore, we hypothesize:

Hypothesis 6: The user's perception of fit between the creative task and the technology is positively related to goal commitment.

Hypothesis 7: The user's perception of fit between the creative task and the technology is negatively related to perceived cognitive effort.

Exploitation and Exploration

In COR, fear of resource loss motivates individuals to conserve resources because resource pools are finite and poor allocation decisions are equivalent to lost opportunities (Halbesleben et al. 2014). To conserve resources, individuals adopt allocation strategies that seek to find a balance between achieving the highest level of performance and allocating the fewest possible resources. At the organizational level, this phenomenon is similar to innovation strategies of exploitation and exploration where exploitation refers to “the refinement and extension of existing competences, technologies, and paradigms” and “exploration is experimentation with new alternatives” (March 1991, p. 85).

Exploitation and exploration are mutually exclusive strategies that are intended to optimize the allocation of an organization's finite resources (Gupta et al. 2006; March 1991). In general, both strategies seek to address the need to organizational innovation, but they differ in that the benefits of exploration are less certain and more remote while exploitation tends to hew to the status quo, producing more immediate but more incremental improvements. At an individual level, this process unfolds within the individual's usage behaviors in that Exploitative Use and Exploratory Use are competing

strategies that differ in their goal orientation, conservation of resources and performance benefits.

Exploitative Use is the use of a set of well-known or well-practiced system features (Bala and Venkatesh 2016). Just as an organization might exploit existing routines and capabilities to gain an immediate and predictable advantage while limiting the risk of resource misallocation, individual users might appropriate well-known (i.e. the user knows the feature exists, how to access it and what it does) features to automate portions of a task and achieve a more certain outcome. These features are deployed more easily “because employees leverage a set of features that they learn from training or from others” (Bala and Venkatesh 2016, p. 167). Thus, Exploitative Use leverages practiced system routines to efficiently and effectively simplify the creative task and reduce the uncertainty of achieving a creative outcome. As the goal seems less ambiguous, users are better able to make appropriate allocation decisions, thereby increasing their commitment to the goal. Researchers have shown that this type of usage, which is akin to the use of heuristics in complex problem-solving (Huber and Neale 1986), serves as a reliable shortcut, increasing goal commitment by improving the user’s sense that the goal is attainable (Hollenbeck et al. 1989; Klein et al. 1999). Therefore, we hypothesize:

Hypothesis 8: The user’s exploitative use of an IS is positively related goal commitment.

Exploratory Use is a learning behavior akin to deliberate practice in which users explore new feature of the IS. Unlike exploitation, exploration has a long-term focus of developing new competencies to face challenges that may or may not be presently

apparent. As such, exploration tends to be a riskier allocation strategy because the payoff is often more remote from the investment than would be expected of exploitation activities (March 1991). Thus, individuals engage in exploration activities as a means of supplementing their present set of competencies (Ericsson and Lehmann 1996). In so doing, they will try features that have unknown (to the user) consequences and may be inappropriate for the task or conflict with the user's intentions. While leading to the acquisition of potentially valuable knowledge, exploring new features is expensive in that it costs the user time and effort to find, try and adapt new features to a specific task. When the task is also demanding, the exploration of the tool and the execution of the task are in competition for the user's limited store of resources. To avoid strain, the user will make some sacrifice in the allocation of their resources either by curtailing their exploration of the technology or by satisficing in the creative task (Hobfoll 2002). Further, exploring the technology will divide the user's attention between the task and the technology (Ericsson 1999). As the user alternates their focus from the task to the technology, they will consume important resources, increasing the perception that the task is difficult. Thus, as users invest time and energy exploring the technology they will perceive the task to require increasing levels of cognitive effort. Therefore, we hypothesize:

Hypothesis 9: The user's exploratory use of an IS is positively related to perceived cognitive effort.

Resource Depletion and Creative Performance

According to COR, both depletion and performance are determined by allocation in that the user's ability to conserve resources inhibits the onset of depletion and ensures

the efficient and effective use of resources in pursuit of a goal (i.e., creativity) (Halbesleben et al. 2014). In the sections below, we explain the role of depletion in creative tasks by showing how perceived cognitive effort and goal commitment affect creative performance.

As discussed above, creativity is the working out of creative ideas. To that end, users who are best able to marshal their cognitive (i.e. skill) and motivational (i.e., will) resources during the task will avoid depletion and will be more likely to produce creative artifacts. According to COR, both depletion and performance are determined by allocation in that the user's ability to conserve resources inhibits the onset of depletion and ensures the efficient and effective use of resources in pursuit of a goal (i.e., creativity) (Halbesleben et al. 2014). Additionally, stress research emphasizes the negative consequences of depletion for task performance and has shown that depleted individuals are more likely to opt for 'good enough' solutions (Hobfoll 2011). Therefore, resource allocation is likely to have both direct and indirect effects on performance where the performance effects of allocation strategies (i.e., Exploitative and Exploratory Use) will be mediated by increased/decreased depletion and effects of task demands (i.e., Task-Technology Fit) will directly affect creative performance.

Goal Commitment

Goal commitment refers to one's general "attachment to or determination to reach a goal, regardless of the goal's origin" (Locke et al. 1988, p. 24). The concept of goal commitment is an outgrowth of goal-setting theory which argues that set-goals are predictive of performance (Hollenbeck and Klein 1987; Locke 1968; Locke et al. 1988).

A fundamental premise of goal-setting theory is that performance increases as goal difficulty and goal specificity increases. That is, hard goals produce higher performance than easy goals and specific goals produce higher performance than ambiguous goals such as “do your best” (Locke 1968). Locke argues that these propositions hold only so long as the subject remains committed to the goal. In fact, commitment likely plays “an important role in determining how easily [individuals] will give up in the face of difficulty” (1968, p. 186). Later works by Hollenbeck and Klein (1987) and Locke et al., (1988) specifically theorize the role of commitment, arguing relationship between goals and performance is strongest when people are most committed to their goals (Locke and Latham 2002).

Research on goal commitment has consistently found a positive relationship between commitment and performance. In a meta-analysis of 83 studies, Klein et al., (1999) found a significant mean-corrected effect size between goal commitment and performance of .23. More recently, in a study of the effects of commitment to a complex business task, Seijts and Latham (2011) found a strong positive effect of commitment on performance where participants who were most committed to the task performed better than other participants. Though intrinsic motivation has long been posited to be a key component of creativity (Amabile 1983), there has been little goal commitment research in the context of creative performance. However, researchers have shown that goal-setting is an important factor in creative performance where individuals given a specific and difficult goal tend to produce more creative works (Shalley 1991, 1995). As

discussed above, the importance of goal-setting implies the value of goal commitment, therefore we hypothesize:

Hypothesis 10: The user's commitment to the task is positively related to creativity.

Cognitive Effort

Cognitive effort represents the mental demands of a task where more difficult tasks are perceived to require more cognitive effort (Blohm et al. 2016). Researchers have long acknowledge that individuals often settle for 'good enough' solutions when the cognitive costs of doing better become too great (Simon 1955). This phenomenon is referred to as satisficing and in decision-making research the costs of deciding—called cognitive effort—are an essential component of the effort-accuracy framework and predictor of decision performance (Payne 1982; Payne and Bettman 1992). Payne's framework suggests that individuals make decisions in such a way as to maximize accuracy while minimizing effort. When these two goals are in conflict, users adopt strategies that balance the trade-off between the two. That is, as the cognitive effort required to achieve a better solution increases, the individual's willingness to accept a less-than-optimal outcome increases. Researchers have illustrated this effect in several ways. Todd and Benbasat (Todd and Benbasat 1994) found that when effort reducing decision aids are present, individuals are more likely to employ more complex choice strategies. A follow-up study similarly found that users are biased toward low-effort solutions and that they will "employ a particular strategy if the decision aid makes it easier to apply relative to competing alternative strategies" (Todd and Benbasat 1999, p. 371). In the context of creative performance, Roskes et al. (2012) found that, all else

equal, individuals who find creativity an effortful endeavor (i.e., requiring high cognitive effort) tend to give up more quickly and exhibit lower levels of creativity. Therefore, we hypothesize:

Hypothesis 11: The user's perception of high cognitive effort is negatively related to creativity.

Creative Performance

Goodhue and Thompson's (1995) TTF theory is useful in developing a theoretical understanding of how an IS may directly affect individual performance of creative tasks. TTF posits that both usage of a technology and task performance with the technology are predicated on the user's perception of congruence between the characteristics of the task and technology. Thus users who sense an incompatibility between the demands of the task and the capabilities of the technology will be less likely to use the tool and less efficient in their use of the tool (Goodhue 1995; Goodhue and Thompson 1995). For example, if a task requires certain activities such as summing numbers or manipulating images and the tool lacks these features or is limited in the extent to which it can perform these tasks, the user will perceive a lack of fit between the requirements of the task and the technology intended to support the task. Likewise, When the perception that the tool is incommensurate with the task, the user is dissuaded from using the tool—because it is not believed to be useful—thus negating any performance benefits that might be incurred from the use of automation or productivity tools.

Goodhue and Thompson (1995) suggest that the negative effects associated with poor fit may be accentuated when the task is complex. This is consistent with the findings

of technostress research which found that a lack of fit between the demands of a task and the available resources to complete the task increases strain (Ragu-Nathan et al. 2008), stress (Ayyagari et al. 2011) and exhaustion (Chen et al. 2009). The stress literature postulates that increased strain results from users deploying excess resources as they struggle to perform a task with a tool, such as an IS, that is incongruent with the requirements of that task (Dishaw and Strong 1999). In the context of creative tasks—tasks that are complex and heuristic, and therefore resource-greedy (Amabile 1988; Harrison and Wagner 2016)—the demands of shifting resources back and forth from controlling the tool to performing the task deplete an individual more quickly than if they were able to allocate resources to one activity and not the other.

While we have argued negatively, we believe that the effects of a well-fitting technology will be consistent across conditions of high and low fit. That is, where poor fit consumes resources that would otherwise support the task, good fit preserves resources for performance of the task. Specifically, we believe that perceived TTF increases creativity through the alignment of tool and task. An individual who perceives a greater fit between the creative task and the technology will expend fewer resources—energy, effort, time—as they coordinate their actions within the tool to perform the assigned task. Similarly, individuals who detect a low degree of task-technology fit will struggle as they cope with demands of a task that requires affordances they perceive to be absent from the technology. These users will devote more attention to the use of the technology leaving fewer cognitive resources for execution of the creative task. Therefore, we hypothesize:

Hypothesis 12: The user's perception of fit between the task and the technology is positively related to creativity.

Method

Research Design

We conducted an observational study to test our research model. An observational study is similar to an experiment in which researchers observe subjects participating in a task, but observational studies lack controlled manipulations. Observational studies also share similarities with field studies in that the goal of the study is to observe the participant's actions as they perform typical work tasks. In both observational and field studies, researchers test hypotheses by measuring the naturally occurring variation among variables (Shadish et al. 2002). Our study differs slightly from a true field study in that our participants perform a normal work task but do so in a controlled technological environment. A true field study would have offered greater generalizability but may also shroud the effect of IS Mastery among the numerous other factors that influence creative performance (Berkowitz and Donnerstein 1982). As such, this structure was necessary to isolate the effect that a user's mastery of an IS has on their ability to conserve and efficiently allocate resources during a creative task.

The participants in this study were undergraduate business students at a large public university in the southeast. The use of student samples is often criticized with many researchers arguing that while the findings may not be wrong, "the findings based on students are always suspect" (Wells 1993, p. 492). However, these criticisms are better directed at convenience samples, rather than student samples, *per se*. Convenience samples are those in which the sample population is selected for reasons such as

accessibility or willingness whereas theoretical samples are chosen for their representativeness of some population of interest. While our sample is comprised entirely of students from a single course, the sample was chosen for its representativeness and not for its accessibility. As mentioned above, our interest is in the user's mastery of an IS and its relationship with creative performance. Though we believe mastery of a tool is essential for creativity, we acknowledge that other relevant skills may compensate for a lack in technical ability thus masking any mastery effects. To highlight the role of IS Mastery in creative performance, we sought participants who had varying levels of skill in the chosen technology, but fewer other skills that might influence their performance on the task. The students in our sample were in the process of completing their core requirements for the business school and had not yet begun their discipline-specific coursework. Also, because these students were sophomores and juniors, it is unlikely they had acquired much relevant work experiences. Additionally, the purpose of the course from which students were recruited is to convey basic knowledge of the Microsoft Office suite of applications with the first third of the semester devoted to the use of Microsoft PowerPoint—the technology used in our study. Therefore, our use of students who had been trained in the use of the focal technology and who had not yet acquired other domain-specific skills is appropriate in the context of this study.

Creative Task

Participants in our study were asked to develop a creative multimedia advertisement using only the features available in Microsoft PowerPoint 2016. We chose PowerPoint as the focal technology because it is widely used, it can be used to perform a

wide variety of tasks, it is complex enough to produce high variation in mastery and, of the applications in the Microsoft Office productivity suite, it is most likely to be associated with creative design tasks. The advertisement was meant to serve as a creative solution for a business problem we designed in conjunction with a local marketing firm. The firm represents many different types of businesses with a variety of marketing needs. The collaborating firm helped us narrow down the pool of potential prompts to three businesses—two restaurants and a miniature golf location. We selected a barbeque restaurant for its generality—barbeque is a popular cuisine in the southeastern United States—and for its low profile—the restaurant is a small, privately owned restaurant more than 100 miles from the data collection site. The restaurant was described to the participants as a “barbecue joint with serious food at not so serious prices” that is “seeking to develop a social media campaign that targets families and enhances the restaurant’s reputation as a neighborhood destination.”

Before beginning the task, all participants watched a three-minute video which described the restaurant, their need for a creative solution to their business problem and the tools the students could use to complete the task. The video also encouraged students to be as creative as possible (Egan 2005). After the video concluded, participants were given instructions for accessing a cloud-based, virtual instance of Microsoft PowerPoint for PC. This Citrix-based instance of PowerPoint ensured that all students were using the same version of PowerPoint, had access to the same resources (i.e., the instance ran on a version of Windows 10 Professional that was standardized across all users) and were unable to incorporate outside resources (i.e., the copy and paste functions were disabled

between the user's computer and the PowerPoint instance). Once connected to PowerPoint, each student was given a PowerPoint document containing two slides. The first slide relayed information about the restaurant (e.g., a logo, a brief description and two on-going promotions) and reiterated the business problem and instructions for completing the task. The second slide was blank and would serve as the canvas for the student's solution. Participants were told to take as much time and use as many PowerPoint features as needed to complete the task, but they were instructed to limit their solution to a single slide.

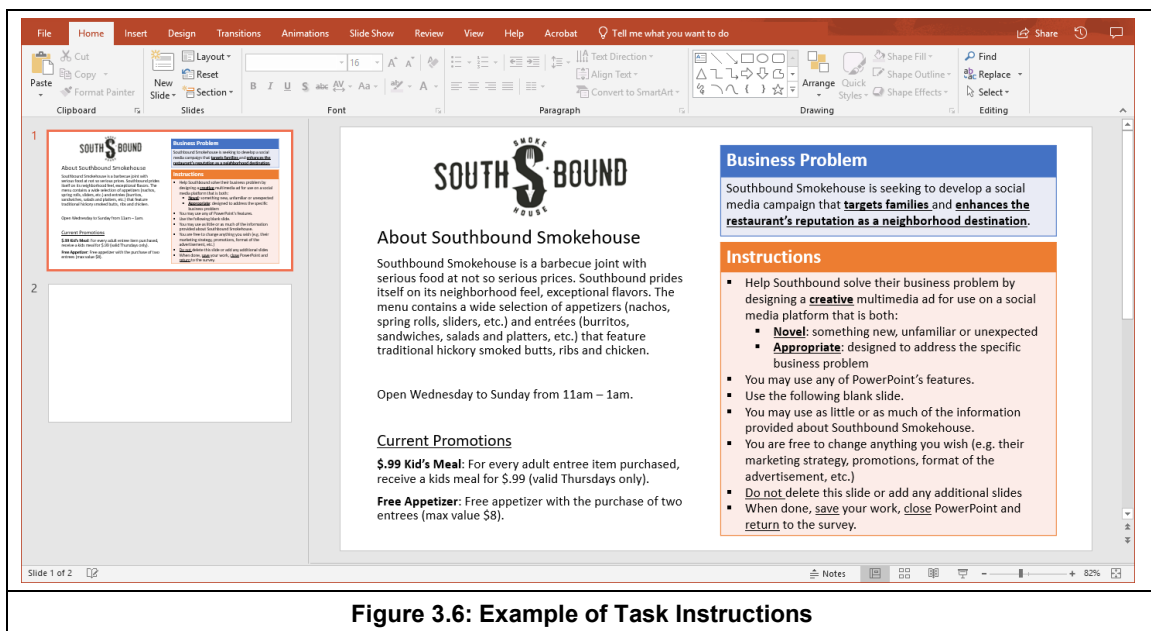


Figure 3.6: Example of Task Instructions

Data Collection

The data collection procedures discussed below were refined over the course of multiple pretests and pilot tests. At the outset, we conducted a pretest with a small group of students (n=4) from the target population to assess the clarity of the items, the flow of the procedure and the task instructions. These students talked openly as they worked

through the creative task and offered feedback as they worked. We then conducted a pilot test with upper-level business students (n=49) to assess construct validity and the further refine the experimental procedure. In both the pretest and the pilot, the participants completed the pre-task survey, creative task and post-task survey in a single session. After analyzing the results from the pilot and discussing the procedure with the members of the research team, we separated the pre-task survey from the task to help guard against method bias and to limit any fatigue effects. In a second pilot with the target population (n=69), the students were introduced to the task and immediately began work on the creative task. Upon completion of the task, they began the post-task survey. Twenty-four hours after leaving the experimental setting, students were emailed a link to complete the post-task survey. In the pretest and pilots one and two, the students used their own computers to complete the creative task in a laboratory setting. After analyzing the data from the second pilot, the research team discovered that the Windows and Apple versions of Microsoft PowerPoint differ greatly in their features and capabilities. To correct this disparity in a final pilot test (n=49), the procedure was moved to a Citrix instance that would standardize the experience for all students. Also, to increase temporal separation, students were asked to complete the pre-task survey 7-14 days prior to completing the creative task. Throughout all pretests and pilot the research team revised the instructions and the introductory content to ensure consistency and clarity. No changes were made between the final pilot and the full study.

Data to test our hypotheses were collected from undergraduate students enrolled in an introductory course on Microsoft Office and from creative professionals who

evaluated the student's work. To encourage students to participate and to be as creative as possible, they were offered three incentives. First, all students were offered extra credit. Second, all students were entered into a raffle to win one of ten \$100 Amazon.com gift cards. To ensure this incentive was aligned with the goal (Hennessey and Amabile 2010), students were informed that submissions deemed to exhibit above average creativity would be given a second entry in to the raffle. Third, the marketing firm that provided the prompt agreed to review the submissions and make contract opportunities available to the students with the most creative solutions.

Data were collected in three phases. We opted for multiple phases both as a safeguard against method bias and to reduce any fatigue due to the length of the instrument. During the first phase, students were invited to participate in the study via email solicitation (n=479). Respondents completed an initial online survey containing items to assess IS Mastery, Creative IT Identity and Creative Self-Efficacy, and a registration question that allowed them to select a date 7-14 days in the future at which they would like to complete the study. Two hundred sixty-five students completed phase 1 (55% response rate). For the second phase, participants were contacted via email approximately 30 minutes prior to their selected start time and given instructions for accessing the creative task described above. Once complete, participants uploaded their solution as a response to an online survey question and then completed the post-task questionnaire which measured Exploitative Use, Exploratory Use, Perceived Task-Technology Fit, Goal Commitment and Perceived Cognitive Effort. Phase 2 lasted seven days and 214 students participated (81% response rate). Upon completion of Phase 2, all

solutions were downloaded, converted into videos and uploaded to a custom website that had been designed to standardize the process of rating the students' work. Once uploaded, Phase 3 began. Each rater was given a unique login to access the site where they could see all submissions on a single page (Amabile 1982) but could only rate one submission at a time. The raters could watch the video of the presentation and could download the work file, but they had no access to any other information about the submission's author or their responses to survey questions. The raters worked independently and could only see their ratings for each submission.

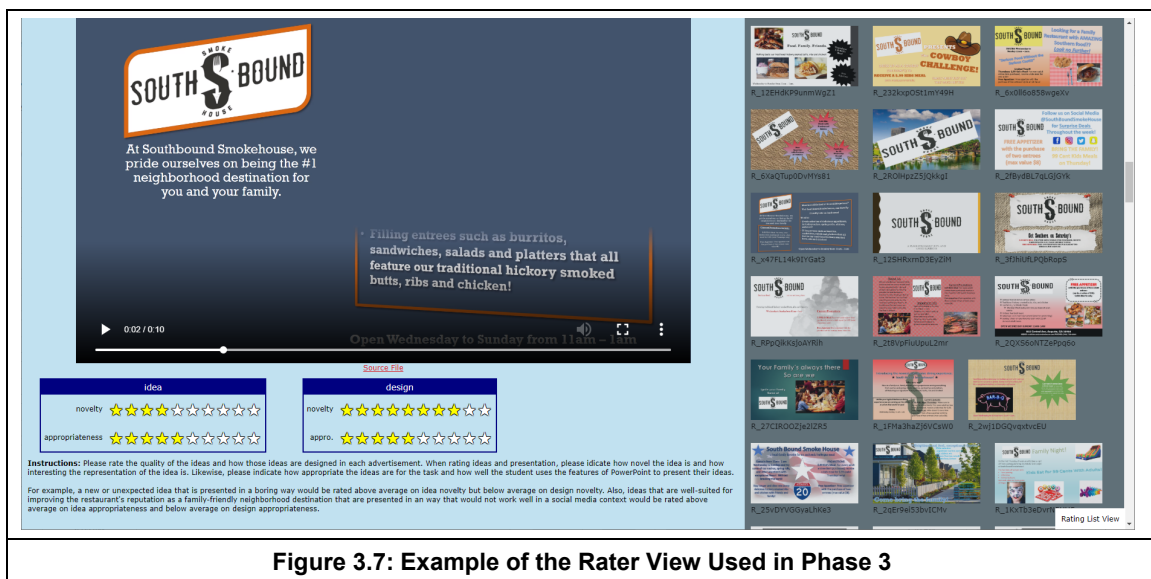


Figure 3.7: Example of the Rater View Used in Phase 3

Measures

Research variables were measured with pre-validated instruments where available. In the event that existing scales were insufficient, new scales were created following the guidelines set forth by MacKenzie et al. (2011). Unless otherwise indicated, items were measured on a 7-point Likert scale. *Creative IT Identity* was

adapted from Farmer et al.'s (2003) measure for creative role identity and Luhtanen and Crocker's (1992) measure of social identity (E. Randel and Jaussi 2003; Hass et al. 2016). Sample items include "I often think about being creative with information technology" and "My ability to be creative with information technology is an important part of who I am." *Exploitative Use* was measured using five items developed by Bala and Venkatesh (2016), and sample items include "I used features that I've used often to perform other tasks" and "I used features that I knew well from prior experience." *Exploratory Use* was adapted from Ke et al.'s (2012) measure and included items "I tried to use new features that helped me complete my task" and "I experimented with new features that helped me perform my assigned task." Both Exploratory and Exploitative Use items were prefixed with a stem prompting the participating to express agreement with "statements about **the features** you used to design your creative multimedia advertisement." *Perceived Task-Technology Fit* was measured using eight semantic differential items adapted from Jarupathirun and Zahedi (2007). Each couplet was prefixed with the phrase "**As a tool** for designing a creative multimedia advertisement, Microsoft PowerPoint was," and sample items include Very inadequate vs. Very adequate, Very inappropriate vs. Very appropriate, etc. *Goal Commitment* was measured using Latham and Steele's four-item goal acceptance instrument (1983). These items were prefixed with the statement: "Please indicate the extent to which you agree or disagree with the following statements about **the goal** of designing a creative multimedia advertisement in PowerPoint," and included items such as "I was very committed to attaining the goal that was set" and "I worked very hard to attain the goal that was set."

Perceived Cognitive Effort was measured using Wang and Benbasat's six-item scale (2009). Sample items include "It was very frustrating" and "It required too much effort," and the items had the following stem: "Please indicate the extent to which you agree or disagree with the following statements about **the task** of designing a creative multimedia advertisement in PowerPoint." Finally, *Creative Self-Efficacy*, a control variable was measured using five items adopted from Carmeli and Schaubroeck's (2007) creative self-efficacy scale which includes items such as "I will be able to achieve most of the goals that I have set for my self in a creative way" and "I am confident that I can perform creatively on many different tasks." We include Creative Self-Efficacy as a control because it is a strong predictor of creative performance (Tierney and Farmer 2002), and we want to understand the unique effect that the acquisition, allocation and depletion of resources has on creative performance. Task-technology Fit, Creative IT Identity, Creative Self-Efficacy, Exploitative Use, Exploratory Use, Goal Commitment and Perceived Cognitive Effort are modeled as reflective latent variables. For a full list of items, see Appendix A.

Scales to measure IS Mastery were developed using best practices in construct conceptualization and instrument development (Churchill 1979; MacKenzie et al. 2011; Moore and Benbasat 1991). We followed a multi-stage iterative process whereby mastery and its sub-dimensions were conceptualized from research literature and from practitioner input. First, a multi-discipline definition of mastery was developed from similar concepts in the fields of management, psychology and education. This definition resulted in three sub-dimensions—competence, improvisation and routinization—which were similarly

defined. Prior research on competence, suggested two second-order dimensions—breadth and depth. As with the higher-order constructs, definitions for each second-order dimension were drawn from our review of relevant literature. Mastery is modeled as a first-order formative construct composed of competence, routinization and improvisation dimensions. The routinization and improvisation subdimensions are reflectively modeled. The subdimension of competence is modeled as a multiplicative composite of breadth and depth (Polites et al. 2012). For more details on this process, please refer to Appendix C.

To measure creativity, we used Amabile's Consensual Assessment Technique (CAT) (Amabile 1996). The CAT proposes that solutions are creative to the extent that a panel of knowledgeable experts agree that a solution is creative. We invited a creative professional from a local non-profit (approximately 35 employees) who was responsible for creating marketing materials for the organization to join the first author in evaluating the creativity of each submission. Each rater was asked to assess the novelty and appropriateness of the *ideas* represented in the advertisement, and to assess the novelty and appropriateness of the *design* of each advertisement. All four ratings were done on a scale of one to ten with one representing very low novelty/appropriateness and ten representing the highest possible novelty/appropriateness. Agreement between raters is represented by a score that differs by no more than two points (Althuizen and Wierenga 2014). Measures of both raw interrater agreement and Cohen's Weighted Kappa are in acceptable ranges (see Table 3.4). Raw agreement between raters for idea appropriateness, idea novelty, design appropriateness and design novelty are 96%, 97%,

94% and 92%, respectively. Likewise, Cohen’s weighted estimate of agreement between two raters on an ordinal scale with 10 levels is .74, .77, .63, and .66 respectively, with all representing substantial agreement (Landis and Koch 1977). Additionally, the Intraclass Correlation Coefficient for each measure is in an acceptable range to justify averaging rater scores. For more details on the rating process, please see Appendix E.

Table 3.4: Measures of Interrater Agreement				
	Average Absolute Difference¹⁸	Raw Agreement	Interrater Agreement (Kappa)	Interclass Correlation Coefficient
Idea Appropriateness	0.991	0.962	0.744	0.745
Idea Novelty	0.872	0.976	0.772	0.772
Design Appropriateness	1.043	0.943	0.630	0.631
Design Novelty	0.886	0.924	0.658	0.659

Data Analysis

We used semPLS (v1.0-10) in R (3.5.1) for measurement validation and for testing the relationships in the research model. We chose to use PLS for several reasons. First, PLS is capable of handling complex models (Ringle et al. 2012) and models with formatively and reflectively measured latent variables (Chin 2010). Also, using PLS to evaluate models with formatively measured latent variables in endogenous positions, such as our creativity construct, avoids problems related to identification (Temme et al. 2014) and underrepresenting the variance of the underlying constructs (Lee and Cadogan 2013). Finally, in exploratory research where a strong theoretical foundation is lacking,

¹⁸ Average absolute agreement represents the average of the sum of the absolute differences between the two raters. For example, if Rater 1 assigns scores of 4 and 5 to two different submissions and Rater 2 assigns scores of 5 and 4 to the same submissions, the average difference between the raters is 0 ($1 + -1 = 0/2$) while the average absolute difference is 1 ($1 + 1 = 2/2$). So, the average absolute difference is a more conservative measure of agreement and it can range from 0 (perfect agreement) to 9 (absolute disagreement).

PLS is preferable to covariance-based methods for its less stringent requirements such as accommodating uncorrelated measurement errors (Chin 2010) and partial model misspecification (Henseler et al. 2016).

The significance of the relationships in our model was established using 1000 bootstrapped iterations with bias corrected 95% confidence intervals. IS Mastery and Creativity were estimated using a two-step approach (Becker et al. 2012; Riel et al. 2017). Creativity was estimated in this manner because almost all of its variance was explained by its first-order dimensions, and mastery was estimated in this way to correct for an unequal number of indicators among its second-order components. In the first step, the first-order factor is excluded and direct paths to and from each second-order latent variable are estimated. In the second step, the factor scores for the formative dimensions serve as manifest variables first-order factors. The component factors are removed from the model and the paths are redirected to and from the first-order factor (Ringle et al. 2012).

To ensure the quality of the results, our method included several safe-guards. First, we logged the user's IP address to verify they were accessing the task through the Citrix environment. Second, we tracked how long each participant spent on each phase of the task. Third, we analyzed the content of the PowerPoint submission to make sure the uploaded file was consistent with the start file, to ensure the submission did not exceed one slide and to check for the use of external resources. We found approximately 30 submissions that violated one or more of these checks. We scrutinized each submission to determine whether the violations were severe enough to skew our analyses. We elected to

remove one cases from our analysis that had violated several checks and produced extreme outliers (e.g., greater than 4 standard deviations from the mean).

Results

Measurement Model

We employed both procedural and statistical remedies to mitigate the threat of common method biases as recommended by prior researchers (Conway and Lance 2010; Podsakoff et al. 2003). First, data were collected in multiple phases which introduced temporal separation between predictor and criterion variables. Also, independent variables were collected from one source (i.e., the participant) and data for the dependent variables were collected from a different source (i.e., expert ratings of creativity). Finally, we used the unmeasured latent method construct method (ULMC) (Williams et al. 1989) to assess the likelihood of bias and found very little evidence of method bias. The change in variance explained after including the common method factor was less than 10% for all predicted variables measured with a common method (Podsakoff et al. 2003). Despite this finding, we should note that more recent investigations of common method bias have questioned the validity of statistical techniques for assessing and controlling method bias (Conway and Lance 2010), with some going as far as specifically discouraging the use of the ULMC technique, despite its popularity (Chin et al. 2012; Richardson et al. 2009).

Reliability and validity are assessed differently for reflective and formatively measured constructs (Petter et al. 2007). The results of our measurement model assessment are presented in Table 3.5. For the reflectively measured constructs, we used composite reliability (CR) scores to assess reliability and found the values to be well

above the threshold (0.7) recommended by (Fornell and Larcker 1981). Validity was assessed by showing that indexes of convergent and discriminant validity exceed commonly accepted thresholds. For convergent validity, the average variance extracted (AVE) of each construct must exceed 0.50. Discriminant validity is assessed by comparing the square root of each construct's AVE with the construct's correlation with all other constructs, and by showing that the construct's indicators load higher on the focal construct than on any other construct. All AVEs are above 0.50 and all AVE square roots are larger than the construct's correlation with other constructs. Also, Table 3.5 shows that items have the highest loadings on the focal construct. These indices give us confidence that our measures display appropriate levels of convergent and discriminant validity (Chin 2010).

For formatively measured constructs, validity is assessed by analyzing the indicator's weights and loadings and by calculating the variance inflation factor for the formative indicators. the weights of formative indicators are analogous to beta coefficients in a standard regression model and indicate the relative importance of each indicator (Cenfetelli and Bassellier 2009). The formative indicators for the components of Creativity—Idea Creativity and Design Creativity—both had one significant weight and one non-significant weight (Design Novelty: $b = 0.969$, $p < 0.05$; Design Appropriateness: $b = 0.040$, $p > 0.05$; Idea Novelty: $b = 1.255$, $p < 0.05$; Idea Appropriateness: $b = -0.325$, $p > 0.05$). This result indicates that the appropriateness measures do not significantly contribute beyond the effect of the other formative indicators. That is not to say the indicators are not important—all indicators have

significant loadings greater than .7—but they do not significantly contribute to the measure of the latent variable beyond the effect of the other indicator. In fact, the mixed message between weights and indicators suggests that the correlations between indicators is leading to suppression effects (Cenfetelli and Bassellier 2009). We retained these indicators for their absolute value (i.e., loading) and for theoretical reasons.

Two of the three formative indicators of IS Mastery had significant loadings (IS Competence: $b = 0.11$, $p > 0.05$; IS Routinization: $b = 0.40$, $p < 0.05$; IS Improvisation: $b = 0.64$, $p < 0.05$). As discussed above, the non-significant loading indicates that Competence's absolute value is marginal. We chose to retain this item in our measure of IS Mastery, but it is possible, both statistically (Cenfetelli and Bassellier 2009) and theoretically (Dreyfus and Dreyfus 1980), that the importance of Competence is subsumed in the measures of IS Routinization and IS Improvisation. We encourage future researchers to explore the role of competence in contributing to mastery of an IS.

Multicollinearity assess the extent to which indicators share explanatory variance, a problem that is hinders the validity of constructs with formative indicators. To assess the multicollinearity of Creativity and IS Mastery, variance inflation factor (VIF) statistics of the formative indicators were examined; these should be lower than 5 for formative factors (Hair et al. 2011). The VIF statistics for the three first-order indicators of IS Mastery are 1.80 (IS Improvisation) 1.76 (IS Routinization) 1.23 (IS Competence). The first-order indicators of creativity have elevated VIFs ranging from 3.42 to 4.28, but they are all below the recommended threshold. The VIF statistics for the second-order

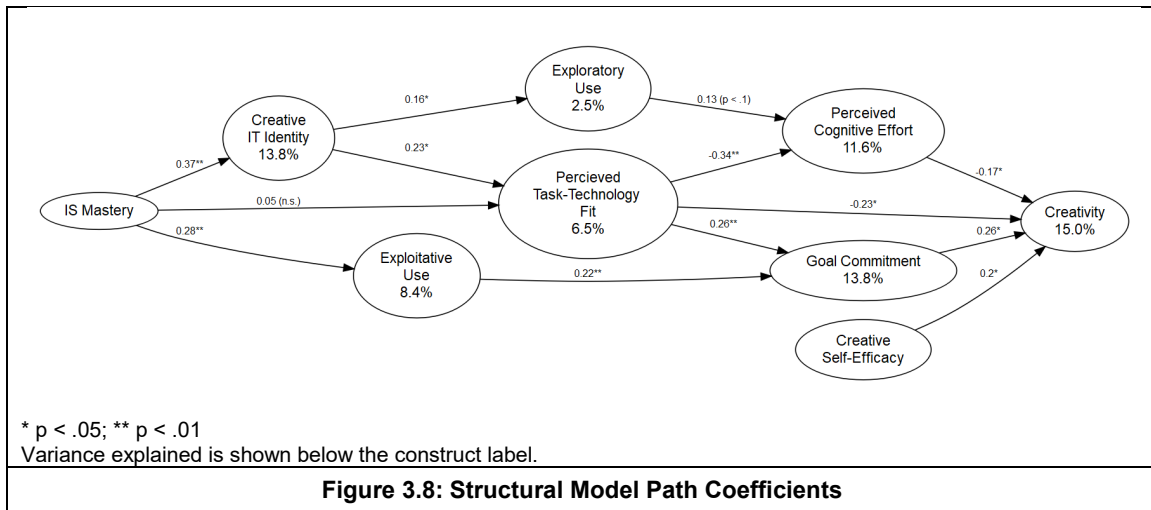
indicators (Idea Creativity and Design Creativity) are both low (1.94). Therefore, we conclude the formative measures exhibit appropriately low levels of multicollinearity.

Table 3.5: Composite Reliability and Correlations												
	CR	Item	AVE	routine	improv	tff	explore	exploit	cognitive	commit	ident	efficacy
routine	.935	8	.642	.801	.643	.137	.251	-.028	-.169	.080	.295	.396
improv	.955	9	.700	.643	.837	.117	.238	.076	-.124	.122	.368	.540
tff	.973	8	.817	.137	.117	.904	.151	.147	-.313	.295	.251	.180
explore	.851	4	.595	.251	.238	.151	.771	.082	-.044	.261	.158	.210
exploit	.938	3	.834	-.028	.076	.147	.082	.913	.079	.159	.164	.134
cognitive	.871	5	.583	-.169	-.124	-.313	-.044	.079	.764	-.312	-.147	-.096
commit	.882	4	.653	.080	.122	.295	.261	.159	-.312	.808	.151	.039
ident	.936	4	.784	.295	.368	.251	.158	.164	-.147	.151	.886	.449
efficacy	.933	5	.737	.396	.540	.180	.210	.134	-.096	.039	.449	.858

Note: Reflectively modeled constructs (variable name) are IS Routinization (routine), IS Improvisation (improv), Perceived Task-Technology Fit (tff), Exploratory Use (explore), Exploitative Use (exploit), Perceived Cognitive Effort (cognitive), Goal Commitment (commit), Creative IT Identity (ident) and Creative Self-Efficacy (efficacy).

Table 3.6: Outer Model Loadings and Cross Loadings									
	routine	improv	tff	exploit	explore	cognitive	commit	ident	efficacy
ROUTINE_2	0.706	0.443	0.158	0.105	-0.043	-0.186	0.131	0.187	0.247
ROUTINE_4	0.853	0.566	0.091	0.239	-0.090	-0.155	0.081	0.269	0.288
ROUTINE_5	0.823	0.549	0.099	0.257	-0.018	-0.088	0.065	0.239	0.296
ROUTINE_6	0.771	0.446	0.061	0.189	-0.030	-0.134	0.005	0.191	0.283
ROUTINE_7	0.843	0.498	0.117	0.205	-0.038	-0.105	0.045	0.243	0.332
ROUTINE_8	0.786	0.537	0.191	0.154	-0.001	-0.256	0.080	0.298	0.410
ROUTINE_9	0.839	0.560	0.080	0.231	-0.016	-0.079	0.078	0.265	0.349
ROUTINE_10	0.775	0.497	0.082	0.209	0.068	-0.082	0.027	0.163	0.316
IMPROV_1	0.555	0.843	0.064	0.285	0.116	-0.035	0.097	0.288	0.467
IMPROV_2	0.486	0.810	0.093	0.164	0.058	-0.135	0.111	0.260	0.383
IMPROV_3	0.474	0.812	0.145	0.177	0.114	-0.092	0.085	0.408	0.481
IMPROV_4	0.457	0.798	0.093	0.155	0.029	-0.111	0.160	0.218	0.477
IMPROV_5	0.516	0.820	0.078	0.184	0.028	-0.123	0.106	0.210	0.367
IMPROV_6	0.563	0.847	0.159	0.236	0.105	-0.118	0.131	0.382	0.463
IMPROV_7	0.606	0.863	0.084	0.201	0.044	-0.130	0.071	0.305	0.465
IMPROV_9	0.601	0.853	0.033	0.173	0.050	-0.067	0.048	0.306	0.458
IMPROV_10	0.573	0.881	0.097	0.189	-0.017	-0.133	0.118	0.308	0.474
TTF_1	0.102	0.128	0.906	0.128	0.164	-0.276	0.235	0.238	0.166
TTF_2	0.056	0.041	0.912	0.096	0.093	-0.231	0.210	0.178	0.183

TTF_3	0.081	0.052	0.912	0.090	0.135	-0.280	0.292	0.200	0.158
TTF_4	0.131	0.078	0.925	0.180	0.136	-0.287	0.275	0.201	0.138
TTF_5	0.152	0.091	0.900	0.174	0.162	-0.251	0.324	0.233	0.142
TTF_6	0.114	0.141	0.908	0.139	0.093	-0.294	0.292	0.252	0.159
TTF_7	0.196	0.169	0.869	0.166	0.157	-0.330	0.265	0.282	0.197
TTF_8	0.139	0.125	0.899	0.107	0.115	-0.300	0.221	0.209	0.161
EXPLOIT_1	0.199	0.159	0.113	0.868	0.044	-0.060	0.210	0.099	0.142
EXPLOIT_3	0.117	0.107	0.082	0.539	0.172	0.049	0.119	0.115	0.086
EXPLOIT_4	0.241	0.269	0.149	0.822	0.099	-0.087	0.223	0.203	0.231
EXPLOIT_5	0.194	0.169	0.113	0.812	-0.012	-0.002	0.229	0.068	0.158
EXPLORE_1	0.010	0.083	0.131	0.086	0.908	0.046	0.149	0.141	0.119
EXPLORE_2	-0.010	0.137	0.151	0.052	0.921	0.083	0.169	0.125	0.119
EXPLORE_3	-0.065	0.007	0.124	0.083	0.911	0.084	0.123	0.175	0.128
COGNITIVE_1	-0.139	-0.043	-0.347	0.015	0.035	0.846	-0.278	-0.100	-0.056
COGNITIVE_3	-0.083	-0.105	-0.166	0.026	0.078	0.796	-0.223	-0.066	-0.079
COGNITIVE_4	-0.191	-0.104	-0.269	-0.104	0.051	0.483	-0.090	-0.247	-0.108
COGNITIVE_5	-0.079	-0.127	-0.177	-0.049	0.045	0.825	-0.311	-0.046	-0.090
COGNITIVE_6	-0.136	-0.112	-0.169	-0.067	0.103	0.807	-0.266	-0.088	-0.040
COMMIT_1	0.025	0.037	0.171	0.253	0.116	-0.265	0.832	0.084	0.008
COMMIT_2	0.135	0.192	0.158	0.285	0.102	-0.200	0.803	0.168	-0.012
COMMIT_3	0.034	0.103	0.198	0.183	0.197	-0.172	0.822	0.141	0.079
COMMIT_4	0.072	0.072	0.400	0.134	0.099	-0.352	0.773	0.101	0.045
IDENT_1	0.297	0.383	0.227	0.156	0.140	-0.206	0.127	0.854	0.442
IDENT_2	0.235	0.256	0.218	0.146	0.153	-0.090	0.104	0.876	0.350
IDENT_3	0.185	0.290	0.222	0.108	0.159	-0.075	0.129	0.892	0.393
IDENT_5	0.314	0.359	0.220	0.146	0.131	-0.134	0.169	0.919	0.394
EFFICACY_2	0.385	0.436	0.147	0.141	0.140	-0.097	0.044	0.454	0.835
EFFICACY_3	0.307	0.494	0.091	0.175	0.074	-0.063	0.001	0.336	0.847
EFFICACY_4	0.319	0.468	0.150	0.181	0.168	-0.023	0.024	0.386	0.868
EFFICACY_5	0.328	0.471	0.217	0.164	0.098	-0.170	0.034	0.343	0.879
EFFICACY_6	0.381	0.443	0.168	0.249	0.080	-0.072	0.073	0.424	0.863
Note: Dropped Items are noted in Appendix A.									



Path	Estimate	Std.Error	Lower	Upper
IS Mastery -> Creative IT Identity	0.369	0.066	0.243	0.496
IS Mastery -> Exploitative Use	0.280	0.073	0.132	0.421
Creative IT Identity -> Exploratory Use	0.163	0.072	0.028	0.303
IS Mastery -> Perceived TTF	0.048	0.083	-0.104	0.213
Creative IT Identity -> Perceived TTF	0.233	0.084	0.059	0.390
Exploratory Use -> Perceived Cognitive Effort*	0.129	0.072	-0.023	0.261
Perceived TTF -> Perceived Cognitive Effort	-0.337	0.069	-0.475	-0.196
Exploitative Use -> Goal Commitment	0.220	0.065	0.096	0.353
Perceived TTF -> Goal Commitment	0.265	0.072	0.122	0.400
Perceived TTF -> Creativity	-0.234	0.079	-0.386	-0.077
Perceived Cognitive Effort-> Creativity	-0.168	0.076	-0.314	-0.001
Goal Commitment-> Creativity	0.259	0.068	0.107	0.376
Creative Self-Efficacy -> Creativity	0.199	0.068	0.090	0.335

Note: All paths estimated with a 1000 bootstrap bias-corrected 95% confidence interval
* p = .09

Structural Model

Table 3.7 and Figure 3.8 show the results of the structural analysis. IS Mastery explains 13.8% and 8.4% of the variance in Creative IT Identity and Exploitative Use, respectively. Together with Creative IT Identity, IS Mastery predicts 6.5% of the

variance in Task-Technology Fit. Creative IT Identity explains 2.5% of the variance in Exploratory use. Task-Technology Fit and Exploratory Use explain 11.6% of the variance in Perceived Cognitive Effort and Task-Technology Fit and Exploitative Use explain 13.8% of the variance in Goal Commitment. Perceived Cognitive Effort, Goal Commitment, Task-Technology Fit and Creative Self-Efficacy explain 15.0% of the variance in Creativity. These results are consistent with studies using similar sample sizes, predictors and external assessments of creative performance that explain 9-23% of the variance in creativity (Althuizen and Reichel 2016; Amabile et al. 2005; George and Zhou 2007; Jaussi et al. 2007; Tierney and Farmer 2002)

Table 3.8 provides a summary of hypotheses testing. Perceived Cognitive Effort, Goal Commitment and Task-Technology Fit all have a significant effect on Creativity, lending support to Hypotheses 10 and 11; however, Task-Technology Fit was hypothesized to have a positive effect on Creativity and we found a negative effect (Hypothesis 12).¹⁹ All three relationships were significant above and beyond the significant effect of Creative Self-Efficacy which was included as a control variable. Additionally, Task-Technology Fit (Hypothesis 6) and Exploitative Use (Hypothesis 8) have a significant positive effect on Goal Commitment. Though Task-Technology Fit's relationship with Perceived Cognitive Effort was significant (Hypothesis 7), Exploratory Use's relationship was only moderately significant (Hypothesis 9, $p < .10$). Similarly,

¹⁹ While unexpected, the negative relationships between TTF and Creativity remained consistent and statistically significant across three pilot tests. Additionally, TTF and Creativity are independently assessed with students providing values for TTF and expert judges providing ratings of Creativity. Therefore, we have sufficient reason to believe that the result is neither accidental nor due to systemic error in data collection.

Creative IT Identity’s relationship with Task-Technology Fit (Hypothesis 4) was significant while IS Mastery’s relationship was not significant (Hypothesis 1). Both IS Mastery’s effect on Exploitative Use (Hypothesis 2) and Creative IT Identity’s relationship with Exploratory Use (Hypothesis 5) are significant. Finally, IS Mastery’s positive relationship with Creative IT Identity lends support to Hypothesis 3.

Table 3.8: Summary of Proposed Hypotheses	
Hypotheses	Supported?
H1: IS Mastery will have a positive effect on Perceived Task-Technology Fit	No
H2: IS Mastery will have a positive effect on Exploitative Use	Yes
H3: IS Mastery will have a positive effect on Creative IT Identity	Yes
H4: Creative IT Identity will have a positive effect on Task-Technology Fit	Yes
H5: Creative IT Identity will have a positive effect on Exploratory Use	Yes
H6: Perceived Task-Technology Fit will have a positive effect on Goal Commitment	Yes
H7: Perceived Task-Technology Fit will have a negative effect on Perceived Cognitive Effort	Yes
H8: Exploitative Use will have a positive effect on Goal Commitment	Yes
H9: Exploratory Use will have a positive effect on Perceived Cognitive Effort	Partially
H10: Goal Commitment will have a positive effect on Creativity	Yes
H11: Perceived Cognitive Effort will have a negative effect on Creativity	Yes
H12: Perceived Task Technology Fit will have a positive effect on Creativity	Partially

Discussion

A fundamental premise of our work is that the capabilities of information technologies are evolving such that their roles in effecting organizational performance are growing beyond simple deterministic tasks to encompass more heuristic tasks such as creativity. In this case, the use of or intention to use the tool is no longer sufficient for understanding how employees might use the tool to accomplish their goals and improve their performance. Our work begins by arguing that an IS is a tool that, in the hands of a skilled artisan, might be wielded in such a way as to allow individuals to express their creativity, beyond what their lesser skilled peers might produce. We refer to this ability as IS mastery and define it as the intersection of competence, routinization and

improvisation. We then draw on COR theory to explain how mastery of an IS would allow users to distinguish themselves on a creative task. Specifically, we contend that creativity is a resource-hungry task and that individuals who have acquired skills and abilities that fortify them for the task or enhance their ability to efficiently allocate resources during the task, will be better positioned to achieve higher levels of creative performance. Thus, we argue that IS Mastery affects how an individual uses the technology to perform a creative task and that efficiencies gained through mastery allow users to allocate more cognitive and motivational resources to task itself.

Predicting Creativity

As expected, we found that the user's commitment to the task and the cognitive effort experienced during the task are both predictive of creativity. These two factors illustrate the demanding nature of creative tasks such that users who find the task to be more cognitively demanding underperform with respect to their peers. Likewise, individuals who remain committed to the goals of the task (i.e., creativity) throughout are better able to achieve their goal.

Surprisingly, we found a negative relationship between Task-Technology Fit and Creativity. This finding is unexpected and casts doubt on the utility of a fit relationship between technology and task. While it is counterintuitive—and perhaps counterproductive—to encourage the use of poor fitting systems as a means of increasing creativity, these results indicate that users consistently produce more creative works when they feel their technology tools are a poor match for the task. It is unclear why this would be, but the answer may lie in multiple areas of research. First, creativity research has

shown that creativity tends to be higher when users devote more time to planning prior to the task (Getzels and Csíkszentmihályi 1976), and when users are encouraged to explore remote associations during the task (Althuizen and Reichel 2016). Some believe that this effect is due to a type of priming that occurs once work on the task begins such that it is increasingly difficult to break from an initial conceptualization of the problem (Bargh and Chartrand 2000). Research on priming supports this, showing individuals who are primed for behaviors (Stajkovic et al. 2006), goals (Dennis et al. 2013), stereotypes (Bargh et al. 1996) or concepts (Duncker and Lees 1945) tend to act in accordance with the priming. Duncker and Lees (1945) use the term ‘functional fixedness’ to describe a similar phenomenon in which individuals who have previously used an object as a tool in one context (e.g., using a stick as a ruler) have difficulty imagining a different role for the same object (e.g., using a stick as a crutch). Thus, it is possible that the perception of fit is indicative of the extent to which the technology activates an automatic response to the task. Conversely, those users who feel fit is lacking are forced into a deliberative process (i.e., breaking perceptual set (Amabile 1983)) by which they must carefully consider both the capabilities of the technology and their goals for a creative solution. In this way, users who detect a mismatch between the technology and the task are freed of any biases that might proscribe how the technology should be used to perform a creative task, and instead use the technology as a mismatched, but capable tool for producing creative works. Whatever the causes, this result indicates a strong disconnect between user evaluations of a technology and their ability to apply the technology to creative tasks, and the need for further research into this phenomenon.

Predicting the Conservation of Resources

Despite the unexpectedly negative relationship with Creativity, we found Task-Technology Fit to be useful in conserving resources during a task. Specifically, we found TTF to have a strong negative relationship with Perceived Cognitive Effort and a strong positive relationship with Goal Commitment indicating that users who find the technology appropriate for a creative task exhibit higher levels of goal commitment and believe the task requires lower levels of cognitive effort. These results highlight the psychological value of fit between one's tool and their task. That is, users who are equipped with the appropriate tools tend to think the task less difficult and are more likely to remain committed to their goals.

The ways in which individuals use their technology tools also contribute to the conservation of resources. First Exploratory Use has a weak positive influence ($p < 0.10$) on Perceived Cognitive Effort. This result points to the inherently limited nature of one's psychological resources. While Exploratory Use is often associated with different types of creative behaviors (Sun 2012) and is itself a kind of creative behavior (Ke et al. 2012), users who explore a technology in the context of a demanding task, find the task more demanding than those who spend less time trying out new features. Second, Exploitative Use has a strong positive effect on commitment ($p < 0.01$). Unlike Exploratory use which is concerned with identifying new features or uses of the tool, Exploitative use is focused on exploiting well-known features, and this result highlights the motivational benefit of relying on a well-practiced skills to accomplish a goal (Ericsson and Lehmann 1996). Together, these results show how an individual's usage patterns with an IS affect their

ability to achieve creative outcomes by increasing their perceived cognitive burden and their commitment to the creative task.

IS Resources for Creative Tasks

To avoid resource depletion during a creative task, users acquire skills and abilities that help them guard against depletion during a demanding task. We explored the role of two IS-specific concepts that play an important role in this fortifying process. First, we posited that IS Mastery would support an individual during a creative task by enhancing their Creative IT Identity, increasing their ability to use the IS Exploitatively and by increasing their perception that the IS is a good fit for the task. As expected, IS Mastery has a positive effect on Creative IT Identity. This result is consistent with a performative view of identity where one's creative IT identity is established through acting out their creativity with an IT. Thus, as users establish competence in an IS, routinize its features and develop an improvisational view of their abilities, they begin to see themselves as creative users of IT. Also, as expected, IS Mastery has a positive relationship with Exploitative Use. This finding reinforces the notion that deliberate practice helps users encode certain usage patterns. When these patterns are exploited, users create task-specific efficiencies by employing overlapping actions within the IS. Surprisingly, IS Mastery had no effect on the user's perception of TTF. This finding seems to contradict the common sense that users more skilled in a technology would believe that technology to be appropriate in a wider array of tasks. However, Goodhue's initial findings (1995) may have foreshadowed ours. He found that computer literacy was only significantly related to three of the 12 dimensions of TTF, and that two of those

dimensions had a strong negative correlation suggesting that more experienced users felt the system produced results that were hard to find (Locatability) and hard to interpret (Meaning). He interprets these results as showing that as experienced users engage “in more various, difficult, interdependent and "hands-on" tasks, they will place more demands on their information systems and find them less able to meet their needs” (Goodhue 1995, p. 1833).

Second, we hypothesized that Creative IT Identity would fortify the user by increasing their perception of TTF, and that the need to verify their identity would drive users to spend more time exploring the technology. Our analyses lend support to the idea that Creative IT Identity enhances the perception of fit between the technology and the creative task. When considered in light of the non-significant relationship between IS Mastery and TTF, this finding suggests that the user’s identity may contribute to a more general view of IT whereby users with a strong creative IT identity would be more likely to see all technology as a potential venue for enacting their identity and thus an appropriate technology for a creative task. Also, we found that Creative IT Identity is related to an increase in exploratory behavior during the creative task. This finding further supports to prior research which argues that a salient identity will drive users toward behaviors that they believe to be congruent with their chosen identity—in this case, exploring new features of the technology.

Implications

Research Implications

Our work has several implications for research. First, our research seeks to understand the role an IS plays as a conduit for creative work. Despite the long history of use and performance research in IS, few researchers have sought to understand how IS use affects creativity. Also, to our knowledge, this is the first study in which study participants are tasked with using an IS to develop an observable creative artifact. Though difficult to study, it is important that creativity researchers develop a better understanding of the recursive and iterative process by which ideas are converted into artifacts, and how the tools of translation affect the creativity of the final product. For IS researchers, our work offers insight into the ways in which the user's relationship with the technology (i.e., IS Mastery and Creative IT Identity) affects their use of the tool as they seek to develop creative solutions to a business problem. Thus, our research contributes to both creativity research and IS research in its exploration of the factors affecting the elaboration of creative ideas through ISs.

Second, our work contributes to the emerging Conservation of Resource stream within IS research. Though COR Theory is highly regarded in peer domains, it has been little used in IS research. This trend is changing as researchers have recently begun to explore how effort expenditures within an IS affect both the individual using the technology and their performance with the technology. As more work is mediated through technologies, it is important that IS researchers lead the effort to understand how

IS affect users and their performance on both heuristic and deterministic tasks, and our work adds to this effort.

Third, we introduce the concept of mastery as a skill that IS users develop through the deliberate practice of increasingly difficult tasks. IS researchers have complained that self-reported experience and proxy measures such as hours spent using an IS lack the granularity needed to fully capture the usage and capability differences that exist between novice and expert users. In our conceptualization of IS Mastery, we leverage the skill acquisition and expert performance literature to explain that mastery is exhibited when users acquire a broad and deep knowledge of an IS that is ingrained (i.e., routinization) and adaptable (i.e., improvisation) to a wide variety of tasks. Thus, users who have mastered an IS are capable of higher levels of performance and creativity because their use of the IS is both more efficient and more innovative than that of novice users.

Finally, our work contributes to TTF Theory by exploring the role of fit in heuristic tasks. Though the precise role of fit has been questioned, TTF Theory traditionally posits a positive relationship between fit and performance. Subsequent research has borne this out when the task is deterministic, and the technology is well-suited for the task. However, the relationship is likely more complex in heuristic tasks for which there is neither a clear right answer nor a predetermined approach to performing the task. Our study begins to address this gap by showing that fit indirectly affects performance by making the task appear easier and by increasing the user's commitment to the goal. Interestingly, our study also reveals an unexpected negative direct effect on performance, suggesting that TTF may lull users into an uncritical posture thus limiting

their ability to effectively achieve the goals of the task. Clearly, further research is needed to better understand the role of fit in creative and other non-deterministic tasks.

Practical Implications

Our work has several implications for practitioners. First, we offer an initial exploration of the factors influencing creativity in a digital environment. As organizations digitize more work and more work outputs, managers and business leaders need to understand what effect this shift from physical to digital creation has on workers and their performance. Our research shows that the technology and the user's relationship with the technology affects creativity and that those users who are least encumbered by the technology are most capable of performing creatively. This finding reinforces the notion that ISs are active participants in modern work and that adoption, deployment and training decisions are unlikely to be neutral in their effect and may not necessarily be positive. These are valuable insights for organizations seeking to leverage the creative potential of their digitally-enabled workforce.

Second, our research shows that, as an active participant in the creative task, the IS can have a depleting effect on the user. Just as managing other collaborators can deplete users of valuable resources that are needed to complete a task, a contentious relationship with the IS—believing the IS to be a poor fit for a task, not having mastery over an IS—can rob users of cognitive resources, leaving them with fewer resources to devote to the task itself. Conversely, when the user is capable of maintaining a symbiotic relationship with the IS throughout the task, they become both more efficient in their use

of the IS (i.e., Exploitative Use) and more effective in their performance of the task (i.e., Creative Performance).

Third, our research highlights the importance of IS Mastery and suggests the need for mastery-focused training. Training regimens that emphasize deliberate practice, increasingly difficult tasks and performance-based feedback are well established in other domains but have been little emphasized in the context of IS skill acquisition. Our research indicates that users who have mastered an IS are both more efficient in their use of the IS and more confident in their ability to achieve creative outcomes with an IS. As the need for creativity remains constant even as organizations continue to move toward increasingly digitized work environments, training initiatives that emphasize knowledge, routinization and improvisation will help employees transition from the physical to the digital while also equipping them with an increased sense of their own creative capacities with information technologies.

Finally, our research sounds a warning against a simplistic evaluation of technology fit when considering the potential effects on performance. Though organizational leaders consider many factors when assessing the potential adoption of an IS, the extent to which the capabilities of the IS match the requirements of the task, is likely the most important. Our research suggests that TTF alone may actually decrease performance when the tasks performed within the IS are heuristic in nature. That is, performance of tasks that require problem-solving, trial and error, creativity and deduction may be inhibited to the extent that the user outsources to the technology the more creative and cognitively demanding aspects of the task.

Limitations

This research has limitations. First, our study is conducted as an observational study. As such, our study is dependent upon the naturally occurring variation of the variables that comprise our analyses. Whereas an experimental design might force variation into the study by controlling for different levels of IS Mastery or ISs with different fit profiles, our results assume that these factors are sufficiently random within our sample and that the randomness explains the other variables in our model. Second, our use of perceptual measures for some variables may not accurately reflect the underlying phenomenon. For example, self-report measures of skill have been shown to have poor reliability and it is not obviously true that individual users are capable of accurately assessing the fit of a technology to the demands of the task. Third, though our data are collected in three phases, our study is cross-sectional in nature. This means we are unable to ensure the temporal order of the relationships in our model. Though theory suggests that TTF would lead to the perception of reduced Perceived Cognitive Effort, the effect may actually be reversed. That is, users may find the task easy and as a result, feel that the technology must be a good fit for the task. Likewise, our proxies for the depletion effects (i.e., Perceived Cognitive Effort and Goal Commitment) are only measured after the task. Lacking a pre-task measure of Goal Commitment and Perceived Cognitive Effort, we cannot know for sure if the task and/or technology are responsible for the post-task levels of each variable.

Conclusion

As more creative work tasks are mediated through information technologies, it is important to understand how the user and the technology interact during the creative task, and the consequences of that interaction on creativity. In this study, we aim to explore this question by showing how a user's relationship with technology influences creative performance. We employ a conservation of resources lens through which we envision creativity to be an effortful working out of creative ideas and argue that the user's acquisition of technology-specific resources (i.e., IS Mastery and Creative IT Identity) will fortify them throughout the task. Further, the extent to which these resources allow users to efficiently redirect cognitive resources away from interacting with the technology and toward managing the creative task, will encourage more creative solutions. Our study shows that the user's mastery of an IS and the extent to which they identify as a creative user of IT will affect the ways in which they use the technology to perform creative tasks, and these usage patterns will influence the user's commitment to and effort required by the task.

CHAPTER FOUR

4. FINDING A FIT FOR CREATIVITY: INTERIM STRUGGLES EXPLORING THE LINK BETWEEN TECHNOLOGY FIT AND CREATIVE PERFORMANCE

Abstract

Task-Technology Fit (TTF) Theory has been a staple of IS research for more than 20 years. Despite this, some researchers contend that the theory is lacking in its ability to explain why performance on a task would increase when the user is equipped with a technology well-suited for the task. Further, as work tasks become increasingly heuristic and/or complex, it is unclear why or how TTF might improve performance. In this research, we investigate TTF in the context of a creative task and set out to show that TTF should have positive effect on creativity. We test this relationship across five studies in which undergraduate business students are tasked to use Microsoft PowerPoint to design a creative multimedia advertisement. We find that TTF does have a strong relationship with creativity, but that the effect is consistently negative. This unexpected finding marks the beginning of our exploration of the true nature of the relationship between TTF and creativity. Through the application of alternate study designs, theoretical models and performance measures we find that for creative tasks, TTF is highly sensitive to specific experience with the technology and task, that TTF is a necessary but insufficient predictor of creativity and that TTF encourages users to discount their own ideas in deference to those of the technology. We conclude our journey along the path between TTF and Creativity by developing an updated map of the technology-to-performance chain.

Introduction

Although TTF theory poses a link between use and performance, it does not speak to whether this link is positive or what it would take to make it more positive. (Burton-Jones and Grange 2013, p. 652)

Task-Technology Fit (TTF) Theory has a long and important history in IS research. Goodhue offers TTF as explanation for the elusive relationship between IS use and performance (Goodhue 1988, 1992, 1995; Goodhue and Thompson 1995). At its heart, TTF is a rebellion against the hammer and nail fallacy that was pervasive at the start of the personal computer boom: every work task began to look like a task that could be done better and faster with a computer. The reality, Goodhue and Thompson (1995) argue, is more nuanced; tasks are not generic nails to be hit with a generic hammer (i.e., technology). That is, to see marked performance increases, users must be equipped with and make use of technologies that are appropriate tools for the intended task. The appeal and longevity of TTF Theory, therefore, exists in its simplicity and its logic which has been cited widely within and beyond the domain of information systems (IS) research (Burton-Jones and Grange 2013; Gebauer and Ginsburg 2009)²⁰.

Despite its popularity, some have begun questioning the foundations of TTF Theory because the capabilities of information technologies and the variety of tasks users perform with information technologies have greatly increased. Early TTF research found support for the Goodhue and Thompson's technology-to-performance chain (1995) in studies that focus on the ability of technologies to support individual and group

²⁰ "MIS Quarterly's Most Cited Articles," *MIS Quarterly*, November 21, 2013, <https://www.misq.org/skin/frontend/default/misq/pdf/MISQStats/MostCitedArticles2013.pdf> (accessed June 3, 2019)

information processing performance on deterministic (e.g., data storage, retrieval, representation) and heuristic (e.g., decision making, idea generation) tasks (Dishaw and Strong 1999; Goodhue 1995; Zigurs and Buckland 1998). Over time, research on heuristic tasks began to diverge from the TTF model as evidence emerged that the predictive value of fit weakens as users learn and adapt to the technology's capabilities (Fuller and Dennis 2009). Simultaneously, technological advancements have increased the capacity of information technologies to support a wider variety of work tasks, with many being more heuristic in nature. These changes have led some to call for a "complete rethinking" of TTF's link to performance (Fuller and Dennis 2009, p. 14).

Over the same period, organizations were likewise rethinking their definition of performance with old models of efficiency and effectiveness giving way to new strategies of creativity and innovation. During the personal computer boom, organizations adopted readily quantifiable indicators of individual performance such as speed and accuracy. In this setting, technological automation of tasks is an obvious lever for managers to pull to increase performance. However, as the market shifted from a managerial economy to an innovation economy, organizations and managers began to elevate individual creativity as a key metric of individual performance (Drucker 2014). Consistently, leaders rate creativity as a key ingredient of their strategies for maintaining and growing their competitive advantage ("IBM - Global C-Suite Study" 2016). In an increasingly digital environment, managers who seek to encourage and enable individual creativity need to understand how this evolution of the performance metric affects the technology-to-performance chain.

While these changes in the IS's capabilities and the organization's performance outcomes reckon a shifting work environment, there has been little research in how TTF explains performance in heuristic, non-deterministic tasks. On the surface, the logic remains alluring: to encourage greater creativity, employees must have tools fit for creative tasks, but there is little to explain how or why this relationship holds. When the task and performance are easily defined, organizations can adopt technologies that ensure successful linkages between task and performance. However, modern digital work tasks are amorphous and varied, and creativity is subjective and often only identifiable retrospectively; in this context it is no longer obvious what role the technology will play, much less what effect it will have.

In this essay, we describe our unexpected journey along the path from TTF to creativity. Because our journey was unexpected, our telling of it will be unconventional. We begin with a review of TTF Theory, highlighting the theoretical and operational underpinnings of task-technology fit. We then provide a brief review of creativity as a performance outcome and hypothesize the link between TTF and creativity. Next, we present our findings from across five studies. Because the results deviate from our expectations in consistent and unusual ways, we then explore this relationship by reconsidering the methodological, theoretical and operational assumptions that undergird our studies. We conclude by consolidating our findings in a conceptual model of the technology-to-creativity relationship in the context of technology-mediated creative tasks.

Theoretical Background

Task-Technology Fit

The idea that task performance depends, to some extent, on the congruence between the requirements of the task and the capabilities of the technology has a long history in IS research. Vessey and Galletta (1991), early pioneers in this stream of research, borrowed the concept of cognitive fit from decision-making research and applied it to an information technology context. They argue that, increasingly, information technologies are responsible for constructing mental representations of organizational problems (i.e., graphs and tables of problem-relevant information), and that decision-making performance depends on the fit between the decision task and the representation of the problem (Vessey 1991; Vessey and Galletta 1991).

Later researchers expanded on this idea to argue that the technology itself and not just the output of the technology has an explicit role in influencing task performance. These arguments were made in two simultaneously emerging perspectives on task-technology-fit research (Gebauer et al. 2010; Goodhue and Thompson 1995; Zigurs and Buckland 1998) that primarily diverge on their conceptualizations of fit. First, Goodhue (1992) initially introduced the task/system fit concept that would later become known as task-technology fit (Goodhue 1995, 1998; Goodhue and Thompson 1995). Goodhue and Thompson contend that in the context of improving individual task performance, “the technology *must be utilized*, and the technology *must be a good fit with the tasks it supports*” (1995, p. 213, emphasis in original). That is, users will be more efficient in their tasks when a fit or match exists between the characteristics of the task and the

capabilities of the technology. An alternative perspective on the task-technology fit relationship is posited by Zigurs and Buckland (1998), who maintain that task performance is an optimization problem in that performance depends on the extent to which the technology supports the specific activities required by the task. According to this perspective, performance suffers from both underfit (i.e., the technology does not support required activities) and overfit (i.e., the technology supports activities not required by the task). This conceptualization of the fit relationship, often called a fit profile (Venkatraman 1989), implies that different types of tasks (i.e., simple, problem, decision, judgement, fuzzy) require varying levels of technology support (i.e. support for communication, process structuring, information processing), and that fit occurs when tasks are supported by a technology that closely adheres to some ideal profile of features. This perspective of task-technology fit has an intellectual lineage that extends from media richness theory (Daft and Lengel 1986) and continues through to media synchronicity theory (Dennis et al. 2008), all three of which contend that tasks (i.e., information processing, decision-making, communication) can be decomposed into essential activities for which some ideal profile of technological features exists.

Table 4.1: Comparison of Fit Conceptualizations in TTF Research		
Source	Goodhue and Thompson (1995)	Zigurs and Buckland (1998)
Fit Conceptualization	Matching	Ideal Profile
Outcome Anchoring	Criterion-Free	Criterion-Specific
Fit Complexity	Simple	Complex
Fit Factors	Two	Many
Adapted from Venkatraman (1989)		

While both approaches seek to explain how the fit between task and technology predicts performance, their differences on mechanisms by which fit is established has

implications for the application and generalizability of each. For example, Goodhue and Thompson's (1995) concept of fit is more flexible as it is contingent upon a match between the characteristics of the technology and the demands of the task, independent of any outcome variable. This conception of fit contrasts with Zigurs and Buckland's (1998) fit profiles which result from an objective analysis of a task that is intentionally linked to a specific type of performance (e.g., decision performance). Thus, fit profiles are necessarily dependent on some criterion assessment that may not be generalizable across tasks or outcomes. Also, specifying fit profiles is more complex as researchers must establish theoretical and empirical support for the appropriate levels for each dimension in the profile (e.g., Problem Tasks require technologies that have *high* support for information processing and *low* support for communication and process structuring (Zigurs and Buckland 1998)). A fit as matching perspective requires only that researchers justify the relationship between the two dimensions that determine fit. Finally, the profile approach is more accommodating of multivariate fit relationships. For example, Zigurs and Buckland (1998) develop profiles for five types of tasks across three dimensions of technology capabilities (e.g., Communication Support, Process Structuring Support, Information Processing). A matching approach to fit, such as that suggested by Goodhue and Thompson (1995) and Goodhue (1995), is limited to a bivariate relationship between two variables.

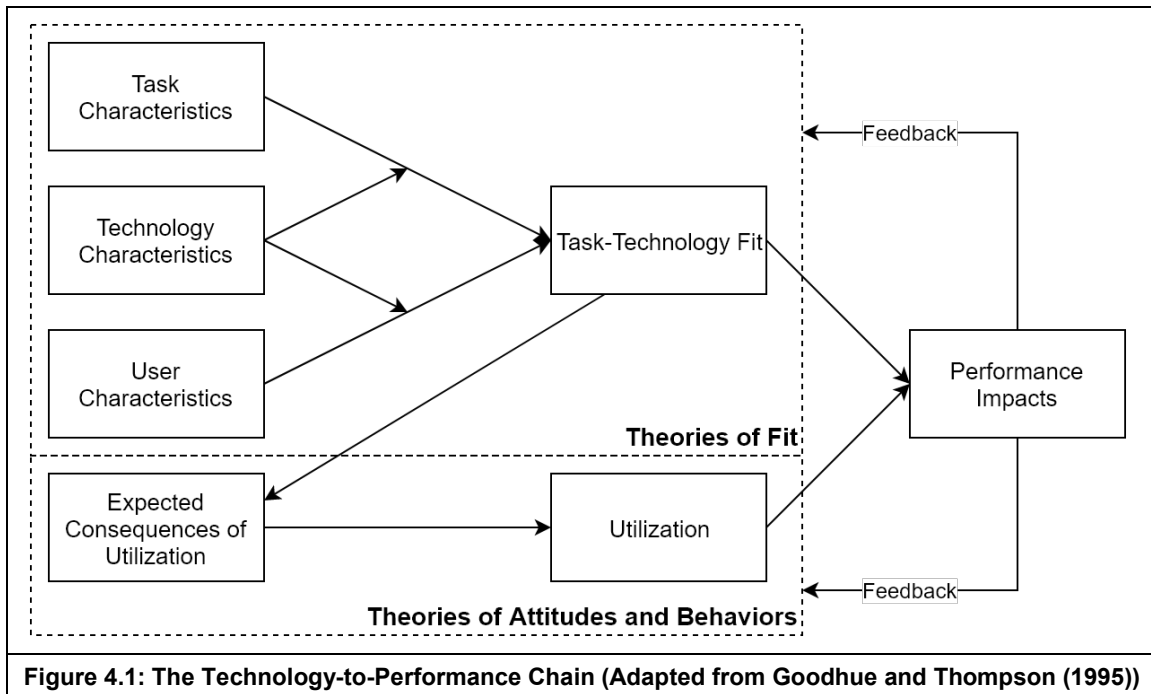
Both conceptualizations of fit have advantages and disadvantages with ideal profiles offering complex and systematic insights into the link between technology fit and performance, and the matching approach offering a more flexible and efficient

exploration of the relationship between technology and task. However, in the context of exploratory research investigating the link between technology tools and creative tasks, we expect that Goodhue and Thompson's (1995) TTF Theory will provide a better foundation for our study. Therefore, we review Goodhue and Thompson's (1995) seminal contribution to TTF Theory in the following section and establish a framework for understanding the Technology-to-Creativity chain. Then, we discuss the various ways in which their concept of fit has been operationalized in IS research.

Theoretical Foundations

Though first introduced several years earlier (Goodhue 1988, 1992), TTF's conceptual foundations were formally established in Goodhue and Thompson's (1995) influential contribution to information systems (IS) research. In it, they sought to offer an explanation for the elusiveness of individual IS success (DeLone and McLean 1992)—the relationship between technology use and individual performance. Their argument is that it is not enough that a technology be used—raw measures of use may obscure the system's inefficiencies—to enhance performance of a task, the technology must also be a good match for the task. Thus, performance depends on fit and when fit is lacking, performance suffers. This logic underlies the technology-to-performance chain (Goodhue 1992; Goodhue and Thompson 1995) which posits that task, user and technology characteristics interact to create a fit between the task and the technology. Fit then affects performance directly by making the task easier and more efficient, and indirectly through the user's beliefs about the technology's capabilities and their attitudes toward using the technology. Finally, the experience of performing the task creates a feedback loop that

alters both the user's perception of fit (i.e., task/user/technology characteristics) and their attitudes about the technology. These relationships are illustrated in the technology-to-performance chain in Figure 4.1.



The concept of task-technology fit emerges from an interaction between task, technology and user characteristics. Task characteristics refer to the various demands the user will face throughout the task. Tasks are commonly classified according to their degree of nonroutineness and interdependence (Gebauer et al. 2010; Goodhue 1995; Karimi et al. 2004). Nonroutine tasks are those which are difficult and are likely to include variety of novel and unexpected events. Interdependent tasks are those which cannot be completed without the coordination of other tasks or organizational units (Fry and Slocum 1984). Technology characteristics refer to the technology and support systems that assist users in their tasks (Goodhue and Thompson 1995). As with tasks,

technology characteristics are often classified along dimensions “presumed to have some impact on the target task process” (Goodhue 1995, p. 1832), such as system integration, system penetration, support availability, functionality, user interface and adaptability (Gebauer et al. 2010; Goodhue 1995). User characteristics refer to skills and abilities that users bring to the task. Though user characteristics are believed to be important to the evaluation of task-technology fit (Goodhue 1992, 1995; Marcolin et al. 2000), they are sometimes excluded from evaluations of fit (Gebauer et al. 2010; Goodhue and Thompson 1995). Together, task, technology and user characteristics are believed to interact to form the perception of task-technology fit, defined as the “degree to which a technology assists an individual in performing his or her portfolio of tasks” (Goodhue and Thompson 1995, p. 216).

Fit is a concept that is commonly acknowledged, but much debated in IS research (Polites et al. 2012; Zigurs and Buckland 1998). Organizational researchers commonly acknowledge six distinct types of fit (Venkatraman 1989), which result in unique conceptualizations and operationalizations for each type of fit. Though Goodhue and Thompson (1995) are not explicit—they define fit as a match between technology and task (Goodhue 1995) and as interactions between task, technology, and individual (Goodhue and Thompson 1995)—it is likely that fit was intended to be either a type of moderation or a match between variables. Though similar these approaches differ on the theoretical link between fit and performance. When fit is operationalized as moderation, performance is contingent upon fit and degrades when fit is lacking. Fit as matching makes no such criterion claim. Instead, fit is an objective measure of congruence among

variables that may or may not be related to some set of outcome variables (Venkatraman 1989). Despite this initial framing, later researchers have suggested that fit could be conceptualized as a covariation between task, technology and user (Dishaw and Strong 1999; Marcolin et al. 2000).

Throughout much of the history of IS research, researchers have been concerned with the issues of inducing individuals or groups to use a technology, bolstered by the belief that the technologies “if used, would generate significant performance gains” (Davis et al. 1989, p. 982). Use or utilization refers to the actual use of a technology, and it is posited that beliefs about the usefulness and accessibility (i.e., ease of use) of a technology predict both the user’s intention to use a technology and their actual employ of a technology in accomplishing a task (Davis et al. 1989; Dishaw and Strong 1999). The technology-to-performance chain supplements this argument by suggesting that the fit of a technology with a task enhances an individual’s attitude toward the technology thereby increasing the likelihood of use. Though described as having an indirect effect on utilization, researchers have found fit to have a direct effect as well (Dishaw and Strong 1998, 1999)

Performance refers to a user’s successful completion of a portfolio of tasks and may include “some mix of improved efficiency, improved effectiveness, and/or higher quality” (Goodhue and Thompson 1995, p. 218). Though IS researchers tend to avoid direct measures of performance (DeLone and McLean 1992), Goodhue and Thompson’s (1995) technology-to-performance chain proposes a direct and indirect—through utilization—relationship between fit and performance such that when the technology is

an adequate match for the task, performance increases. Over time, researchers have found consistent positive relationships between fit and both perceived (Goodhue and Thompson 1995; Hee-Dong Yang et al. 2013; Lu and Yang 2014) and actual performance (Aljukhadar et al. 2014; Fuller and Dennis 2009; Junglas et al. 2008; Mathieson and Keil 1998; Parkes 2013).

The final component of the technology-to-performance chain is feedback. Feedback refers to any new information a user gleans from having been taught to use, having attempted to use, or having actually used an information system to perform some task. This new information then has important consequences for future technology use (Bhattacharjee 2001) and performance (Jaspersen et al. 2005). Goodhue and Thompson (1995) argue that feedback may alter the user's attitude toward use of a technology, their beliefs about the technology's capabilities, or both. Fuller and Dennis's (2009) study of user appropriation of group support systems confirms the value of feedback. They find that when users assigned to use a poor fitting tool receive feedback on their task performance, they develop more revolutionary uses for the technology to overcome fit problems.

In summary, Goodhue and Thompson's (1995) TTF theory develops valuable insight into the link between technology use and task performance. They do this by arguing that use alone is insufficient for predicting performance. Instead, the user must be equipped with a technology that is a good fit for the task and their abilities. When fit is present, the user will be more amenable to using the technology and will perform more

effectively and efficiently. Through using the technology, they will gain valuable feedback about the tool that will further support their performance on subsequent tasks.

Operationalization and Measurement

As discussed above, fit is a complex concept and the posited fit relationship will determine the ways in which the fit construct is measured. In this section, we will discuss the different ways researchers have operationalized TTF. In our review of the literature, we found four different approaches to measuring the TTF construct: as a hierarchal construct, as an interaction, as a predefined profile and as a user perception. We discuss each in the following paragraphs.

First, TTF has been measured as a hierarchical construct. Though initially proposed as an interaction between task, technology and user, the first studies of TTF treated the construct as a composite of several dimensions (Goodhue 1995, 1998; Goodhue and Thompson 1995). This construct—user evaluations of task-technology fit—is composed of 12 dimensions (Confusion, Right Level of Detail, Meaning, Locatability, Accessibility, Assistance, Ease of Use of Software and Hardware, System Reliability, Accuracy, Compatibility, Currency, Presentation) which together serves as a surrogate for fit (Goodhue 1995). Each dimension is hypothesized to have a unique relationship with its antecedents—characteristics of the task, technology and user—and with its consequents—performance and utilization. Across several studies, user evaluations of TTF is shown to be reliable and to have adequate convergent, predictive and nomological validity (Goodhue 1998). Other researchers have taken a similar approach to measuring TTF in different contexts (D’Ambra and Rice 2001; D’Ambra and Wilson 2004a, 2004b;

Howard and Rose 2018; Staples and Seddon 2004). Conceptually, this approach suggests that fit is highest when a user evaluates a system as having high levels of representation for each of TTF's sub-dimensions.

TTF has also been operationalized as an interaction among variables. Sometimes called atomistic fit (Edwards et al. 2006), this approach independently measures technology characteristics and task characteristics and then offers an algebraic combination of the two variables as a measure of TTF. Many studies have used the atomistic approach, with most opting for a multiplicative combination of the task and technology variables (Belanger et al. 2001; Dishaw and Strong 1998, 1999, 2003; Hee-Dong Yang et al. 2013; Keller 1994; Strong et al. 2006). Conceptually, this approach is most consistent with a contingency view of TTF such that fit between task and technology is the primary determinant of performance. When predicting performance, the atomistic approach is often useful for its ability to discriminate between varying levels of fit and misfit (Edwards et al. 2006; Hee-Dong Yang et al. 2013). However, the validity of this approach depends on the researcher's ability to comprehensively measure the salient task and technology characteristics.

A third approach to measuring TTF is the profile or profile deviation approach. Conceptualizing fit as a profile suggests that for a given task, an ideal profile of technology capabilities exist that adequately fit the requirements of the task. Fit, therefore, degrades as the characteristics of the technology deviate from the optimum profile. As discussed above, the profile view of TTF is illustrated in Zigurs and Buckland's (1998) research. Though sometimes appearing in theoretical works (Gebauer

et al. 2010; Maruping and Agarwal 2004; Zigurs and Buckland 1998), the profile view is most often found in the treatment variables of experimental research. That is, these studies develop technology conditions that represent high and low ‘fit’ for a given experimental task (Aljukhadar et al. 2014; Fuller and Dennis 2009; Goodhue et al. 2000; Junglas et al. 2008; Mathieson and Keil 1998; Parkes 2013; Shirani et al. 1999). Studies employing the profile approach have consistently found evidence that an ideal profile of technology capabilities is predictive of improved task performance.

Finally, TTF has been measured as a self-reported perception (Jarupathirun and Zahedi 2007). This approach, called molar fit (Edwards et al. 2006), attempts to directly measure the perceived fit or match between a task and the supporting technology. This method of measuring TTF asks users to gauge the extent to which a given technology is sufficient for the demands of the task, and it is more common in recent research (Goodhue et al. 1997; Jarupathirun and Zahedi 2007; Lu and Yang 2014), perhaps indicating an acknowledgement among researchers that both the technologies we study and the tasks they support are increasingly complex. Conceptually, this method is consistent with the idea of a fit construct, but it shifts the focus away from specific task and technology characteristics and toward the holistic judgement of the user. As with other operationalizations of TTF, researchers have found consistent support for the relationship between TTF and task performance.

As with any operationalization, each of the above comes with tradeoffs and caveats. For example, the hierarchical, interaction and profile approaches all potentially offer insight into the precise mechanisms by which fit induces performance. Because

these approaches segregate various task/technology characteristics, the researcher can understand how specific characteristics influence (or not) user evaluations and performance outcomes. These insights are lost when TTF is measured as a perception—a black box of ideas and beliefs about the technology, task and any number of salient variables. Despite this, perceived fit is a more portable, flexible and accessible measure of TTF. To measure TTF using the hierarchical/interaction/profile method, the researcher must first analyze both the task and the technology to identify the essential characteristics of each. As previous research has shown, these dimensions/characteristics are neither stable within an IS (Goodhue 1998) or consistent across ISs (D'Ambra and Rice 2001; Gebauer et al. 2010; Goodhue and Thompson 1995; Zigurs and Buckland 1998). Also, perceived fit instruments tend to be shorter, making them easier to integrate into larger studies where fit is of theoretical importance but is not the focal concern of the study. Finally, there is evidence that atomistic approaches may not fully address the content domain of the fit construct, which is more easily covered by a molar assessment of fit (Edwards et al. 2006).

In summary, TTF has been operationalized in many ways and each approach has distinct advantages and disadvantages. The hierarchical approach is intensive but helpful in understanding how different task/technology characteristics affect different perceptions of fit. The moderation approach is faithful to TTF theory and the definition of TTF but is at risk of underspecifying the task and technology. Profile approaches are beneficial in highly controlled settings such as experiments or tasks requiring a technology with limited uses but shift the fit assessment from the user to the researcher. The perceived fit

approach is flexible and consistent with popular definitions of TTF but lacks the granularity of more complex measures. Given the risks and benefits inherent in each approach, we chose to use a perceived fit approach to investigate the relationship between TTF and creativity. In the following section, we will describe the creative task and creative performance.

Creative Tasks

Creativity is the outcome of a heuristic task (Amabile 1983). Heuristic tasks, contra deterministic tasks, are those for which there is no known best method for completing the task. These tasks typically involve trial and error where the user relies on previously established strategies for approaching similar tasks and adjusts their strategy according to stimuli that arise during the performance. Creativity, defined as the creation of a “novel product or idea that is accepted as useful, tenable or satisfying by a significant group of people at some point in time” (Stein 1975, p. 253), is a common metric for assessing performance on heuristic tasks. Essential to an understanding of performance on a heuristic task (i.e., creativity), is the subjective and consensual nature of the evaluation of the outcomes of these tasks. For example, when researchers assess the quality of decision tasks such as admission to a university, the optimal choice is often determined by a panel of experts made up of university administrators and recruiters (Fuller and Dennis 2009). This is true of creativity as well (Althuizen and Reichel 2016; Althuizen and Wierenga 2014). Though the user may chart their own course through the task and making decisions in response to task and tool stimuli to develop solutions they

deem creative, performance is ultimately assessed by experts knowledgeable in the task domain (Amabile 1982; Csikszentmihalyi 1996).

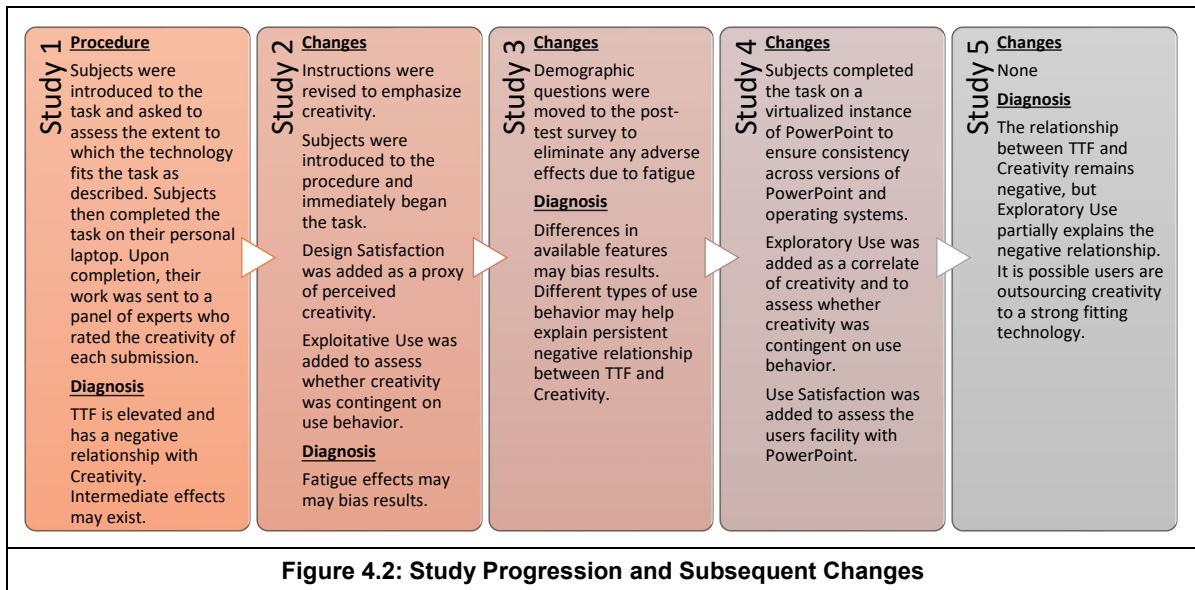
The consensual nature of creativity elevates the importance of skill in achieving task performance. Though myths of novice or outsider creativity abound, it is more likely that creative artifacts are the works of creative individuals skilled in the syntax of the domain (Csikszentmihalyi 1996; Sawyer 2012). These individuals are more likely to achieve creativity in their performances because, through study and practice, the tools of the domain have become so ingrained that little effort is expended in using the tools allowing the majority of their focus to be directed toward the task itself (Ericsson 1999; Glăveanu 2012). Though these insights largely emerge from research on physical performance or the fine arts, similar phenomena have been found in IS research. In their discussion of the flow experience, Agarwal and Karahanna (2000) suggest that for individuals cognitively absorbed in the use of a technology, the “mental workload associated with technology use should be lower since more cognitive resources are allocated to the task” (2000, p. 675). Similarly, (Vessey and Galletta 1991) argue that when problem representations match the task, the user is freed to devote more focus to the task at hand, improving problem solving efficiency and effectiveness. Conversely, when assigned a tool that poorly supports a task, users are more likely to be frustrated in their efforts and overall performance as they divert their focus from the task and to use of the technology (Goodhue 1995). In the context of using an information technology tool to design a creative artifact, we would expect to find a positive relationship between perceptions of task-technology fit and creative performance. Therefore, we hypothesize:

Core Hypothesis: Task-Technology Fit will have a positive relationship with Creativity.

Method

We conducted one study to test our core hypothesis. As we explain below, the results of this study deviate from our initial expectations and from established theory. Therefore, we shifted the focus of our study from confirmatory to exploratory and conducted four additional studies to assess the robustness of our findings. In each study, we measure the relationship between TTF and creative performance and hold constant the sampling frame, task and technology to ensure the results are comparable across all studies.²¹ Additional measures are added in subsequent studies as a means of explaining the results and assessing their reliability. Our diagnosis of the findings and the subsequent changes are highlighted in Figure 4.2. In the following sections we describe the methods that remain consistent throughout each study.

²¹ We also held constant our measure of Perceived TTF. Though an alternative operationalization of our fit variable (see the discussion of Task-Technology Fit Operationalizations above) would have helped triangulate our findings, we felt it important to understand how TTF relates to creativity for two reasons. First, the measure we use is a measure that has been used in other published works so any contrasts between our findings and those of other researchers will provide important insight into the validity of this operationalization and into the generalizability of contexts to which this measure might apply. Second, we opted to continue with a molar measure of fit because it is not clear that different measures of fit necessarily measure the same phenomenon (see Edwards et al. (2006)), and our interest is in how a subjective assessment of TTF relates to creative performance.



Design

The studies reported in this research were conducted at a large public university in the Southeastern part of the United States. Study participants were undergraduate business students who used Microsoft PowerPoint to perform a creative task. Students were recruited from an undergraduate course serving as an introduction to the Microsoft Office suite of applications.²² Pre-task and post-task surveys were administered to assess the student’s perceptions of the task and the technology. The study context differed across studies with students performing the task using PowerPoint installed on their own

²² While our sample is comprised entirely of students from a single course, the sample was chosen for its representativeness and not for its accessibility. To highlight the role of technology-fit in a creative, we sought participants who had varying levels of experience with the chosen technology, but few other skills that might influence their performance on the task. The students in our sample were in the process of completing their core requirements for the business school and had not yet begun their discipline-specific coursework. Also, because these students were sophomores and juniors, it is unlikely they had acquired much relevant work experiences. Additionally, the purpose of the course from which students were recruited is to convey basic knowledge of the Microsoft Office suite of applications with the first third of the semester devoted to the use of Microsoft PowerPoint—the technology used in our study. Therefore, our use of students who had been trained in the use of the focal technology and who had not yet acquired other domain-specific skills is appropriate in the context of this study.

laptop in a classroom setting for studies one through three and students performing the task in a virtualized PowerPoint environment in studies four and five.

Procedure

In all studies, participants were asked to develop a creative multimedia advertisement using only the features available in Microsoft PowerPoint 2016. Students were introduced to the task (i.e., to design a multimedia advertisement for a local restaurant highlighting the restaurant's family appeal and neighborhood feel that would be posted on a social media platform) and the rules for participating, reminded of the incentives for being creative and encouraged to be as creative as possible (Egan 2005). After this introduction, each subject was given a PowerPoint document which contained two slides. The first slide contained information about the restaurant (e.g., a logo, a brief description and two on-going promotions), the business problem and instructions for completing the task. The second slide was blank and would serve as the canvas for their solution. Upon completion, students uploaded their work to an online survey where it was linked to their responses to pre- and post-task instruments.

Task

The advertisement was meant to serve as a creative solution for a business problem we designed in conjunction with a local marketing firm. The firm represents many different types of businesses that had various marketing needs. The collaborating firm helped us narrow down the pool of potential prompts to three businesses—two restaurants and a miniature golf location. We selected a barbecue restaurant for its generality—barbecue is a popular cuisine in the southeastern United States—and for its

low profile—the restaurant is a small, privately owned restaurant more than 100 miles from the data collection site. The restaurant was described to the participants as a “barbecue joint with serious food at not so serious prices” that is “seeking to develop a social media campaign that targets families and enhances the restaurant’s reputation as a neighborhood destination.” Participants were told to take as much time as needed and were encouraged to use any and all features to complete the task, but they were instructed to limit their solution to a single slide.

Data Collection

To encourage participation and creativity, students were offered three incentives. First, all students were offered extra credit. Second, all students were entered into a raffle to win one of ten \$100 Amazon.com gift cards, and the students responsible for submissions that were deemed to be above average were given a second entry in to the raffle. Third, the marketing firm agreed to review the submissions and make contract opportunities available to the students with the most creative solutions. Across the five studies, 46 people (25 female) participated in Study 1, 70 people (33 female) participated in Study 2, 118 people (49 female) participated in Study 3, 46 people (21 female) participated in Study 4, and 213 people (108 female) participated in Study 5. Additional demographic information is presented in Table 4.2.

Table 4.2: Sample Demographics					
	Study 1	Study 2	Study 3	Study 4	Study 5
Male	21	37	69	24	105
Female	25	33	49	21	108
Freshman	0	5	9	0	0
Sophomore	11	39	75	1	140
Junior	17	22	31	23	68
Senior	18	4	3	21	6
Accounting	8	9	10	3	27
Economics	1	3	4	2	6
Financial Management	5	15	26	7	58
Management	29	22	38	21	60
Marketing	2	13	27	10	53
Non-Business Major	1	8	13	2	10
Age Mean	21.89	21.09	20.82	21.33	19.96
Age S.D.	1.46	1.85	1.22	1.48	0.95

For each study, data were collected in three phases. During Phase 1, students were introduced to the study and asked to register for the study by completing a brief online survey (i.e., pre-task survey). Those who completed the registration were later invited to participate in the full study and given instructions for accessing the creative task described above. Once complete, the solution was uploaded as a response to an online survey question and participants were then asked to complete the post-task questionnaire, thus concluding Phase 2 and their participation in the study. For Phase 3 all solutions were downloaded, converted into videos and uploaded to a custom website that was designed to standardize the process of rating the students' work. These solutions were independently rated by two judges²³. Each rater was given a unique login to access the

²³ The first author and another creative professional rated each submission. Both raters had worked with organizations to design online marketing campaigns and were thus capable of assessing creativity in this context (Amabile 1982).

submissions. The advertisements were anonymized and presented randomly, and the rater could rate them in any order they chose. The raters could not see each other's ratings. For more information on the coding process, please refer to Appendix A.

Measures

Research variables were measured with pre-validated instruments and/or techniques. *Perceived Task-Technology Fit* (all studies) was measured using a eight semantic differential items adapted from Jarupathirun and Zahedi (2007). Each couplet was prefixed with the phrase “**As a tool** for designing a creative multimedia advertisement, Microsoft PowerPoint was,” and sample items include Very inadequate vs. Very adequate, Very inappropriate vs. Very appropriate, etc. *Design Satisfaction* (studies 2 and 3) and *Use Satisfaction* (studies 4 and 5) were measured using four 7-point semantic differential items adapted from (McKinney et al. 2002). For Design Satisfaction, each couplet was prefixed with the phrase “Overall, how do you feel about **the creativity of your final product.**” For Use Satisfaction, each couplet was prefixed with the phrase “Overall, how do you feel about **how well you used** PowerPoint to design your creative multimedia advertisement.” Sample items include Very Pleased vs. Very Displeased, Very Contented vs. Very Discontented and Very Satisfied vs. Very Dissatisfied. *Exploitative Use* (studies 2 and 3) was measured with 5 7-point Likert items adapted from (Bala and Venkatesh 2016). Sample items include “I used features that I’ve used often to perform other tasks” and “I used features that I knew well from prior experience.” *Exploratory Use* (studies 4 and 5) was measured with 3 7-point Likert items adapted from (Ke et al. 2012). Sample items include “I tried to use new features that

helped me complete my task” and “During the task, I discovered new features to use.”

For a full list of items, see Appendix B.

To measure creativity, we used Amabile’s Consensual Assessment Technique (CAT) (Amabile 1982, 1996). The CAT proposes that solutions are creative to the extent that a panel of knowledgeable experts agree that a solution is creative. We invited a creative professional from a local non-profit (approximately 35 employees) who was responsible for creating marketing materials for the organization to join the first author in evaluating the creativity of each submission.²⁴ Each rater was asked to assess the novelty and appropriateness of the *ideas* represented in the advertisement, and to assess the novelty and appropriateness of *design* of each advertisement. All four ratings were done on a scale of one to ten with one representing very low novelty/appropriateness and ten representing the highest possible novelty/appropriateness (Althuizen and Reichel 2016). The raters exhibited adequate levels of agreement (Cohen’s kappa for each study was at least .63). For more information on the coding process, please refer to Appendix A.

Data Analyses

We used semPLS (v1.0-10) in R (3.5.1) to test our hypothesis. We chose to use PLS for its ability to handle formative and reflective variables (Chin 2010), and its ability to evaluate endogenous formative variables, such as our creativity construct (Temme et al. 2014). Also, in exploratory research where a strong theoretical foundation is lacking, PLS is a preferable to covariance-based methods for its less stringent requirements such

²⁴ The first author had served for 7 years as a consultant in a marketing firm prior to returning to academe.

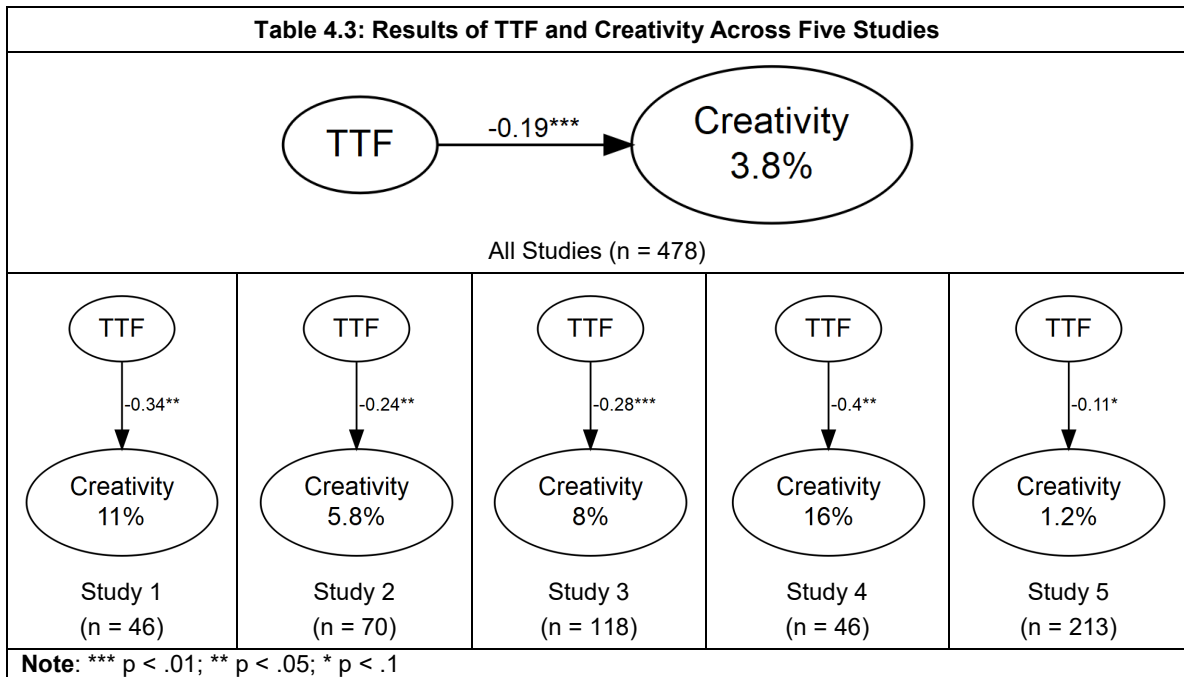
as accommodating uncorrelated measurement errors (Chin 2010) and partial model misspecification (Henseler et al. 2016).²⁵ To assess the significance of the relationships in our model, we used a bootstrap method with 1000 iterations and a bias-corrected 95% confidence interval. Creativity was estimated using a two-step approach (Becker et al. 2012; Riel et al. 2017). We chose the two-step approach because almost all of creativity's variance was explained by its first-order dimensions.²⁶ All post hoc analyses employed the same approach.

Results

The results of our studies are presented in Table 4.3. Across all five studies, TTF explained 3.8% of the variance in Creativity, with a range of explained variance from 1.1% (Study 5) to 16% (Study 4). The path estimate is $-.19$ ($p \leq .01$) for the combined studies and ranges from $-.11$ for the weakest relationship (Study 5; $p \leq .1$) to $-.28$ for the strongest relationship (Study 3; $p \leq .01$). These results support the existence theoretical link between TTF and performance but show that the relationship between TTF and creative performance (i.e., Creativity) is negative, rather than positive. This result was surprising both for its valence and its consistency. In the following sections, we discuss the steps we took to explore this relationship.

²⁵ We would like to note that we also used covariance-based SEM techniques with a computed creativity score (Polites et al. 2012) and found equivalent results.

²⁶ In the two-step method, the first step involves excluding the first-order factor and estimating the direct paths to and from each second-order latent variable. In the second step, the factor scores for the formative dimensions serve as manifest variables for the first-order factors. The component factors are removed from the model and the paths are redirected to and from the first-order factor. For more information, see Ringle et al. (2012).



Exploring the Fit/Creativity Interface

Though we expected to find a positive relationship between fit (TTF) and performance (Creativity), we found a consistent and strong negative relationship across five independent rounds of data collection. This finding is both unexpected and unusual—it is almost illogical to say that as the perceived fit between the technology and the task increases, performance decreases. In behavioral research, unexpected findings may have many causes, but they are most likely to hinge on the method employed to collect the data, the theory undergirding the relationships among variables, and the operationalization of the variables under study (Creswell 2014; Shadish et al. 2002). Decisions made in each of these areas will have consequences that may alter the results of the study. Table 4.4 summarizes our concerns in each area and the steps we took to address each concern. In the section below, we explore alternate study designs,

theoretical explanations and performance outcomes to better understand the persistent and unlikely negative TTF-to-Creativity relationship. We conclude with a summary of our findings and potential implications for TTF Theory.

Exploratory Mechanism	Description	Concern	Assessed
Design	Determines how the data are collected and from whom.	Experience may bias Perceived TTF	Study 1
Theory	Determines what data are collected and how those data are believed to be related to one another.	Intermediate factors (mediators and moderators) may explain the TTF-Creativity relationship	Mediators: Design Satisfaction (Study 2, 3) Use Satisfaction (Study 4, 5)
			Moderators: Exploitative Use (Study 2, 3) Exploratory Use (Study 4, 5)
Analysis	Determines the ways in which the relationships among variables are measured.	Measure of Creativity may obscure true TTF-Creativity relationship	Study 2, 3, 4 and 5

Alternate Designs and the Validity of TTF

Method bias is a common problem in cross-sectional studies. Method bias refers to any systematic variance attributable to the methods employed to collect data (Chin et al. 2012; Clark and Watson 1995; Podsakoff et al. 2003). After the first study, we were concerned that the order in which we collected data for the model variables might be partially responsible for the results. While this effect is present in many studies, we felt it might be uniquely problematic in our study due to the nature of the fit variable. As researchers have shown (Fuller and Dennis 2009; Goodhue and Thompson 1995), fit is emergent and somewhat dependent on prior experience with the tool and the task. In our case, we asked respondents to prospectively assess the perceived fit of a task-technology combination they had likely never encountered. Additionally, the nature of creative tasks is that they are heuristic with no right or wrong solution and no proscribed approach.

Thus, it would be difficult for a participant to accurately assess how well the technology fit the task until they had some knowledge of the task's requirements (Zigurs and Buckland 1998). To correct for this, we moved the TTF items from the pre-test to the post-test instrument. Our expectation is that in the post-test position, respondents would no longer rely on a general understanding of the task's demands and the technology's ability to support it but would instead be able to retrospectively assess the fit of the technology to the specific task they had just completed.

Table 4.5: Comparison of TTF in Sequential Studies						
Welch Two Sample t-test						
Comparison (TTF Mean)		t-value	df	sig.	95% Confidence Interval	
					Upper	Lower
Study 1 (5.361)	Study 2 (4.655)	3.377*	113.79	.001	1.120	0.292
Study 2 (4.655)	Study 3 (4.708)	-0.243	154.46	.809	0.374	-0.243
Study 3 (4.708)	Study 4 (5.035)	-1.406	96.13	.163	0.135	-0.790
Study 4 (5.035)	Study 5 (5.290)	-1.231	66.33	.222	0.159	-0.669

To test the difference between a post-test and pre-test measure of TTF, we compare the mean TTF score for consecutive studies. Because changes are made in each subsequent study, any significant difference between TTF means for sequential studies would suggest that the method is partially responsible for the calculated difference. The results of these two-sample T-tests are listed in Table 4.5. The results show that asking the user to assess TTF after having performed the creative task had a significant effect on the user's perception of TTF. All other studies show no difference in mean TTF.

These results illustrate the dynamic nature of TTF and emphasize the importance of design social science research. Researchers have shown that use of the tool alters ones evaluation of the tool's capabilities (Serrano and Karahanna 2016). Our findings seem to

support this finding as users who are asked to assess TTF prior to the creative task indicate that the fit between technology and task is significantly better than the ratings of TTF given by those users who have direct experience using the technology to perform the creative task. This suggests that incongruities between task and tool may only become salient after the user has tried to apply the technology in a particular context. Also, this finding further emphasizes the importance of research design and the risks inherent in cross-sectional designs when practice, feedback and experience are important correlates of study variables (Clark and Watson 1995). Going forward, TTF researchers should be cautious in using measures of task-technology fit as these measures are highly sensitive to the experience of using the tool to perform the task, and researchers should, when possible measure Perceived TTF after subjects perform the focal task as this measure would provide a more accurate measure of molar fit (Edwards et al. 2006). Additionally, this effect is likely to exist in measures of atomistic and molecular fit as it seems unlikely that a subject would be able to accurately assess either the demands of the task or the capabilities of the technology without having first attempted the task or used the technology.

Alternate Explanations and the Role of Mediating and Moderating Effects

When Goodhue and Thompson (1995) first theorized TTF's role in the technology-to-performance chain, they found that users whose jobs involve more non-routine tasks were significantly more likely to rate the focal system as being a poor fit for their assigned role. They explain that this result suggests these users "make more demands on systems and are more acutely aware of shortcomings" (Goodhue and

Thompson 1995, p. 226). Put another way, these results suggest that the contingency view of TTF Theory may not hold in circumstances where the task is more complex or less deterministic. When the solution and the steps required to achieve a solution are both unknown, it is likely that TTF's relationship with performance will be affected by intermediate factors having to do with the cognitive or technological processes at work during the task such as one's ability to faithfully appropriate the features that support the goals of the task (Dennis et al. 2001) or one's ability to use the technology in an effective and efficient way (Burton-Jones and Grange 2013). We will discuss these mediating and moderating relationships in the following sections.

Mediating Indicators of Performance

For deterministic tasks, the logic for a direct relationship between the user's perception of task-technology fit and their performance on the task is sound. Because the requirements of these tasks are easily defined, performance would be contingent on fit. This is illustrated in the task characteristics used in prior studies. For example, a user would be able to more quickly find a specific place using a location-enabled technology than they would if they had to rely on someone describing the steps to take, because the solution is known and the technology has features tailored to fit this type of task (Junglas et al. 2008). Similarly, tasks that require users to perform calculations (Parkes 2013) or send messages to their friends (Lu and Yang 2014) will achieve higher levels of performance when they are equipped with tools that fit these tasks.

However, as task requirements become less well-understood, the logic for a direct effect is less convincing because the task is open-ended, and the steps one takes to

achieve high levels of performance are subjective. In heuristic tasks where the destination is uncertain and the path unknown, the effect of technology fit on task performance is likely to be mediated by a variety of cognitive and affective states (Ortiz de Guinea and Markus 2009). That is, TTF is an assurance that this technology is commensurate with the task and adequately represents the affordances the task might require. Thus, TTF becomes a necessary pre-condition to using the technology in a way that would produce a desired outcome (Burton-Jones and Grange 2013).

Table 4.6: TTF-Creativity Mediation	
Study 2 (n = 70)	<pre> graph LR TTF((TTF)) -- 0.7*** --> DS(Design Satisfaction 49%) DS -- 0.43** --> Creativity((Creativity 11%)) TTF -- -0.43*** --> Creativity </pre>
Study 3 (n = 118)	<pre> graph LR TTF((TTF)) -- 0.62*** --> DS(Design Satisfaction 38%) DS -- 0.49*** --> Creativity((Creativity 16%)) TTF -- -0.43*** --> Creativity </pre>
Study 4 (n = 46)	<pre> graph LR TTF((TTF)) -- 0.69*** --> US(Use Satisfaction 47%) US -- 0.2 (ns) --> Creativity((Creativity 17%)) TTF -- -0.52*** --> Creativity </pre>
Study 5 (n = 213)	<pre> graph LR TTF((TTF)) -- 0.74*** --> US(Use Satisfaction 54%) US -- 0.25** --> Creativity((Creativity 3%)) TTF -- -0.18 (ns) --> Creativity </pre>
Note: *** p < .01; ** p < .05; * p < .1	

Suspecting that TTF might have an indirect effect on creativity, we added measures of satisfaction (Studies 2 & 3: Design Satisfaction; Studies 4 & 5: Use Satisfaction) as post-test variable to assess the extent to which the user is satisfied with their use of an IS in performance of the task. Measures of satisfaction were chosen because other researchers have argued that using a technology well is a necessary

precursor to performing well (Burton-Jones and Grange 2013; Dennis et al. 2001). Also, Burton-Jones and Grange (2013) contend that a perception of fit between the technology and the task (representational fidelity) sets the stage for making good usage decisions (informed action). The results of these test are presented in Table 4.6. In all four studies, TTF has a strong positive effect on satisfaction ($p < .01$), explaining 49% and 38% of the variance in Design Satisfaction and 47% and 54% of the variance in Use Satisfaction. Design Satisfaction has a significant ($p < .05$) positive effect on Creativity in both studies and explains an additional 5% and 8% of the variance in Creativity. Likewise, Use Satisfaction had a significant positive effect on Creativity in Study 5 and explains an additional 2% of the variance in Creativity.

There are two possible interpretations for these results (MacKinnon et al. 2006). First, TTF may be the cause of an increase in satisfaction (for design and use) which then causes an increase in creativity. This interpretation offers initial support for the effective use paradigm (Burton-Jones and Grange 2013) which argues that TTF serves as a necessary first step toward informed action (Use Satisfaction) and effective use (Creativity). Consistent with the Theory of Effective Use (Burton-Jones and Grange 2013), these results show that TTF is a necessary but insufficient component of effective use. That is, the technology must be seen as a good fit for the task, but the user must also make good choices within the tool to achieve a creative solution. An alternative interpretation is that TTF and Satisfaction are covariates which together offer a better prediction of Creativity (MacKinnon et al. 2006). Because the indirect (i.e., TTF→Satisfaction→Creativity) and direct (i.e., TTF→Creativity) have different signs,

this result suggests competitive mediation and that our analysis omits an important mediator along the direct path (Zhao et al. 2010). Regardless of the interpretation, the clear takeaway is that satisfaction with both use and design are important mediators of TTF, but neither fully explains the negative relationship between TTF and creativity. Further research is needed to fully understand the nature of the disconnect between Perceived TTF and Creativity.

Moderating Indicators of Performance

Another similar line of argument is the institutionalist view which suggests that how a user appropriates the features of a technology “is at least as important as its fit with the task” (Dennis et al. 2001, p. 172). That is, to perform a creative task well, the user must use their tools well. As an example of this perspective, Todd and Benbasat (1999) argue that while fit between technology and task matters, the technology must also stay out of the user’s way. A user may acknowledge that a tool supports the task requirements, but still perform poorly if the technology makes achieving the desired outcome so cumbersome that the user settles for less accurate but more accessible solution.

The same is likely to be true of creative expression within a technology. While a user may be aware that the tool has an adequate feature set, they may struggle in appropriating the features that would allow them to accurately express their ideas. As the struggle increases, the user is more willing to accept the tradeoff between what they desire and what they can produce (Payne 1982). In this way, the user’s appropriation of various features, would moderate the relationship between TTF and performance with

performance increasing as users more successfully or accurately appropriate the tool's features (Dennis et al. 2001).

Table 4.7: TTF-Creativity Moderation	
Study 2 & 3 (n = 188)	<p>Exploitative Use → Creativity (0.22***) Exploit X TTF → Creativity (-0.16**) TTF → Creativity (-0.28***)</p>
Study 4 & 5 (n = 260)	<p>Exploratory Use → Creativity (0.17***) Explore X TTF → Creativity (0.09 (ns)) TTF → Creativity (-0.13**)</p>
Note: *** p < .01; ** p < .05; * p < .1	

To explore this possibility, we consider two types of use in our analyses: Exploitative Use and Exploratory Use. The results are presented in Table 4.7. In studies 2 and 3, we test the role of Exploitative Use, defined as the extent to which a user uses features of an IS that the user knows well (Bala and Venkatesh 2016), as a moderator of the relationship between TTF and creativity. In both studies combined, TTF and

Exploitative Use explain 10.0% of the variance in Creativity. The interaction effect has a significant ($p < .05$) negative effect on the relationship between TTF and Creativity and explains an additional 2.7% of the variance in Creativity. In studies 4 and 5, we investigate the role of Exploratory Use, defined as the extent to which the user explored the different features of the IS (Ke et al. 2012), as a moderator. TTF and Exploratory Use explain 5.9% of the variance in Creativity. Exploratory Use has a strong significant ($p < .01$) positive effect on Creativity; however, the moderating effect is not significant ($p < .1$). Together TTF, Exploratory Use and the interaction term explain 6.7% of the variance in Creativity.

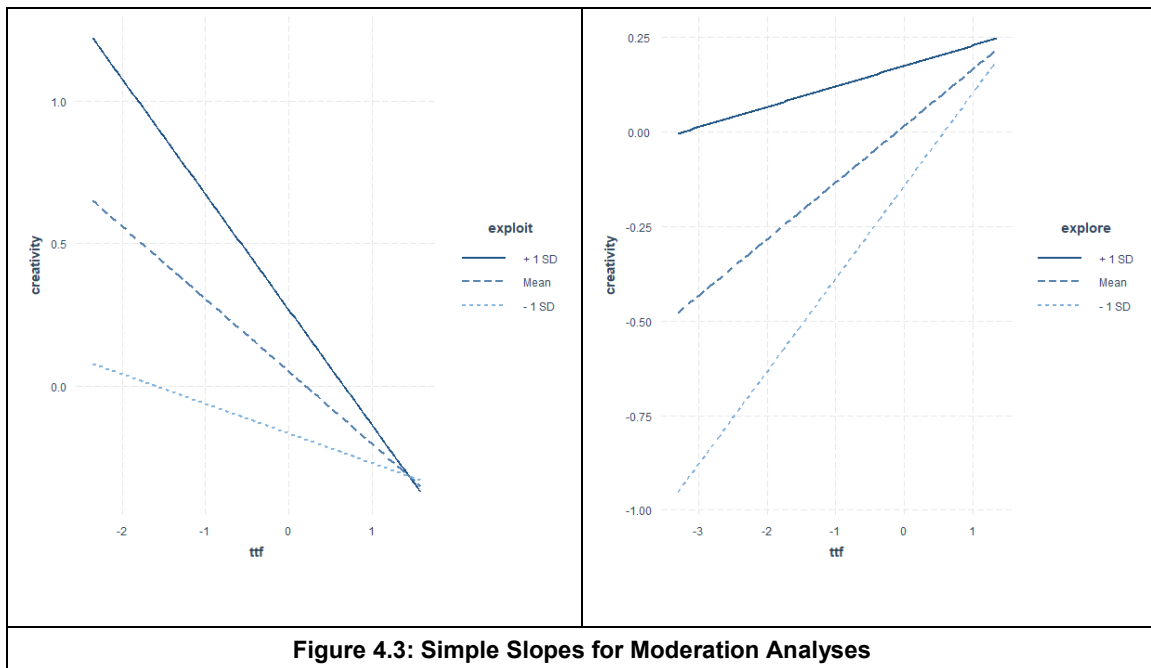


Figure 4.3: Simple Slopes for Moderation Analyses

Though only one moderating effect is significant, we find the results of these analyses to be interesting (Figure 4.3). For Exploitative Use, the negative relationships between TTF and Creativity becomes more pronounced when users exploit well-known

features and routines thus further decreasing creativity for those who believe the tool to be a good fit to the task. For Exploratory Use, interaction effect, though weakly significant, is interesting as it suggests that TTF has a positive effect on Creativity when controlling for Exploratory Use, and that effect increases as users explore more of the technology.²⁷ Taken as a whole, these results offer further support to previous research (Dennis et al. 2001; Todd and Benbasat 1999) which argues that the performance depends on both the use of an appropriate technology and the appropriate use of that technology. What is less clear is the extent to which different forms of use affect performance. More research is needed to better understand how different types of usage interact with pre-task perceptions to affect various goals and performance outcomes.

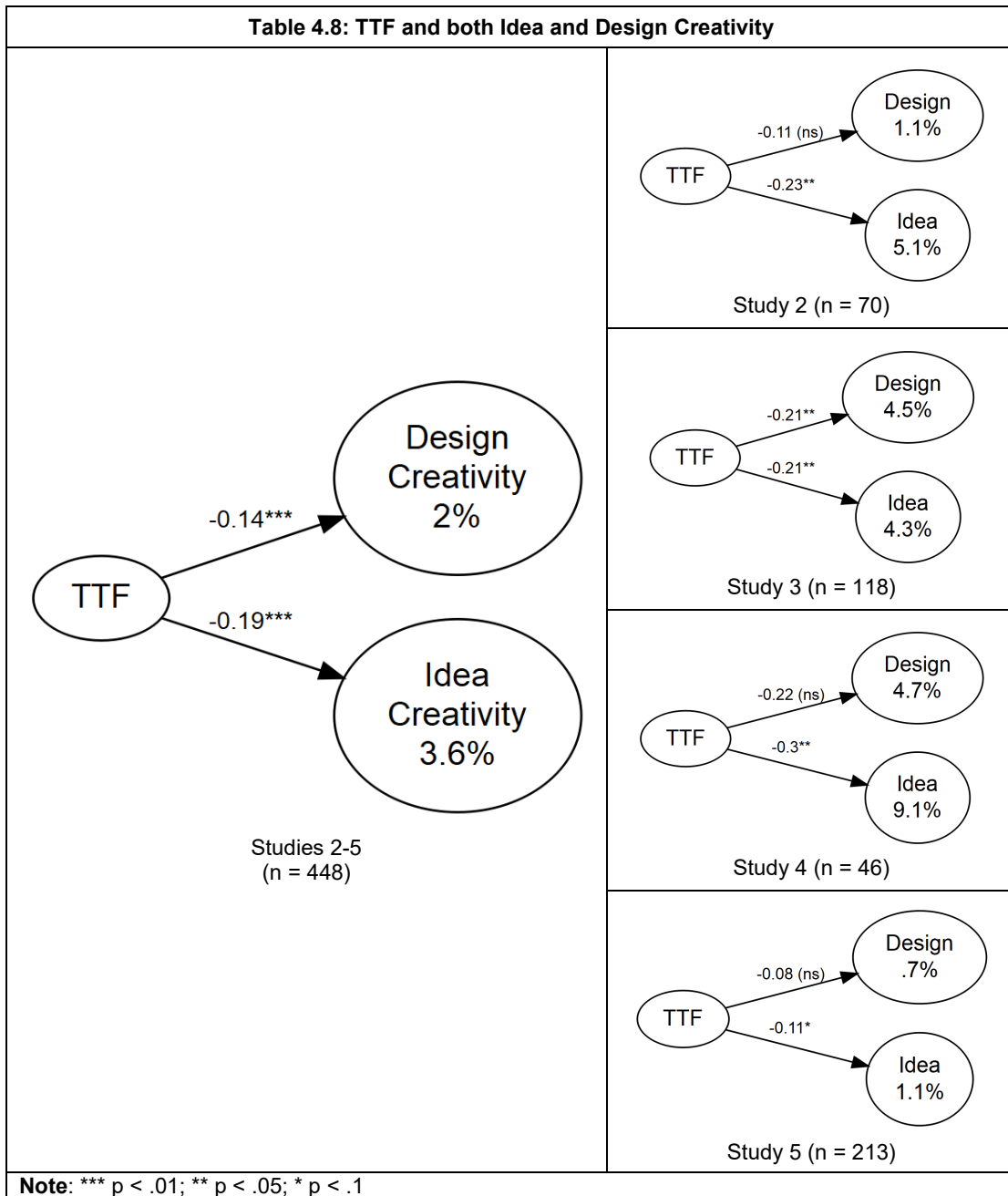
Alternate Outcomes and the Role of Measurement

Measuring performance in the context of a heuristic task is complex and fraught with subjectivity. When a user is using an IS to find a data element or piece of information, measuring their performance is straightforward: does the participant find the data element and how long does it take. The same cannot be said for more equivocal tasks because, by nature, these tasks do not have right and wrong solutions. Researchers interested in creative performance typically acknowledge that creativity is in the eye of the beholder. Therefore, to assess performance, most researchers employ a multiple rater approach (Amabile 1983), assuming that an artifact is creative if a plurality of raters

²⁷ The valence of the TTF-Creativity relationship is weakly ($p < .1$) positive in the Exploratory Use model, but the bivariate correlation between the two factors is $-.26$ ($p < .01$); therefore, we interpret this change in sign to indicate that TTF has a positive relationship on Creativity only when controlling for Exploratory Use and the interaction term (Cenfetelli and Bassellier 2009)

deem it so. A similar approach is to conceptualize creativity as the intersection of various artifact attributes, which are independently evaluated (Dean et al. 2006). The argument behind this approach is that creative artifacts have certain characteristics (e.g., novelty, usefulness, originality, technical goodness, etc.) and that solutions are creative when they contain these characteristics in increasing measure. Operationally, these dimensions are then combined to form a composite creativity value.

Our approach to measuring creativity is similar, but slightly more complex. Multimedia advertisements are an amalgamation of the creator's ideas and design choices. When faced with the creative problem our participants had to do two things simultaneously and combine them into a single artifact: generate a creative idea and realize that idea in the technology environment. We measure each component independently (i.e., raters assessed the novelty and usefulness of the participant's ideas and their design) and then combined these ratings into a single outcome variable (i.e., Creativity). Though this approach is parsimonious, it assumes that TTF relationship with creativity will be uniform across each component, and obscures information that may be valuable in understanding TTF's role if affecting creative performance. That is, though both ideas and design contribute to the creativity of an advertisement, it is not clear that TTF would have an equal effect on both. To better understand exactly how TTF effects creativity, we isolated Idea Creativity and Design Creativity as distinct constructs and calculated TTF's effect on each.



To open the black box of creativity, we modeled a direct relationship between TTF and both Idea Creativity and Design Creativity. The results of these tests appear in Table 4.8. Across four studies, TTF has a consistent negative effect on Idea Creativity with TTF explaining 5.1%, 4.3%, 9.1% and 1.1% of the variance in Idea Creativity in

studies 2 through 5, respectively (studies 2-4, $p < .05$; study 5, $p < .10$). Though TTF's effect on Design Creativity is consistently negative, the effect is significant only in study 3, where TTF explains 4.5% of the variance in Design Creativity. In all other studies, the effect fails to achieve significance.

These results are interesting because they suggest that TTF's negative effect on creativity is achieved primarily by way of reduced Idea Creativity. Though TTF also has a negative effect on the design creativity, this effect is weak and inconsistent. Together these results suggest that TTF inhibits creative idea *generation* while having little to no effect on the creativity exhibited in idea *translation*. Though there is little theory to explain this finding, it is possible that users who see the IS as an appropriate tool for creative tasks (high TTF) might also see the IS as an appropriate source for creative ideas. These users might then defer to the technology when it makes suggestions, thereby leading many users to create advertisements that are essentially the same ideas packaged in slightly different ways. Also, this effect suggests a longitudinal approach to the creative process whereby the creative idea is translated into a creative product. This finding is consistent with creativity theory which posits independent creative stages that have different goals, and thus would require different measures of performance (Amabile 1988; Amabile and Pratt 2016; Sawyer 2012; Wallas 1926). Our study clearly shows that ISs can influence performance differently in each stage.

In sum, we look to alternate methods, theories and outcomes to explain the unusual and unexpected negative relationship between TTF and creativity. Our exploration of this relationship shows that perceived TTF is highly sensitive to the user's

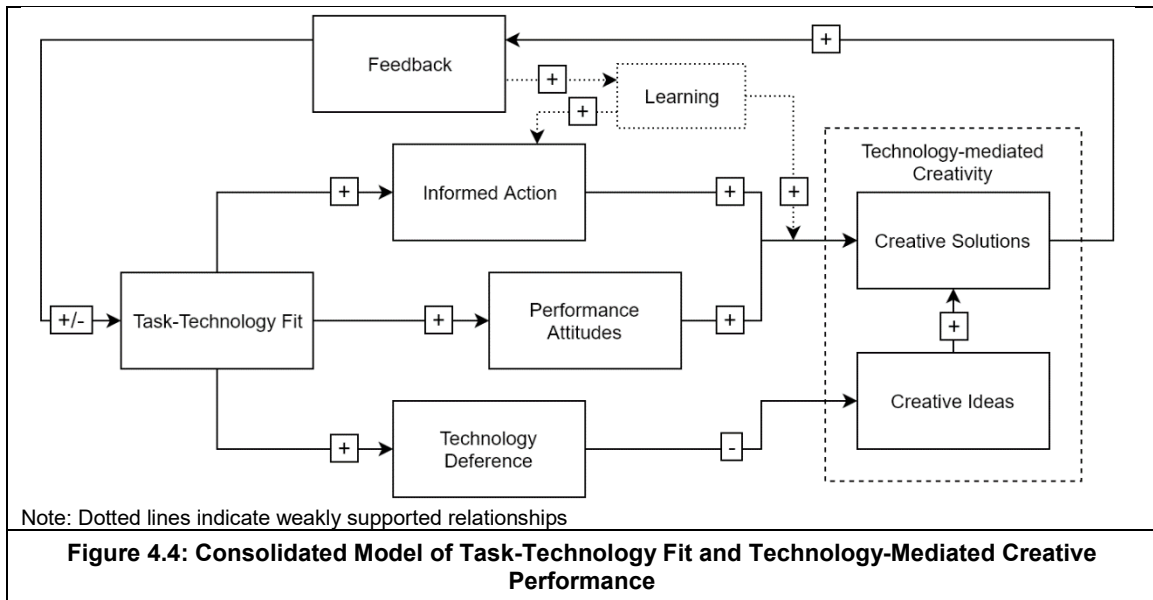
actual experience using the technology to perform the creative task. Also, we find support for mediated relationships between TTF and creativity whereby fit serves as a necessary precondition for achieving a satisfactory outcome and making informed decisions within the IS, which improve creative performance. Also, we find inconsistent evidence that the way a user appropriates a technology moderates the TTF-performance relationship. Specifically, we find that exploitative behaviors are likely to weaken the negative TTF-creativity relationship while exploratory actions strengthen the negative relationship, but these effects are weak. Finally, we find that TTF does not affect creative performance uniformly in that it has a strong negative effect on the user's ability to generate creative ideas, while having only a weakly negative effect on the user's ability to develop a creative design. In the following section we discuss the implications of our findings with respect to TTF Theory in the context of creative performance. These findings and their theoretical implication are outlined in Table 4.9.

Explanatory Mechanism	Findings	Theoretical Implications
Design	Method Bias – Perception of the appropriateness of a technology is sensitive to experience with the technology and the task.	Feedback is an important factor in the technology-to-performance chain. This is especially true when the task is unique or ad-hoc. While users are capable of forming perceptions about a technology independent of any experience with the technology, feedback anchors their perceptions in reality and must be considered in models of individual use and performance.
Theory	Representation Theory – Using an appropriate technology creates a foundation from which users may pursue informed actions.	Users are capable of identifying advantageous uses of a technology and discriminating good outcomes from bad. This means that the extent to which users believe they are equipped with an appropriate tool is an important predictor of both attitudes about the tool/task and the types of actions users employ during a task.
	Appropriation Theory – Performance is contingent on the advantageous use of an appropriate technology	Learning is a dynamic process that benefits both performance during the task and performance on subsequent tasks. Users who had previously routinized IS features or techniques were well-positioned to exploit that knowledge when needed and enhance their creative performance. Similarly, users who

		explore a technology are capable of finding advantageous uses of the features they learn.
Analysis	Ideation vs. Verification – In creative performance, use of an appropriate IS affects generating ideas and translating ideas differently	Creative performance is a process with stages that place different demands on both the user and the IS. While perceptions of fit may be helpful during the externalization phase, it can be detrimental during an earlier formulation stage as fit encourages reliance on and deference to the technology during both stages.

Discussion and Implications

The purpose of this study is to explore the usefulness of TTF theory in predicting creative performance. Over the course of five studies, we find a consistent and unexpectedly negative relationship between TTF and creativity. On the face, this result is nonsensical: as the match between a technology and a creative task increases, performance decreases. A simplistic reading of this result would encourage managers seeking greater creative output from their teams to replace powerful, flexible and appropriate systems with those which are poorly aligned with the task. Therefore, this research aims to add context to a very unusual finding by employing a series of exploratory techniques to investigate the methodological, theoretical and operational choices implicit throughout our studies. These steps reveal a more complex relationship between TTF and performance in the context of creative tasks. Figure 4.4 illustrates our findings and we will use this diagram to discuss our findings in the following paragraphs.



First, perceived TTF is sensitive to the user’s prior experience using the technology to perform a similar creative task. We find that users who have little or no specific experience using an IS to perform a creative task tend to perceive a higher level of fit than those whose perceptions are anchored in direct experience with the technology and task. Methodologically, this finding is important because it highlights the difference between a general perception and one anchored in experience. When users lack this direct experience, they are likely to believe that the technology is a good fit for the task, but as they struggle to express their creative ideas, they become aware of the technology’s shortcomings. This effect, highlighted in the path from Technology-mediated Creativity through Feedback to Task-Technology Fit in Figure 4.4, is likely to be more pronounced in the context of creative tasks, because the user will have little knowledge of the specific task requirements until they begin to formulate a solution to the problem (Dorst and Cross 2001). As their understanding of the problem evolves, the presence or absence of

needed affordances will become more salient and their assessment of fit will become more accurate. This finding offers further support for Goodhue and Thompson's (1995) contention that users with non-routine tasks tend to be more aware of the technology's inadequacies and illustrates the heuristic nature of creative tasks.

Next, we find support for partial mediation of the TTF-creativity relationship, illustrated in the paths from Task-Technology fit through Informed Action and Performance Attitudes to Creative Solutions in Figure 4.4. Though the direct effect of TTF on creativity is negative, we find that TTF increases the user's satisfaction with both their use of the tool and the outcome of that use and that these effects make a significant positive contribution to creativity (MacKinnon et al. 2006). For Use Satisfaction, we believe this is indicative of Burton-Jones and Grange's (2013) Informed Action in that users who believe the technology to be an appropriate tool for the task are more likely to make better or more satisfactory decisions within the tool. In this way, TTF suggests that the tool is faithful representation of the creative task which provides a foundation for further action. As the faithfulness of the representation increases, the user is better situated to make advantageous or informed decisions throughout the task, leading to increased performance. Similarly, Design Satisfaction mediates the relationship between TTF and Creativity, highlighting the importance of Performance Attitudes—believing that the technology will help or has helped you achieve your goals—in predicting performance. Those users for whom fit is predictive of their design satisfaction are intimating that they believe the use of an appropriate technology to be partly responsible for their satisfaction with their designs. The idea that TTF would affect the user's

attitudes was first presented by Goodhue and Thompson (1995) and later supported by Dishaw and Strong (1999) when they show that TTF enhances the user's perception of technology usefulness and ease of use. Though these studies focus on TTF's influence on attitudes about the technology, it is likely that, because the technology is instrumental in performing the task, TTF would improve general beliefs about the task itself such as motivation (Deci and Ryan 1985; Locke 1968) and task difficulty (Hobfoll 1989; Payne 1982), which have been shown to be predictors of creative performance (Amabile and Pratt 2016).

In addition to mediating factors, the TTF-creativity relationship is likely benefit from techniques and use behaviors that result from feedback and learning. Though our results only partially support this claim, there is considerable theoretical and anecdotal evidence to support the idea that users more skilled in the application of creative tools will exhibit higher levels of creativity with those tools (Burton-Jones and Grange 2013; Dennis et al. 2001; Ericsson 1999; Gladwell 2011; Glăveanu 2012). Learning would thus improve both the quality of the user's actions and the ways in which those actions are performed. First, users who have a deeper knowledge of a technology would simply be better equipped to perform a creative task. This is supported by our finding that Exploratory Use is directly and positively related to Creativity and illustrated in the path from Feedback through Learning to Informed Action in Figure 4.4. These users who explore the technology are finding features within the IS that directly improve their performance on the immediate task. Additionally, as users continue to practice with the system, they will begin to develop time- and effort-saving techniques such as shortcuts,

hotkeys and stored procedures that would improve the expert's efficiency and allow them to devote more attention to the task at hand. This is illustrated in the path from Feedback through Learning to moderate performance in Figure 4.4. These users are bolstered by their knowledge of the IS and achieve higher levels of performance by exploiting the well-known features and techniques of an appropriate technology. For example, most enterprise business intelligence (BI) tools have drag-and-drop interfaces for creating ad hoc reports. Expert users would be well-versed in these features but would also have a knowledge of more advanced features such as stylesheets, custom queries, JavaScript injection and API integration. While these skills may not improve performance in basic BI tasks, they would give experts access to a wider diversity of creative solutions as the tasks become more complex.

Finally, our work indicates that computer-mediated creativity is a multi-dimensional concept and TTF's effect is not uniform across dimensions. Most creativity research in the IS domain focuses on the generation of ideas. Those studies which move beyond ideas to include creative artifacts, limit the scope of the artifact to narrative solutions (e.g., descriptions of an advertising campaign (Althuizen and Reichel 2016)). When the level of abstraction between ideas and solutions is low—as it is in written solutions—the differential effects of TTF on ideas and design will be indistinguishable. As the abstraction increases fit will begin to affect each differently.

Absent in our analysis is an explanation for the negative relationship between TTF and Creativity. We have shown that creative designs will be positively influenced by the user's perception of fit and their skill with the technology as design is primarily an act

of externalizing one's ideas. However, it is possible that creative ideas will be negatively affected to the extent that the user defers to the preferences of the technology. IS researchers have long acknowledge that systems are *designed*, and are therefore enmeshed with the assumptions and preferences of the designers (Orlikowski and Iacono 2001; Sun 2012). During the act of creation, these biases arise in many forms (e.g., default fonts, colors, layouts, values, relationships, etc.) and each prompts the user to a decision. Though the user is working alone, the technology, through these suggestions, becomes a kind of collaborator on the task whose opinions and preferences bias the final result. When a user perceives a high level of fit between technology and task, they are more likely to discount their own ideas, believing that the technology is better suited for the task and has better ideas than they do. As a result, users opt for solutions that nearly-but-not-quite expresses their intent, trusting the technology knows best. As users increasingly defer to the technology, their works take on an increasingly anodyne appearance; perhaps attractive but lacking any originality from the user.

Limitations and Future Research

The limitations of this research stem from its exploratory nature. At the outset, we expected to find a positive relationship between TTF and creativity and, thus had a very different project in mind. As the consistent and unexpected negative relationship emerged, our project began to evolve in hopes of explaining this very unusual relationship. Regardless, our findings reveal other areas of inquiry that should interest IS researchers. Specifically, we find that use Design and Use Satisfaction generally mediate the TTF-creativity relationship. Though the effect was absent in Study 4, there is reason

to believe that using an IS well is a necessary link in the Technology-to-Performance chain (Goodhue and Thompson 1995). Future researchers should use our finding to build a more sound measure of informed action (Burton-Jones and Grange 2013). Also, our moderation analyses reveal theoretically consistent valences for the Exploitative Use and Exploratory Use moderators, but the relationships are weakly supported. It is likely that learning would have a moderating influence on creative performance, and our work should encourage researchers to explore these relationships. Additionally, there is little research to support the hierarchical nature of creativity where creative artifacts emerge from creative ideas. As creativity is increasingly mediated through technology the field needs a better understanding of this relationship. Finally, our research points to a deference phenomenon where users subsume their preferences to those of the technology. While these choices may increase efficiency or consistency, they are detrimental to creativity. However, there is very little research explaining how or why ISs might have an inhibiting effect on performance. Future researchers should explore these issues.

Conclusion

TTF is an important conceptual framework for understanding the technology-to-performance chain but the landscape of technologies and technology-supported tasks has changed drastically since its introduction to the field of IS. As digitization spreads to more organizational process and products, ISs are increasingly used to perform tasks that are more complex and heuristic than was common in the 1990's. In this research, we investigate TTF's relationship to performance in the context of creative tasks and find something very unexpected: a strong and consistent negative relationship. This finding

serves as a launching point for further exploration. Across five independent studies, we search for alternate study designs, theoretical explanations and performance measurements that might shed light on the unusual finding that users who believe the IS to be a good fit for their task tend to produce less creative solutions. These further investigations show that TTF is highly dependent on first-hand knowledge of both the IS and the task, that TTF is a necessary but insufficient requirement for improved performance and that TTF may cause users to discount their own ideas and instead defer to the technology, thus limiting the creativity of their solutions. Our work both illustrates TTF's value as a predictor of performance and the need for further theorizing in this area. We hope that these findings encourage other researchers to continue exploring the role of TTF in affecting performance for creative and heuristic tasks.

APPENDICES

APPENDIX A. CODING PROCEDURES FOR CHAPTER 1

We followed a multi-step systematic process to code each article in our sample. In this section, we list and describe each of these steps. An example of our data collection for follows.

Identify Sample Frame

Our aim was to summarize a representative population of creativity research conducted within the IS discipline. The Association for Information Systems (AIS), the field's professional society, recognizes eight journals as the top journals in the field, and encourages deans and department chairs to similarly acknowledge these eight journals as sources of high quality IS research²⁸. As such, we elected to limit our survey to any research article ever published in one of the *AIS Senior Scholar's Basket of Journals*.

Search Criteria

To build our sample, we began by identifying prior reviews of creativity research. At the time of our search, two such reviews have been conducted. In the first review, (Seidel et al. 2010) searched basket journals for articles including “creativity*” in the title, keyword, and abstract fields. Their search returned 42 articles. In a second review, (Müller-Wienbergen et al. 2011) searched the top 20 MIS journals for articles including the search terms “(creativ* manage* OR innov* manage*) AND (information system* or IS).” Their search revealed 19 articles published five of the eight basket journals (MIS Quarterly, Information Systems Research, Journal of Management Information Systems, Journal of Strategic Information Systems, Journal of the Association for Information

²⁸ <https://aisnet.org/page/SeniorScholarBasket>

Systems). After combining these samples, we began with an initial sample of 50 unique publications from the eight basket journals. It is common for reviews to use a single article as the genesis of all future research in a domain (Jones and Karsten 2008), but creativity research lacks a single defining theoretical frame. Therefore, to add to this sample, we used Thomson/Reuters WebOfScience to search each journal for articles matching the keyword “creativ*”. WebOfScience offers a more exhaustive search than similar databases because their search algorithm scans titles, abstracts, user provided keywords and WebOfScience derived keywords which are generated intelligently according to the citation patterns (citation to and citations of) of the published work. This search identified 60 additional articles and brought our initial sample to 110 published works.

Inclusion Criteria

Though an article matches our search criteria, it may not necessarily relate to creativity research. Therefore, we developed a coding checklist to separate those articles that scientifically or theoretically engage the creativity phenomenon from those that might use creativity terms casually or euphemistically. First, we read the abstract, introduction and conclusion of each article. If the authors suggest that their work makes a contribution to creativity research, the paper was included in the sample. Articles that failed this check were submitted to a second, more in-depth check. If the article was a conceptual or design paper, we searched its theoretical development for indication that the authors were building their work on a foundation that was reliant upon prior creativity research. If the article was an empirical paper we expanded this search to include support

for hypotheses. If we found links to creativity research or a creativity construct, the article was included. If no links were found, we searched the body and references of the article for matches to the term “creativ*” to assess whether the creativity phenomenon represented a significant concern for the authors. Articles which fail all three tests were excluded from the sample. The final sample contained 58 articles.

Coding Procedures

The coding procedures were developed iteratively over two rounds of coding. The first round of coding was conducted to refine the procedures to ensure consistency across the entire sample. In the first round, half of the original sample of 107 articles were analyzed. Each article was assessed according to the inclusion criteria described above. The articles that were included were then read and coded with respect to four measures: view of the IS, role of the IS, Creativity Systems and Creativity Activities. For view of the IS, articles were assigned a value of tool, proxy, ensemble, computational or nominal. For role of the IS, articles were assigned a value of enable, inhibit, both or none. A single research article may explore multiple systems and activities so each system and activity was coded according to whether it was discussed in the article. Also, the type of research, research design, type of analysis and stream of research was recorded for each article.

After the first round of coding, the results were discussed, and problems and potential problems were discussed. A primary concern was our ability to consistently classify evidence of interest in a particular creative system or category. To address this concern, a coding instrument was developed which allowed the first author to extract and store quotes from each article. To justify the presence of a system or activity, a quote

would be entered into the instrument and would then serve as evidence of the specified system/activity. Upon completion of the instrument, the entire sample of 107 articles was coded (or re-coded).

Figure A.1: Sample Coding Instrument

Journal		Iss.	Vol.	Year	Include
Information Systems Journal		4	19	2009	<input checked="" type="checkbox"/>
Title			Authors		
From generative fit to generative capacity: exploring an emerging dimension of information systems design and task performance			Avital, Michel; Te'eni, Dov		
Abstract					
Information systems (IS) research has been long concerned with improving task-related performance. The concept of fit is often used to explain how system design can improve performance and overall value. So far, the literature has focused mainly on performance evaluation criteria that are based on measures of task efficiency, accuracy, or productivity. However, nowadays, productivity gain is no longer the single evaluation criterion. In many instances, computer systems are expected to enhance our creativity, reveal opportunities and open new vistas of uncharted frontiers. To address this void, we introduce the concept of generativity in the context of IS design and develop two corresponding design considerations –'generative capacity' that refers to one's ability to produce something ingenious or at least new in a particular context, and 'generative fit' that refers to the extent to which an IT artefact is conducive to evoking and enhancing that generative capacity. We offer an extended view of the concept of fit and realign the prevailing approaches to human–computer interaction design with current leading-edge applications and users' expectations. Our findings guide systems designers who aim to enhance creative work, unstructured syntheses, serendipitous discoveries, and any other form of computer-aided tasks that involve unexplored outcomes or aim to enhance our ability to go boldly where no one has gone before. In this paper, we explore the underpinnings of 'generative capacity' and argue that it should be included in the evaluation of task-related performance. Then, we briefly explore the role of fit in IS research, position 'generative fit' in that context, explain its role and impact on performance, and provide key design considerations that enhance generative fit. Finally, we demonstrate our thesis with an illustrative vignette of good generative fit, and conclude with ideas for further research.					
Tags					
creativity; environment; Technology; Innovation; human-computer interaction; Systems design; software; impact; human-computer interaction; architecture; creativity support-systems; generative capacity; generative design; ideas; requirements engineering; style; team					
Theories			Constructs		
convergent thinking and divergent thinking; Design Theory; Generativity			Generative Fit; Generative Capacity		
Research Design	Research Type	Analysis	Stream		
Theory	Conceptual	Qualitative	1) Information Systems Developme ▾		
Summary					
In this article, the authors introduce the concept of generative fit (GF). GF is the extent to which a system accommodates a user's generative capacity (GC). GF is a trait of the system while GC is a trait of the individual. Systems designed to improve fit will allow users to fully express their GC.					
IS Conceptualization					
Tool View					
This perspective views the computing resource as a particular piece of equipment, application or technique which provides specifiable information processing capabilities. An information technology-based system is designed to complement, bolster and enhance the inherent generative capacity of its users					
IS Effect					
Enabler					
IT is believed to have a positive effect (directly or indirectly) on creativity We define generative fit as the extent to which the functionality and process support of a (computer) system are designed to complement and enhance one's innate generative capacity in a particular task-driven context.					
Creativity System					
Behavior					
It evokes new thinking and enables them to translate their ideas into a new context					
Self					
The collection of exhibited or believed individual traits which are most likely to enhance or stifle creativity. Generative capacity, however, relates to one's ability to deal with unclear tasks with high ambiguity, open-ended in nature and in which one is expected to be innovative, expansive and make a difference					
Creativity Activity					
Acquiring					
Collecting broad sets of information or skills which might be useful in addressing the problem as it is currently framed. Supporting the ability to overlay traditionally unrelated subsystems or objects through integrated platforms provides much insight about interoperability between heterogeneous systems and promotes system-wide boundary crossing, across-the-board sharing and cross-fertilization					
Supplementing					
Receiving problem-relevant instruction, training or information from peers and mentors. Communication refers to one's ability to talk and share information with other actors and stakeholders with no regard to institutionally imposed boundaries. Communication tools enable cross-fertilization through sharing of information, participative action, ad hoc and ongoing cooperation and collaborative work practices					
Combining					
Enlarging an existing idea by integrating ideas or parts of ideas from members of the social environment. Communication tools enable cross-fertilization through sharing of information, participative action, ad hoc and ongoing cooperation and collaborative work practices					
Translating					
Using the tools and syntax of the domain to translate an idea into a tangible solution. Designing adaptive systems that incorporate continuous learning and improvement based on codified use patterns and other performance measures allows users to shift resources from system operations to generating the desired outputs					
Improving					
Integrating feedback from the field for the purpose of enhancing the novelty or usefulness of the translated artifact. Peer-production promotes innovation through collective action that yields chains of uncoordinated successive evolutionary changes in response to market demands and emerging opportunities. Renewal refers to building an integrative path for continuous fine-tuning as well as radical innovation					

APPENDIX B. INCLUDED STUDIES

Year	Author(s)	Title	Type	Analysis	Stream	View	Role	Systems	Activities
1986	Weber, E. Sue	Systems to Think With: A Response to A Vision for Decision Support Systems	Design	Qualitative	DSS	tool	Enabler	Cognitive, Self	Sensing, Framing, Activating, Integrating, Isolating
1987	Nunamaker, Jay F.; Applegate, Lynda M.; Konsynski, Benn R.	Facilitating Group Creativity: Experience with a Group Decision Support System	Exploratory	Both	GDSS	tool	Both	Behavior, Cognitive, Group	Framing, Acquiring, Generating
1990	Elam, Joyce J.; Mead, Melissa	Can Software Influence Creativity?	Empirical	Both	DSS	tool	Enabler	Behavior, Cognitive, Social	Framing, Acquiring, Isolating, Generating, Converting, Translating
1990	Easton, George K.; George, Joey F.; Nunamaker, Jay F.; Pendergast, Mark O.	Using Two Different Electronic Meeting System Tools for the Same Task: An Experimental Comparison	Empirical	Quantitative	GDSS	tool	Both	Behavior, Group	Generating, Combining, Refining, Converting
1992	Lilley, S.	Overcoming the disabling effects of executive information systems	Conceptual	Qualitative	DSS	tool	Inhibitor	Behavior, Cognitive	Sensing, Socializing, Framing, Generating, Converting
1993	Couger, J. Daniel; Higgins, Lewis F.; McInyre, Scott C.	(Un)Structured Creativity in Information Systems Organizations	Conceptual	Qualitative	IS Development	nominal		Behavior, Group	Framing, Acquiring, Generating
1993	Dennis, Alan R.; Daniels, Robert M.; Hayes, Glenda; Nunamaker, Jay F.	Methodology-Driven Use of Automated Support in Business Process Re-Engineering	Design	Qualitative	IS Development	tool	Enabler	Behavior	Generating, Combining, Refining, Converting, Translating
1994	Nagasundaram, Murlil; Bostrom, Robert P.	The Structuring of Creative Processes Using GSS: A Framework for Research	Conceptual	Qualitative	GDSS	tool	Enabler	Behavior, Cognitive, Group, Social	Generating
1995	Ocker, Rosalie; Hiltz, Starr Roxanne; Turoff, Murray; Fjermestad, Jerry	The Effects of Distributed Group Support and Process Structuring on Software Requirements Development Teams: Results on Creativity and Quality	Empirical	Quantitative	GDSS	tool	Enabler	Behavior, Group	Framing, Activating, Generating, Combining, Refining, Converting, Translating
1996	Wastell, D. G.	The fetish of technique: Methodology as a social defence	Exploratory	Qualitative		tool	Inhibitor	Behavior, Cognitive	
1996	Masseti, Brenda	An Empirical Examination of the Value of Creativity Support Systems on Idea Generation	Empirical	Quantitative	DSS	tool	Both	Behavior, Self	Activating, Generating
1997	Vandenbosch, B.; Huff, S. L.	Searching and scanning: How executives obtain information from executive information systems	Exploratory	Both	DSS	ensemble	Both	Behavior, Self, Social	Sensing, Framing, Acquiring, Generating
1998	Wierenga, Berend; van Bruggen, Gerrit H.	The Dependent Variable in Research into the Effects of Creativity Support Systems: Quality and Quantity of Ideas	Conceptual	Qualitative	DSS	tool	Enabler	Behavior, Self	Generating

Year	JMIS	Author(s)	Title	Type	Analysis	Stream	View	Role	Systems	Activities
1998	JMIS	Schenk, K. D.; Vitalari, Nicholas P.; Davis, K. Shannon	Differences between Novice and Expert Systems Analysis: What Do We Know and What Do We Do?	Empirical	Both	IS Development	nominal		Behavior, Cognitive	Framing, Activating, Isolating, Generating, Converging
1998	JMIS	Ocker, Rosalie; Fiermestad, Jerry; Hiltz, Starr Roxanne; Johnson, Kenneth	Effects of Four Modes of Group Communication on the Outcomes of Software Requirements Determination	Empirical	Quantitative	IS Development	nominal		Behavior, Group	Framing, Translating
1999	JMIS	Satzinger, John W.; Garfield, Monica J.; Nagasundaram, Muri	The Creative Process: The Effects of Group Memory on Individual Idea Generation	Empirical	Quantitative	GDSS	tool	Enabler	Behavior, Cognitive, Group	Framing, Activating, Generating
1999	JSIS	Lee-Partridge, J. E.; Teo, T. S. H.; Lim, V. K. G.	Information technology management: the case of the Port of Singapore Authority	Exploratory	Qualitative	IS Development	nominal		Behavior, Group, Social	Sensing, Socializing, Framing
1999	MISQ	Nambisan, Satish; Agarwal, Ritui; Tanniru, Mohan	Organizational Mechanisms for Enhancing User Innovation in Information Technology	Empirical	Both	IS Development	nominal		Behavior, Cognitive, Self	Acquiring, Supplementing, Integrating
2000	MISQ	Cooper, Randolph B.	Information Technology Development Creativity: A Case Study of Attempted Radical Change	Exploratory	Qualitative	IS Development	nominal		Behavior, Cognitive, Self, Group, Social	Socializing, Framing, Acquiring, Generating, Combining, Translating, Evaluating, Elaborating
2000	ISJ	Lee, J.; Truex, D. P.	Exploring the impact of formal training in ISD methods on the cognitive structure of novice information systems developers	Empirical	Quantitative	IS Development	nominal		Behavior, Cognitive	Framing, Generating, Converging, Translating
2001	MISQ	Majhotra, A.; Majchrzak, A.; Carman, R.; Lott, V.	Radical innovation without collocation: A case study at Boeing-Rockledge	Exploratory	Qualitative	Co-Creation	tool	Enabler	Behavior, Group	Framing, Supplementing, Generating, Combining, Refining, Converging, Translating, Evaluating, Improving
2001	ISR	Garfield, Monica J.; Taylor, Nolan J.; Dennis, Alan R.; Satzinger, John W.	Research Report: Modifying Paradigms/Individual Differences, Creativity Techniques, and Exposure to Ideas in Group Idea Generation	Empirical	Quantitative	GDSS	tool	Enabler	Behavior, Cognitive, Self, Group	Activating, Generating
2002	JMIS	Hender, Jillian M.; Dean, Douglas L.; Rodgers, Thomas L.; Numamaker, Jay F.	An Examination of the Impact of Stimuli Type and GSS Structure on Creativity: Brainstorming versus Non-Brainstorming Techniques in a GSS Environment	Empirical	Quantitative	GDSS	tool	Enabler	Behavior, Cognitive, Group	Framing, Activating, Generating

	Author(s)	Title	Type	Analysis	Stream	View	Role	Systems	Activities
2002	Roubah, K.; Ouid-ali, S.	PUZZLE: a concept and prototype for linking business intelligence to business strategy	Design	Qualitative	GDSS	tool	Enabler	Behavior, Cognitive, Group	Sensing, Socializing, Framing, Activating, Integrating, Generating
2003	Lee, H.; Choi, B.	Knowledge management enablers, processes, and organizational performance: An integrative view and empirical examination	Empirical	Quantitative		nominal		Behavior, Self, Group, Social	Socializing, Framing, Supplementing
2004	Bruque-Camara, S.; Vargas-Sanchez, A.; Hernandez-Ortiz, M. J.	Organizational determinants of IT adoption in the pharmaceutical distribution sector	Exploratory	Both		nominal		Self, Social	
2004	Santanen, E. L.; Briggs, R. O.; De Vreede, G. J.	Causal relationships in creative problem solving: Comparing facilitation interventions for ideation	Empirical	Quantitative	GDSS	tool	Enabler	Behavior, Cognitive, Self	Framing, Activating, Generating, Combining, Refining
2005	Tiwana, Amrit; McLean, Ephraim R.	Expertise Integration and Creativity in Information Systems Development	Empirical	Quantitative	IS Development	nominal		Behavior, Self, Group	Framing, Acquiring, Supplementing, Integrating, Generating, Translating, Evaluating
2005	Ahuja, Manju K.; Thatcher, Jason Bennett	Moving Beyond Intentions and Toward the Theory of Trying: Effects of Work Environment and Gender on Post-Adoption Information Technology Use	Empirical	Quantitative		tool		Behavior, Cognitive, Social	
2006	Dean, Douglas L.; Hender, Jillian M.; Rodgers, Thomas L.; Santanen, Eric L.	Identifying Quality, Novel, and Creative Ideas: Constructs and Scales for Idea Evaluation	Methodology	Both	DSS	nominal		Behavior	Generating
2007	Tarafdar, Monideepa; Gordon, Steven R.	Understanding the influence of information systems competencies on process innovation: A resource-based view	Exploratory	Qualitative	IS Development	proxy	Enabler	Social	Socializing, Acquiring, Supplementing, Generating, Translating
2007	Datta, Pratim	An Agent-Mediated Knowledge-in-Motion Model	Conceptual	Qualitative		computational	Enabler	Behavior, Self, Social	Sensing, Acquiring, Supplementing, Integrating, Generating, Translating, Evaluating, Elaborating
2008	Aeen, Ivan	Essence: facilitating software innovation	Design	Qualitative	IS Development	nominal		Behavior, Neurological, Cognitive, Self, Group, Social	

	Author(s)	Title	Type	Analysis	Stream	View	Role	Systems	Activities
2009	Avital, Michel, Te'eni, Dov	From generative fit to generative capacity: exploring an emerging dimension of information systems design and task performance	Conceptual	Qualitative	IS Development	tool	Enabler	Behavior	Acquiring, Supplementing, Combining, Translating, Improving
2009	Stacey, Patrick; Nandhakumar, Joe	A temporal perspective of the computer game development process	Exploratory	Qualitative	IS Development	nominal		Behavior, Cognitive, Social, Cultural	Framing, Acquiring, Generating, Combining, Translating, Evaluating, Improving
2009	Leimeister, Jan Marco; Huber, Michael; Bretschneider, Ulrich; Krcmar, Helmut	Leveraging Crowdsourcing: Activation-Supporting Components for IT-Based Ideas Competition	Design	Qualitative	Co-Creation	tool	Enabler	Behavior, Cognitive, Social	Acquiring, Supplementing
2009	Füller, Johann; Mühlbacher, Hans; Matzler, Kurt; Jawescki, Gregor	Consumer Empowerment Through Internet-Based Co-creation	Empirical	Quantitative	Co-Creation	tool	Enabler	Behavior, Cognitive, Self	Framing, Elaborating
2009	Gupta, Amar; Mattarelli, Elisa; Seshasai, Satwik; Broschak, Joseph	Use of collaborative technologies and knowledge sharing in co-located and distributed teams: Towards the 24-h knowledge factory	Empirical	Both	IS Development	nominal		Behavior, Group	
2010	Briggs, Robert O.; Reing, Bruce A.	Bounded Ideation Theory	Conceptual	Qualitative	GDSS	tool	Enabler	Behavior, Cognitive, Self, Group	Framing, Acquiring, Activating, Isolating, Escaping, Generating, Combining, Evaluating, Elaborating
2011	Gray, Peter H.; Parise, Salvatore; Iyer, Bala	Innovation Impacts of Using Social Bookmarking Systems	Empirical	Quantitative	Co-Creation	tool	Enabler	Behavior, Social	Acquiring, Supplementing, Generating
2011	Knoll, Stefan; Werner, Horton, Graham	Changing the Perspective: Using a Cognitive Model to Improve thinkLets for Ideation	Design	Qualitative	DSS	tool	Enabler	Behavior, Cognitive, Self	Activating, Generating
2011	Kohler, Thomas; Fueller, Johann; Matzler, Kurt; Stieger, Daniel	Co-Creation in Virtual Worlds: The Design of the User Experience	Design	Both	Co-Creation	tool	Enabler	Behavior, Cognitive	Socializing, Acquiring, Activating, Supplementing, Translating, Evaluating
2011	Müller-Wienbergen, Felix; Müller, Oliver; Seidel, Stefan; Becker, Jörg	Leaving the Beaten Tracks in Creative Work - A Design Theory for Systems that Support Convergent and Divergent Thinking	Design	Qualitative	DSS	tool	Enabler	Behavior, Cognitive, Self	Acquiring, Activating, Isolating, Generating
2011	Arazy, Ofer; Nov, Oded; Patterson, Raymond; Yeo, Lisa	Information Quality in Wikipedia: The Effects of Group Composition and Task Conflict	Empirical	Both	Co-Creation	nominal		Behavior, Self, Group, Social	Framing, Translating, Improving

	Author(s)	Title	Type	Analysis	Stream	View	Role	Systems	Activities
2012	MISO	Sun, Heshan	Empirical	Quantitative		ensemble		Behavior, Cognitive, Self, Social	Framing, Acquiring, Activating, Generating
2013	JAIS	Javadi, Elahe; Gebauer, Judith; Mahoney, Joseph	Design	Qualitative	DSS	tool	Enabler	Behavior, Cognitive, Self, Group	Acquiring, Activating, Integrating, Isolating, Generating, Combining, Converging
2013	ISR	Hildebrand, Christian; Häubl, Gerald; Herrmann, Andreas; Landwehr, Jan R.	Empirical	Quantitative	Co-Creation	nominal		Behavior, Cognitive, Self, Social	Activating, Translating, Evaluating
2013	JMIS	Denis, Alan R.; Minas, Randall K.; Bhagwatwar, Akshay P.	Empirical	Quantitative	DSS	nominal		Behavior, Cognitive	Activating, Generating
2014	JAIS	Schlagwein, Daniel; Bjørn-Andersen, Niels	Exploratory	Qualitative	Co-Creation	tool	Enabler	Behavior, Social	Generating, Translating, Evaluating, Improving, Elaborating
2014	JMIS	Althuizen, Niek; Wierenga, Berend	Empirical	Quantitative	DSS	tool	Enabler	Behavior, Cognitive	Activating, Generating
2016	ISR	Slanko, Michael A.	Empirical	Quantitative	Co-Creation	tool	Enabler	Behavior, Cognitive, Social	Acquiring, Translating
2016	ISR	Blohm, Ivo; Riedl, Christoph; Fuller, Johann; Leinmeister, Jan Marco	Empirical	Quantitative	Co-Creation	tool	Both	Behavior, Cognitive	Evaluating
2016	ISR	Majchrzak, Ann; Malhotra, Arvind	Empirical	Quantitative	Co-Creation	nominal		Cognitive, Self, Group	Framing, Activating, Supplementing, Generating, Combining, Refining, Converging
2016	ISJ	Ebel, Philipp; Bretschneider, Ulrich; Leinmeister, Jan Marco	Design	Quantitative	Co-Creation	tool	Enabler	Behavior, Cognitive, Self	Framing, Acquiring, Escaping, Generating, Combining, Refining, Converging, Translating, Evaluating, Improving, Elaborating
2016	JMIS	Althuizen, Niek; Reichel, Astrid	Empirical	Quantitative	DSS	tool	Enabler	Behavior, Cognitive, Self	Framing, Activating, Isolating, Generating, Converging

	Author(s)	Title	Type	Analysis	Stream	View	Role	Systems	Activities
2017	Bygstad, Bendik	Generative innovation: a comparison of lightweight and heavyweight IT	Exploratory	Qualitative	IS Development	ensemble	Both	Group, Social	
2017	Fiath, Christoph M.; Friesike, Sascha; Wirth, Marco; Thiesse, Frederic	Copy, transform, combine: exploring the remix as a form of innovation	Exploratory	Quantitative	Co-Creation	tool	Enabler	Behavior, Social	Combining
2017	Gleasure, Rob; O'Reilly, Philip; Catalano, Michael	Inclusive technologies, selective traditions: a socio-material case study of crowdfunding book publishing	Exploratory	Qualitative	Co-Creation	tool	Enabler	Behavior, Social	Evaluating, Improving
2018	Zheng, Haichao; Xu, Bo; Hao, Linna; Lin, Zhangxi	Reversed loss aversion in crowdsourcing contest	Quantitative	Empirical	Co-Creation	Tool	Enabler	Behavior, Cognitive	Generating

APPENDIX C. DEVELOPING AN IS MASTERY INSTRUMENT

Scales to measure IS Mastery were developed using best practices in construct conceptualization and instrument development (Churchill 1979; MacKenzie et al. 2011; Moore and Benbasat 1991). We followed a multi-stage iterative process whereby mastery and its sub-dimensions were conceptualized from research literature and from practitioner input. First, a multi-discipline definition of mastery was developed from similar concepts in the fields of management, psychology and education. According to Dreyfus and Dreyfus's (1980) five-stage model of skill acquisition, mastery is the highest level of skill—preceded by expert, proficient, competent and novice levels of skill—and is exhibited by situation-specific knowledge, holistic understanding of the problem condition, an intuitive approach to decision-making, and cognitive absorption during the task. As such, mastery “takes place when the expert, who no longer needs principles, can cease to pay conscious attention to his performance and can let all the mental energy previously used in monitoring his performance go into producing almost instantaneously the appropriate perspective and its associated action” (Dreyfus and Dreyfus 1980, p. 14). Others have similarly describe mastery while emphasizing that mastery is distinguished from expertise by the individual's ability to develop flexible and reflexive responses to stimuli arising from the task (Ericsson 1999; Glăveanu 2012). From these definitions, we identified three essential dimensions of mastery: competence, improvisation and routinization. Thus, mastery is modeled as a first-order formative construct composed of competence, routinization and improvisation dimensions.

Our review of competence revealed several studies that explore IS competence and similar concepts (Benlian 2015; Burton-Jones and Straub 2006; Eschenbrenner and Nah 2014; Munro et al. 1997). These studies define competence as a broad and deep knowledge of an IS and then measure competence by asking users to indicate which features of an IS they know and then specify how well they know each feature. As no competence scale currently exists for Microsoft PowerPoint, we developed a list of PowerPoint skills that are commonly emphasized in training manuals. Across four manuals (Lambert and Cox 2013; Lowe 2013; Wempen 2013; Wood 2013), we identified 39 skills. After discussions with PowerPoint experts and two rounds of consolidation, the 39 skills were reduced to 14 essential PowerPoint skills. For each, respondents first indicate whether they have knowledge of the skill and, if they do, the extent of their knowledge from very limited (1) to complete (5). Breadth and depth are modeled as a multiplicative composite of competence (Polites et al. 2012).

In our review of literature related to improvisation, we found several concepts that are similar to our conceptualization. Feature repurposing—a dimension of Revising the Spirit of Features in Use (Sun 2012)—is defined as using features in new ways. This construct is similar to IS improvisation but is focused more on using technology in unintended ways rather than confidence in one's ability to do so. The same is true of feature extension (Jaspersen et al. 2005) and trying to innovate (Ahuja and Thatcher 2005) which both focus on whether or not features can be used in novel ways. Due to the conceptual similarity, we began by adapting measures for these constructs as we developed 10 items to measure IS Improvisation. For IS Routinization, we were unable to

find any existing measures which emphasize one's ability to efficiently deploy the features of an IS. To develop this measure, we created 10 items from the definition. For both measures, we conducted a sorting exercise pretest with eight graduate students who had been trained in instrument development. The pretest revealed some problems with phrasing, but otherwise confirmed the initial set of items. The items were then presented to a focus group comprised of members of the sample population who had no objections to the items and no problems understanding them. Convergent and discriminant validity were established with three pilot tests with samples of 46, 69 and 46. The final instrument for IS Improvisation contains nine items with sample items such as "I am capable of adapting PowerPoint's features to fit my needs" and "I can improvise with the features in PowerPoint to accomplish my goals." The final instrument for IS Routinization contains nine items with sample items such as "When I want to use a feature of PowerPoint, I know exactly how to access it" and "When using a feature in PowerPoint, I rarely have to think too hard about what it does." Both improvisation and routinization are modeled as reflective latent variables.

APPENDIX D. MEASURES PRESENTED IN CHAPTER 3

The definition, source and the items for each construct are listed below. Dropped items are highlighted with an asterisk. Items were dropped for theoretical and statistical reasons.

Competence

Definition: Extent to which individuals possess broad and deep knowledge of the features of an IS.

Source: Self-developed

BREADTH	In Microsoft PowerPoint, I have experience using features to... (Check all that apply)		Describe your knowledge of these features of Microsoft PowerPoint... (5-Complete, 1- Very Little Knowledge)
DEPTH_1	Create and Format Multimedia Objects (i.e., Pictures, Audio and Video)	<input type="checkbox"/>	⑤ ④ ③ ② ①
DEPTH_2	Create and Format Data Presentation Objects (i.e., Tables and Charts)	<input type="checkbox"/>	⑤ ④ ③ ② ①
DEPTH_3	Create and Format Text Objects (i.e., Paragraphs, Lists, Equations)	<input type="checkbox"/>	⑤ ④ ③ ② ①
DEPTH_4	Create and Format Custom Drawing Objects (i.e., SmartArt, Lines and Shapes)	<input type="checkbox"/>	⑤ ④ ③ ② ①
DEPTH_5	Create and Format Slides	<input type="checkbox"/>	⑤ ④ ③ ② ①
DEPTH_6	Create Animations (e.g., animating slides and slide content)	<input type="checkbox"/>	⑤ ④ ③ ② ①
DEPTH_7	Control the Presentation Look and Feel (e.g., customizing Layouts, Themes and Slide Masters)	<input type="checkbox"/>	⑤ ④ ③ ② ①
DEPTH_8	Control the Presentation Flow (e.g., customizing slide order, redirects and branching)	<input type="checkbox"/>	⑤ ④ ③ ② ①
DEPTH_9	Customize Application Options (e.g., configuring proofing, language and security options)	<input type="checkbox"/>	⑤ ④ ③ ② ①
DEPTH_10	Customize Application Features (e.g., configuring the ribbon, quick-access toolbar and add-ins)	<input type="checkbox"/>	⑤ ④ ③ ② ①
DEPTH_11	Share Presentations with Others (e.g., using cloud collaboration and printed materials)	<input type="checkbox"/>	⑤ ④ ③ ② ①
DEPTH_12	Improve Presentation Content (e.g., using help, grammar and research tools)	<input type="checkbox"/>	⑤ ④ ③ ② ①
DEPTH_13	Integrate External Content (e.g., merging presentations, importing from other MS Office apps)	<input type="checkbox"/>	⑤ ④ ③ ② ①
DEPTH_14	Export Presentation Content (e.g., converting to video, image and PDF document)	<input type="checkbox"/>	⑤ ④ ③ ② ①

Feature Routinization

Definition: Extent to which a user has internalized the features of an IS such that the features are easily accessible and can be used without much effort

Source: Self-developed

Please indicate the extent to which you agree or disagree with the following statements (7-Strongly Agree, 1-Strongly Disagree)			
ROUTINE_1*	When using PowerPoint, I spend significant time trying to remember where to find features that I know exist.	<input type="checkbox"/>	⑦ ⑥ ⑤ ④ ③ ② ①
ROUTINE_2	When I want to use a feature of PowerPoint, I know exactly how to access it.	<input type="checkbox"/>	⑦ ⑥ ⑤ ④ ③ ② ①
ROUTINE_3*	In PowerPoint, I have to click multiple menus before I find the feature I want to use.	<input type="checkbox"/>	⑦ ⑥ ⑤ ④ ③ ② ①
ROUTINE_4	Using features in PowerPoint has become automatic to me.	<input type="checkbox"/>	⑦ ⑥ ⑤ ④ ③ ② ①
ROUTINE_5	Using the features in PowerPoint is natural to me.	<input type="checkbox"/>	⑦ ⑥ ⑤ ④ ③ ② ①
ROUTINE_6	I do not need to devote a lot of mental effort to deciding which of PowerPoint's features to use.	<input type="checkbox"/>	⑦ ⑥ ⑤ ④ ③ ② ①
ROUTINE_7	Finding the right feature in PowerPoint does not involve much thinking.	<input type="checkbox"/>	⑦ ⑥ ⑤ ④ ③ ② ①
ROUTINE_8	Choosing the right feature in PowerPoint requires little mental energy.	<input type="checkbox"/>	⑦ ⑥ ⑤ ④ ③ ② ①

ROUTINE_9	Accessing most features in PowerPoint is first nature to me.	⑦ ⑥ ⑤ ④ ③ ② ①
ROUTINE_10	When using a feature in PowerPoint, I rarely have to think too hard about what it does.	⑦ ⑥ ⑤ ④ ③ ② ①

Feature Improvisation

Definition: Extent to which the user is capable of adapting the features of an IS to serve a variety of purposes in the performance of a task

Source: Self-developed

Please indicate the extent to which you agree or disagree with the following statements (7-Strongly Agree, 1-Strongly Disagree)		
IMPROV_1	Whatever I need to do, I am certain that I can adapt the features in PowerPoint to accommodate the task.	⑦ ⑥ ⑤ ④ ③ ② ①
IMPROV_2	I am capable of manipulating PowerPoint's features to achieve a desired outcome.	⑦ ⑥ ⑤ ④ ③ ② ①
IMPROV_3	When faced with a task, I can use PowerPoint's features in unexpected ways to get the result I want.	⑦ ⑥ ⑤ ④ ③ ② ①
IMPROV_4	I can improvise with the features in PowerPoint to accomplish my goals.	⑦ ⑥ ⑤ ④ ③ ② ①
IMPROV_5	I am capable of adapting PowerPoint's features to fit my needs.	⑦ ⑥ ⑤ ④ ③ ② ①
IMPROV_6	No matter the task, I can tailor PowerPoint's features to accommodate my goals.	⑦ ⑥ ⑤ ④ ③ ② ①
IMPROV_7	I am confident that I can conform the features in PowerPoint to fit the demands of the task.	⑦ ⑥ ⑤ ④ ③ ② ①
IMPROV_8*	I doubt that I would be able to adapt PowerPoint to fit my needs if there are no features designed to perform my specific task.	⑦ ⑥ ⑤ ④ ③ ② ①
IMPROV_9	I am confident in my ability to improvise with PowerPoint's features to achieve my goals in a task.	⑦ ⑥ ⑤ ④ ③ ② ①
IMPROV_10	I can manipulate the features in PowerPoint to get the result I want.	⑦ ⑥ ⑤ ④ ③ ② ①

Creative IT Identity

Definition: Extent to which an individual views creative expression with IT as integral to his or her sense of self.

Source: (E. Randel and Jaussi 2003; Farmer et al. 2003; Hass et al. 2016; Luhtanen and Crocker 1992)

Please indicate the extent to which you agree or disagree with the following statements (7-Strongly Agree, 1-Strongly Disagree)		
IDENT_1	I often think about being creative with information technology	⑦ ⑥ ⑤ ④ ③ ② ①
IDENT_2	It is important to my identity to be a creative user of information technology	⑦ ⑥ ⑤ ④ ③ ② ①
IDENT_3	In general using information technology to express my creativity is an important part of my self image	⑦ ⑥ ⑤ ④ ③ ② ①
IDENT_4*	Overall, being creative with information technology has little to do with my identity	⑦ ⑥ ⑤ ④ ③ ② ①
IDENT_5	My ability to be creative with information technology is an important part of who I am	⑦ ⑥ ⑤ ④ ③ ② ①

Task-Technology Fit

Definition: Extent to which the user perceives the system's capabilities to match the demands of a task.

Source: (Goodhue and Thompson 1995; Jarupathirun and Zahedi 2007)

As a tool for designing a creative multimedia advertisement, Microsoft PowerPoint was			
TTF_1	Very Adequate	⑦ ⑥ ⑤ ④ ③ ② ①	Very Inadequate
TTF_2	Very Appropriate	⑦ ⑥ ⑤ ④ ③ ② ①	Very Inappropriate

TTF_3	Very Useful	⑦ ⑥ ⑤ ④ ③ ② ①	Not Useful at All
TTF_4	Very Compatible with the Task	⑦ ⑥ ⑤ ④ ③ ② ①	Very Incompatible with the Task
TTF_5	Very Helpful	⑦ ⑥ ⑤ ④ ③ ② ①	Not Helpful at All
TTF_6	Very Sufficient	⑦ ⑥ ⑤ ④ ③ ② ①	Not Sufficient at All
TTF_7	Made the Task Very Easy	⑦ ⑥ ⑤ ④ ③ ② ①	Did not Make the Task Easy at All
TTF_8	Fit the Task Very Well	⑦ ⑥ ⑤ ④ ③ ② ①	Did not Fit the Task at All

Exploratory Use

Definition: Extent to which a user uses new system features to support his or her task.

Source: (Barki and Hartwick 1994; Ke et al. 2012)

Please indicate the extent to which you agree or disagree with the following statements about the features you used to design your creative multimedia advertisement (7-Strongly Agree, 1-Strongly Disagree)			
EXPLORE_1	I tried to use new features that helped me complete my task	⑦ ⑥ ⑤ ④ ③ ② ①	
EXPLORE_2	I experimented with new features that helped me perform my assigned task.	⑦ ⑥ ⑤ ④ ③ ② ①	
EXPLORE_3	During the task, I discovered new features to use.	⑦ ⑥ ⑤ ④ ③ ② ①	

Exploitative Use

Definition: Extent to which an individual uses a well-known set of features of an IT to perform his or her task.

Source: (Bala and Venkatesh 2016; Burton-Jones and Straub 2006)

Please indicate the extent to which you agree or disagree with the following statements about the features you used to design your creative multimedia advertisement (7-Strongly Agree, 1-Strongly Disagree)			
EXPLOIT_1	I used features that I've used often to perform other tasks.	⑦ ⑥ ⑤ ④ ③ ② ①	
EXPLOIT_2	I used features that had previously been suggested by others.	⑦ ⑥ ⑤ ④ ③ ② ①	
EXPLOIT_3	I used features that I learned to use in prior courses.	⑦ ⑥ ⑤ ④ ③ ② ①	
EXPLOIT_4	I used features in I had used to perform other day-to-day activities.	⑦ ⑥ ⑤ ④ ③ ② ①	
EXPLOIT_5	I used features that I knew well from prior experience.	⑦ ⑥ ⑤ ④ ③ ② ①	

Perceived Cognitive Effort

Definition: Extent of the psychological costs of performing the task.

Source: (Blohm et al. 2016; Wang and Benbasat 2009)

Please indicate the extent to which you agree or disagree with the following statements about the task of designing a creative multimedia advertisement in PowerPoint (7-Strongly Agree, 1-Strongly Disagree)			
COGNITIVE_1	It was very frustrating.	⑦ ⑥ ⑤ ④ ③ ② ①	
COGNITIVE_2	I had no trouble expressing my ideas.	⑦ ⑥ ⑤ ④ ③ ② ①	
COGNITIVE_3	It took too much time.	⑦ ⑥ ⑤ ④ ③ ② ①	
COGNITIVE_4	It was easy.	⑦ ⑥ ⑤ ④ ③ ② ①	
COGNITIVE_5	It required too much effort.	⑦ ⑥ ⑤ ④ ③ ② ①	
COGNITIVE_6	It was too complex.	⑦ ⑥ ⑤ ④ ③ ② ①	

Goal Commitment

Definition: Extent to which an individual is determined to try for a goal.

Source: (Latham and Steele 1983)

Please indicate the extent to which you agree or disagree with the following statements about the goal of designing a multimedia advertisement in PowerPoint (7-Strongly Agree, 1-Strongly Disagree)		
COMMIT_1	I was very committed to attaining the goal that was set.	⑦ ⑥ ⑤ ④ ③ ② ①
COMMIT_2	It was very important to me that I at least attain the goal that was set.	⑦ ⑥ ⑤ ④ ③ ② ①
COMMIT_3	I worked very hard to attain the goal that was set.	⑦ ⑥ ⑤ ④ ③ ② ①
COMMIT_4	I feel that the goal that was set was very reasonable.	⑦ ⑥ ⑤ ④ ③ ② ①

Creative Self-Efficacy

Definition: The belief one has the ability to produce creative outcomes.

Source: (Carmeli and Schaubroeck 2007; Tierney and Farmer 2002)

Please indicate the extent to which you agree or disagree with the following statements (7-Strongly Agree, 1-Strongly Disagree)		
EFFICACY_1*	I will be able to achieve most of the goals that I have set for my self in a creative way	⑦ ⑥ ⑤ ④ ③ ② ①
EFFICACY_2	When facing difficult tasks, I am certain that I will accomplish them creatively	⑦ ⑥ ⑤ ④ ③ ② ①
EFFICACY_3	In general, I think that I can obtain outcomes that are important to me in a creative way	⑦ ⑥ ⑤ ④ ③ ② ①
EFFICACY_4	I believe I can succeed at most any creative endeavor to which I set my mind	⑦ ⑥ ⑤ ④ ③ ② ①
EFFICACY_5	I will be able to overcome many challenges creatively	⑦ ⑥ ⑤ ④ ③ ② ①
EFFICACY_6	I am confident that I can perform creatively on many different tasks	⑦ ⑥ ⑤ ④ ③ ② ①
EFFICACY_7*	Compared to other people, I can do most tasks very creatively	⑦ ⑥ ⑤ ④ ③ ② ①
EFFICACY_8*	Even when things are tough, I can perform quite creatively	⑦ ⑥ ⑤ ④ ③ ② ①

APPENDIX E. CONSENSUAL AGREEMENT TECHNIQUE PROCESS

Amabile's (1982) Consensual Agreement Technique (CAT) is a commonly applied method for evaluating creativity. This approach acknowledges the subjectivity of taste inherent in any assessment of creativity and seeks to control it by using a multi-rater approach. Simply, this method of measuring creativity assumes that creative works are creative to the extent that a panel of experts agree that the work is creative (Amabile 1996). Though a common and well-documented approach, the CAT emerged from a complex process (Amabile 1982) and continues to be applied inconsistently (Dean et al. 2006). In her initial work to establish the validity of the CAT method, Amabile (1982) asked judges to evaluate creative works across 23 dimensions, and the results of a factor analysis showed that items such as creativity, novelty and originality clustered together as

a creativity factor and items such as neatness, symmetry and technical goodness clustered on a technical goodness factor. From these studies, she concluded that independent judges are capable of consistently discriminating between creativity and technical goodness. As other researchers adopted the CAT method, the specific dimensions used to measure creativity evolved. So much so that, Dean et al. (2006) felt it necessary to consolidate prior research in an effort to bring a halt to the “proliferation of inconsistent definitions and related terms” (2006, p. 647). After analyzing 51 studies, they concluded researchers seeking to use the CAT method use either a general creative measure or a composite measure of novelty and quality (i.e., usefulness).

Following Amabile’s (1982, 1996) and Dean et al.’s (2006) guidance, we adopted a composite approach to measuring creativity whereby we asked judges to rate the creative works based on individual dimensions of creativity. During the pilot phase of this project, raters assessed the novelty, appropriateness and technical goodness of each submission on a 5-point scale. Raters were given a definition of each and asked to use their best judgement in rating each dimension (Amabile 1982). To ensure consistency, the raters met multiple times throughout the pilot phase to discuss their experiences and any problems they encountered. These meetings revealed several deficiencies in our implementation of the CAT method. First, the raters struggled to discriminate between appropriateness and technical quality. Second, the prompt indicated multiple requirements that led to confounded and inconsistent ratings. For example, the prompt asked respondents to create advertisements for a social media platform to target families. Often, advertisements would address one requirement with more novelty than the other,

leaving raters with a single rating to represent two different concepts. Third, the raters reported that the scale was too coarse and that they needed more granularity for assessing the dimensions. To address these issues, the scale was increased from five points to ten, technical goodness was removed as a dimension of creativity and the task was re-imagined as consisting of two sub-tasks: idea generation and idea translation. These changes allowed judges to independently focus their ratings on the ideas contained in the submission and the representation of those ideas. We termed these constructs idea creativity and design creativity with each being a composite of novelty and appropriateness. After this change was instituted, the judges re-rated all pilot submissions on four dimensions of creativity: idea novelty, idea appropriateness, design novelty and design appropriateness.

After refining our version of the CAT method, no further consultation or training of judges was needed. Whereas consistency among raters was poor when rating three dimensions, the four-dimension approach greatly improved agreement with raw agreement scores above 90% for all dimensions (Idea Appropriateness: 96.2%; Idea Novelty: 97.6%; Design Appropriateness: 94.3%; Design Novelty: 92.4%)

APPENDIX F. IS MASTERY AND COMPUTER SELF-EFFICACY

Self-efficacy is defined as one's judgement of "how well one can execute courses of action required to deal with prospective situations" (Bandura 1982, p. 122). Stemming from Bandura's work on Social Cognitive Theory (Bandura 1986, 1997, 2001), self-efficacy seeks to explain the mediating effect of self-referent thought between capability and performance. This theory of self-efficacy explains that individuals who possess the

skill but not the confidence will perform at a level more commensurate with their beliefs than with their capacity. Thus, belief in one's ability to perform is an essential factor in understanding an individual's willingness to engage, persist and accomplish any number of tasks. Compeau and Higgins (1995) introduced the concept of efficacy to IS research in the form of computer self-efficacy which they define as "judgment of one's capability to use a computer" (1995, p. 192). Just as the more general concept of self-efficacy has been predictive of behaviors in various domains (Gist 1987; Gist et al. 1989), computer self-efficacy has been shown to be a strong predictor of an individual's willingness to engage in computer-mediated tasks (Agarwal and Karahanna 2000; Limayem et al. 2007; Venkatesh et al. 2003).

Though self-efficacy is contingent on immediate environmental conditions, this appraisal is built on social cues that emerge from various sources over time. Specifically, Bandura (1982) identified four sources that help form one's self-efficacy: enactive mastery, vicarious experience, verbal persuasion and emotional arousal. Enactive mastery, defined as repeated performance accomplishments (Gist 1987), is the most influential source as it provides the individual with an authentic mastery experience rather than proxy experiences—vicarious experience, verbal persuasion and emotional arousal all provide second-hand performance experiences. In this way, the concepts of Computer Self-Efficacy and IS Mastery are entwined. As the user develops mastery of an IS through deliberate practice of varied and increasingly difficult tasks within the IS, they will simultaneously develop greater confidence in their ability to apply their knowledge of the IS to various tasks. Despite the conceptual overlap, it is not sufficient to focus only

on Self-efficacy as a determinant of performance because the “exercise of effective control requires mastery of knowledge and skills attainable only through long hours of arduous work” (Bandura 2001, p. 13). Also, computer self-efficacy is silent on the mechanisms (i.e., usage patterns) by which the acquired knowledge of and skill with an IS are deployed as the user works to solve specific problems or achieve exemplary levels of performance. Thus, because users who have mastered an IS have competent, routinized and flexible knowledge of an IS, the concept of IS Mastery offers unique insight into the specific resources these users may apply to computer mediated tasks, and the types of training that may be required to achieve different levels of individual performance on those tasks.

APPENDIX G. CODING PROCEDURES FROM CHAPTER 4

To measure creativity, we used Amabile’s Consensual Assessment Technique (CAT) (Amabile 1996). Amabile’s (1982) Consensual Agreement Technique (CAT) is a commonly applied method for evaluating creativity. This approach acknowledges the subjectivity of taste inherent in any assessment of creativity and seeks to control it by using a multi-rater approach. In her initial work to establish the validity of the CAT method, Amabile (1982) found creativity to be a hierarchical construct and asked judges to evaluate the novelty, appropriateness and technical goodness of creative works. Later, Dean et al. (2006) clarified the internal structure of creativity by analyzing 51 studies. They found a composite measure of novelty and quality (i.e., usefulness) to be the most reliable measure of creativity.

Following Amabile's (1982, 1996) and Dean et al.'s (2006) guidance, we adopted a composite approach to measuring creativity whereby we asked judges to rate the creative works based on individual dimensions of creativity (i.e., novelty and appropriateness). Because multimedia advertisements are representations of ideas and both the idea and the representation can be creative, asked raters to assess the novelty and appropriateness of both the ideas and the design of the advertisement. We termed these constructs Idea Creativity and Design Creativity with each being a composite of novelty and appropriateness. Thus, judges provided ratings for four dimensions of creativity: Idea Novelty, Idea Appropriateness, Design Novelty and Design Appropriateness. Raters were given a definition of each and asked to use their best judgement in rating each dimension (Amabile 1982). All four ratings were done on a scale of one to ten with one representing very low novelty/appropriateness and ten representing the highest possible novelty/appropriateness. To ensure consistency, the raters met multiple times to discuss their experiences and any problems they encountered. Agreement between raters is represented by a score that differs by no more than two points (Althuizen and Wierenga 2014). Measures of both raw interrater agreement and Cohen's Weighted Kappa are in acceptable ranges. Additionally, the Intraclass correlation coefficient for each measure is in an acceptable range to justify averaging rater scores.

APPENDIX H. MEASURES PRESENTED IN CHAPTER 4

The measures used in these studies, their definition and their sources are listed below. Asterisks indicate dropped items. Items were dropped for theoretical and statistical reasons.

Task-Technology Fit

Definition: Extent to which the user perceives the system's capabilities to match the demands of a task.

Source: (Goodhue and Thompson 1995; Jarupathirun and Zahedi 2007)

As a tool for designing a creative multimedia advertisement, Microsoft PowerPoint was			
TTF_1	Very Adequate	⑦ ⑥ ⑤ ④ ③ ② ①	Very Inadequate
TTF_2	Very Appropriate	⑦ ⑥ ⑤ ④ ③ ② ①	Very Inappropriate
TTF_3	Very Useful	⑦ ⑥ ⑤ ④ ③ ② ①	Not Useful at All
TTF_4	Very Compatible with the Task	⑦ ⑥ ⑤ ④ ③ ② ①	Very Incompatible with the Task
TTF_5	Very Helpful	⑦ ⑥ ⑤ ④ ③ ② ①	Not Helpful at All
TTF_6	Very Sufficient	⑦ ⑥ ⑤ ④ ③ ② ①	Not Sufficient at All
TTF_7*	Made the Task Very Easy	⑦ ⑥ ⑤ ④ ③ ② ①	Did not Make the Task Easy at All
TTF_8	Fit the Task Very Well	⑦ ⑥ ⑤ ④ ③ ② ①	Did not Fit the Task at All

Design Satisfaction

Definition: Extent to which a user is satisfied with the design they achieved with the IS.

Source: (McKinney et al. 2002)

Overall, how do you feel about the creativity of your final product			
SATIS_1	Very Pleased	⑦ ⑥ ⑤ ④ ③ ② ①	Very Displeased
SATIS_2	Very Satisfied	⑦ ⑥ ⑤ ④ ③ ② ①	Very Dissatisfied
SATIS_3	Very Contented	⑦ ⑥ ⑤ ④ ③ ② ①	Very Discontented
SATIS_4	Absolutely Delighted	⑦ ⑥ ⑤ ④ ③ ② ①	Absolutely Terrible

Use Satisfaction

Definition: Extent to which a user is satisfied with their use of an IS.

Source: (McKinney et al. 2002)

Overall, how do you feel about how well you used PowerPoint (e.g. choice of features and design elements) to design your creative multimedia advertisement			
SATIS_USE_1	Very Pleased	⑦ ⑥ ⑤ ④ ③ ② ①	Very Displeased
SATIS_USE_2	Very Satisfied	⑦ ⑥ ⑤ ④ ③ ② ①	Very Dissatisfied
SATIS_USE_3	Very Contented	⑦ ⑥ ⑤ ④ ③ ② ①	Very Discontented
SATIS_USE_4	Absolutely Delighted	⑦ ⑥ ⑤ ④ ③ ② ①	Absolutely Terrible

Exploratory Use

Definition: Extent to which a user uses new system features to support his or her task.

Source: (Barki and Hartwick 1994; Ke et al. 2012)

Please indicate the extent to which you agree or disagree with the following statements about the features you used to design your creative multimedia advertisement			
EXPLORE_1	I tried to use new features that helped me complete my task	⑦ ⑥ ⑤ ④ ③ ② ①	
EXPLORE_2	I experimented with new features that helped me perform my assigned task.	⑦ ⑥ ⑤ ④ ③ ② ①	
EXPLORE_3	During the task, I discovered new features to use.	⑦ ⑥ ⑤ ④ ③ ② ①	

Exploitative Use

Definition: Extent to which an individual uses a well-known set of features of an IT to perform his or her task.

Source: (Bala and Venkatesh 2016; Burton-Jones and Straub 2006)

Please indicate the extent to which you agree or disagree with the following statements about the features you used to design your creative multimedia advertisement		
EXPLOIT_1	I used features that I've used often to perform other tasks.	⑦ ⑥ ⑤ ④ ③ ② ①
EXPLOIT_2	I used features that had previously been suggested by others.	⑦ ⑥ ⑤ ④ ③ ② ①
EXPLOIT_3	I used features that I learned to use in prior courses.	⑦ ⑥ ⑤ ④ ③ ② ①
EXPLOIT_4	I used features in I had used to perform other day-to-day activities.	⑦ ⑥ ⑤ ④ ③ ② ①
EXPLOIT_5	I used features that I knew well from prior experience.	⑦ ⑥ ⑤ ④ ③ ② ①

APPENDIX I. TASK INSTRUCTIONS

A screenshot of the start file for the creative task is presented in Figure I.1.

Participants used this file to create their solution to the creative task. The first slide contains instructions for the task and the second slide provides a blank canvas which the students use to create their solution.

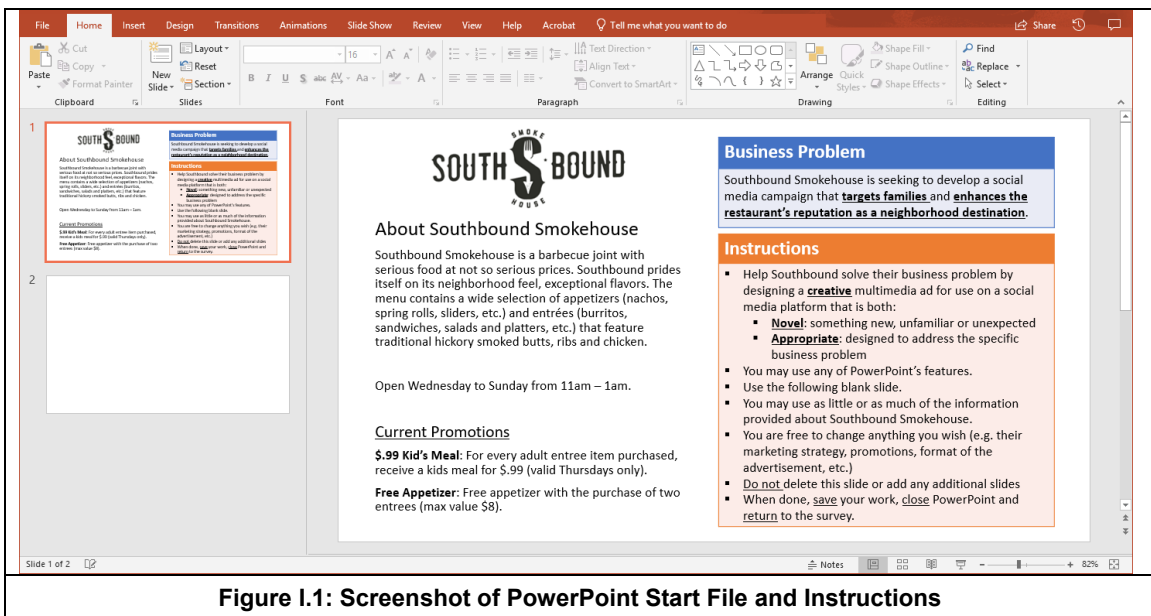


Figure I.1: Screenshot of PowerPoint Start File and Instructions

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