Journal of the Association for Information Systems

Research Paper ISSN: 1536-9323

Choosing a Fit Technology: Understanding Mindfulness in Technology Adoption and Continuance

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Abstract:

Mindfulness is an important emerging concept in society. This research posits that a user's mindful state when adopting a technology is a crucial factor that determines how the technology will fit the task context at the post-adoption stage and, thus, has profound influence on user adoption and continued use of technology. Based on the mindfulness literature, we conceive of a new concept (mindfulness of technology adoption (MTA)) as a multi-faceted reflective high-order factor. We develop a MTA-TTF (task-technology fit) framework and integrate it into the cognitive change model to develop a research model that delineates the mechanisms through which MTA influences user adoption and continued use of technology. We examined the model via a longitudinal study of students' use of wiki systems. The results suggest that mindful adopters will more likely perceive a technology as useful and choose a technology that turns out to fit their tasks. Hence, mindful adopters are likely to have high disconfirmation, perceived usefulness, and satisfaction at the post-adoption stage. The findings have significant implications for IS research and practices.

Keywords: Mindfulness, Task-technology Fit, User Adoption and Continuance of Technology, Longitudinal Study.

Hock Hai Teo was the accepting senior editor. This article was submitted on October 30, 2013 and went through three revisions.

1 Introduction

Mindfulness is receiving an increasing amount of attention in society. It has proven benefits in improving health and decision making (Pickert, 2014, *Time* magazine). In this paper, we introduce the concept of individual level mindfulness to the IS literature because we believe that mindfulness should play an important role in user adoption and continued use of technology. Mindfulness is an important topic given that people often adopt a technology in a less mindful manner by ignoring their own local contexts and/or applying social rules rather than their own information when adopting a technology (Fiol & O'Connor, 2003; Nass & Moon, 2000; Sun, 2013). As a result, an adopted technology often turns out to be a bad fit in local contexts at the post-adoption stage (Abrahamson, 1991). Mindfulness, broadly defined as a state of alertness and lively awareness (Langer, 1989b), can be a crucial factor at the adoption stage for choosing a technology that will be a good fit after adoption. In a mindful state, a person is consciously aware of the context and carefully evaluates the specific qualities of the technology in relation to alternative technologies. Mindful people also scan the environment more thoroughly and, thus, make more discriminating decisions that best accommodate their own context (Fiol & O'Connor, 2003). As a result, we believe that mindfulness can help people make more rational adoption decisions, which manifests as task-technology fit during the post-adoption stage.

The necessity of this research lies in the fact that the existing literature on user adoption and continued use of technology—as the expectation-confirmation theory (ECT) related literature (e.g., Bhattacherjee, 2001; Bhattacherjee & Premkumar, 2004) represents—has not been sufficient in dealing with the rational aspect of adoption decision making. ECT-related research somewhat assumes that users always best use their information at the adoption stage to form user beliefs and choose the technology that best fits their context (i.e., efficient-choice assumption) (Abrahamson, 1991). The fact that people may not always form realistic and well-founded beliefs is largely under-studied. We bridge this gap by decoding how people can make mindful adoption decisions and how such decisions can lead to adopting a technology that better fits their local context at the post-adoption stage. Specifically, we investigate the following research question:

> **RQ:** How can mindfulness help individual users adopt an information technology that best fits their local contexts and that they are more likely to continue using?

We need to study mindfulness at the adoption stage given the potential waste of time and resources—which sometimes could be substantial and irreversible (i.e., sunk costs)—if an adopted technology turns out to be a poor fit at the post-adoption stage. Choosing a fit technology can also help avoid opportunity costs (the missed opportunity to reap the benefits of a more efficient technology) and user regret (Loomes & Sugden, 1982).

To approach the research question, we first develop a new concept of mindfulness of technology adoption (MTA). With this concept, we develop a framework of MTA-TTF (task-technology fit) based on the mindfulness and TTF literature. We then synthesize the MTA-TTF framework and ECT-based cognitive change model (Bhattacherjee & Premkumar, 2004) to develop a research model that delineates the influence of MTA on user adoption and continued use of technology. We examine the research model in an empirical study of students' use of wiki systems.

This research contributes to IS research in several ways. First, this research systematically conceptualizes a new concept, MTA. Existing IS research has studied mindfulness primarily at the organizational level (e.g., Butler & Gray, 2006; Fichman, 2004; Swanson & Ramiller, 2004). Yet, researchers have rarely applied mindfulness to studying technology adoption at the individual level. This research bridges this gap by systematically conceptualizing MTA at the individual level as a multi-faceted reflective second-order construct. Second, this research proposes an MTA-TTF framework, which complements ECT and contributes to IS continuance literature. Specifically, the MTA-TTF framework entails the rational sphere of user adoption decision making, whereas ECT entails the attitude/behavior sphere (Dishaw & Strong, 1999). This distinction is necessary because people may adopt a technology that they do not like because it fits their task. A combined view of both the rational and attitude/behavior aspects can help provide a more comprehensive view of user adoption and continued use of technology. In addition, the MTA-TTF framework enriches the general research on mindfulness. Third, this research also contributes to IS research in methodology. We systematically developed a scale for measuring the four-dimensional construct of MTA, which future IS researchers can use.

2 Theoretical Background

2.1 Mindfulness

> *We're in the midst of a popular obsession with mindfulness as the secret to health and happiness — and a growing body of evidence suggests it has clear benefits.* (Picket, 2014, *Time* magazine)

As the *TIME* magazine quote above illustrates, mindfulness is emerging in many fields (e.g., clinical research, education and learning, marketing, management, organizational behavior) as a key to making optimal decisions and to achieving long-term benefits (Baer, 2003; Brown & Ryan, 2003; Dane, 2011; Fiol & O'Connor, 2003; Langer, Hatem, Joss, & Howell, 1989; Langer, 1989a; Levinthal & Rerup, 2006; Shapiro, Carlson, Astin, & Freedman, 2006; Weick, Sutcliffe, & Obstfeld, 1999). A growing amount of empirical evidence has proven that mindfulness has positive influences on physical and psychological wellbeing, interpersonal relationship quality, work performance, and behavioral regulation (Baer, 2003; Brown & Ryan, 2003; Dane, 2011). Appendix A summarizes our literature review on mindfulness.

Originating from philosophy and religious studies, mindfulness is “a state of alertness and lively awareness, which is specifically manifested in typical ways” (Langer, 1989b, p.138). Langer (1989a, 1997) articulates four dimensions of mindfulness: 1) active information seeking and processing, 2) constant creation of new categories, 3) awareness of local specifics, and 4) openness to multiple perspectives. Further, Dane (2011) summarizes existing research on mindfulness and defines mindfulness as a state of consciousness in which attention focuses on present-moment external (environmental) and internal (intrapsychic) phenomena.

Examining existing research on mindfulness (Appendix A) suggests a generic framework of mindfulness and fit (see Figure 1). The fit described in the framework can be mental or physical fit (e.g., Alexander, Langer, Newman, Chandler, & Davies, 1989; Brown & Ryan, 2003) or fit with the dynamic job environment (e.g., Dane, 2011; Hülsheger, Alberts, Feinholdt, & Lang, 2013).

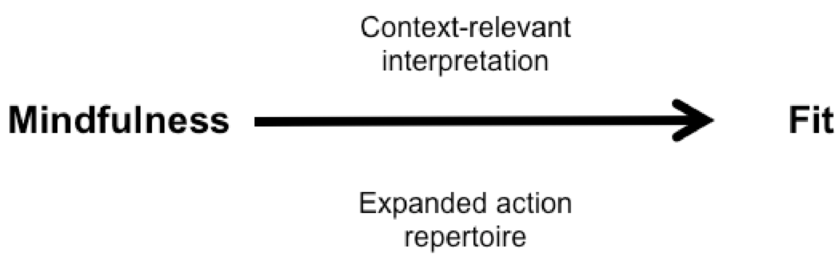


Figure 1. The Mindfulness-fit Framework

Mindfulness can lead to fit through two mechanisms: context-relevant interpretation of information and expanded action repertoire. Individuals engaging in context-relevant interpretation are reluctant to simplify interpretations of real-time information. As a result, the information scanned mindfully is more likely to be “focused on details relevant to current organizational conditions” (Fiol & O'Connor, 2003, p. 62). A mindful person will actively process information relevant to the current contexts regardless of its degree of consistency with prior experience (Louis & Sutton, 1991). Such a relevant information scanning fosters a better alignment between the decision and the context (Fiol & O'Connor, 2003). Researchers believe mindfulness to cause a fundamental shift in perspective and subsequent positive outcomes through self-regulation; values clarification; cognitive, emotional, and behavioral flexibility; and exposure (Levinthal & Rerup, 2006).

Second, mindfulness can also lead to fit with the context through an enlarged action repertoire (Fiol & O'Connor, 2003). Mindfulness helps individuals develop an expanded action repertoire that they can readily employ to match changing environments (Dane, 2011; Fiol & O'Connor, 2003; Shapiro et al., 2006). In studying organizational mindfulness, Levinthal and Rerup (2006, p. 507) argue that:

> *organizational life is filled with special cases that have to be fit to a given repertoire of actions. Because an organization’s environment is likely to provide stimuli that are far more varied than the categories associated with a given set of routines, the response to defined stimuli (e.g., the routine) needs to be flexible and adaptive.*

Similarly, technology users are living in an ever-changing environment. Mindfulness can help them react to the changing contexts at work and adapt their system use for the new tasks to achieve better task-technology fit (Sun, 2012). For example, Dane (2011) argues that, in dynamic environments, mindful lawyers can determine when and how to employ their arguments and other persuasive tactics. In short, mindfulness "fosters a rich action repertoire with which to successfully greet the unknown" (Fiol & O'Connor, 2003, p. 59).

Researchers in the IS field have studied mindfulness (e.g., Butler & Gray, 2006; Goswami, Teo, & Chan, 2008; Swanson & Ramiller, 2004; Vidgen & Wang, 2009). Existing IS research on mindfulness focuses primarily on the organizational or team level. Swanson and Ramiller (2004) lay out the foundation for systematically introducing and defining "mindful innovation in IT" and proposing several directions for studying this topic. Based on case studies of two software development teams, Vidgen and Wang (2009) argue that "collective mindfulness" at the team level characterizes agile development teams. Fichman (2004) considers mindfulness a new concept in IS research and develops a conceptual framework in which one can leverage mindfulness to ensure high innovation quality and positive performance outcomes. Goswami et al. (2008) and Goswami, Teo, and Chan (2009) study the mechanisms through which managers' mindfulness influences organization's adoption of technology.

To date, we know little about mindfulness's influence on making technology-adoption decisions at the individual level. Sun and Fang (2010) conceptualize mindfulness at the individual level and develop a model of mindfulness in technology adoption. That model argues mindfulness to reduce uncertainty and to influence users' perceived usefulness of and intention to use a technology. The model, however, shows only mindfulness' influences on adoption decision making and yields little insight into mindfulness's influence at the post-adoption stage. Roberts, Thatcher, and Klein (2007) study mindfulness as a state in the post-adoption system use context. They focus on users' mindfulness when using a particular application after adoption. For example, "mindful individuals may create multiple uses of a specific application, even uses unintended by the original designer" (p. 3). To date, little if any research has systematically developed a rich concept of mindfulness of technology adoption and explicitly investigated how it influences users' beliefs and behavior at the post-adoption stage. With this research, we bridge this gap by system developing a concept of mindfulness of technology adoption and studying its distal influence on post-adoption user beliefs, satisfaction, and behavior.

2.2 Mindfulness of Technology Adoption (MTA)

Consistent with Dane's (2011) definition, we define mindfulness of technology adoption (MTA) as a psychological state of consciousness in which a person focuses on and is aware of the issues surrounding a technology adoption decision. MTA means that a person investigates technology in detail and in relation to local contexts and alternative technologies. Corresponding to the four dimensions of mindfulness that Langer (1989a, 1997) originally suggests on mindfulness, we conceive MTA as multi-faceted with four dimensions (Table 1).

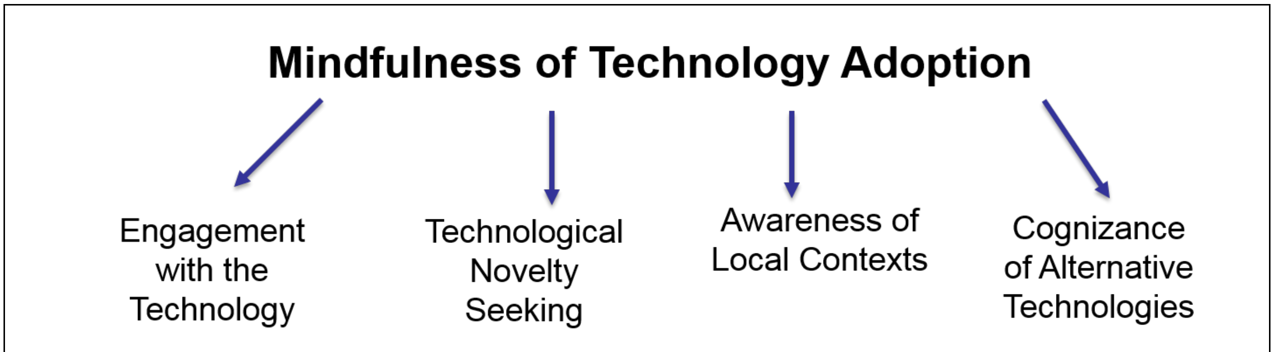
2.2.1 Engagement with the Technology

Being mindful, a person engages with technology by actively gathering information about it and exploring it in detail. A mindful adopter will more likely scan for information about the technology and scan more thoroughly at the function and feature level. Such a detailed investigation affords the user a comprehensive understanding of the technology.

2.2.2 Technological Novelty Seeking

Mindfulness also involves constantly creating new categories (Langer, 1989a). Mindfulness in technology adoption means a person consciously compares a technology with existing technologies so that the person is more aware of its uniqueness and, accordingly, creates a new category for it in relation to existing technologies. For example, a mindful person will more likely realize how local folders are different from the ones stored in cloud computing applications (e.g., Dropbox or Google Drive). Understanding the nuanced difference, the person creates a relevant yet distinct category for folders on the cloud such that these folders can organize files (like local folders) for sharing (uniqueness of the new category).

Table 1. Four Dimensions of MTA



Dimension (Langer's (1989a) original dimensions are in parenthesis)	Definition	Example
Engagement with the technology (active information seeking and processing)	The degree to which a person actively seeks information about the technology in terms of its functionalities.	A person explores the functionality of Open Office in detail when adopting it.
Technological novelty seeking (constant creation of new category)	The degree to which a person compares the technology with existing technologies so that the individual is more aware of its uniqueness.	When adopting SPSS, a person compares it with Excel with which the individual is familiar to figure out how SPSS is different from Excel.
Awareness of local contexts (awareness of local specifics)	The degree to which a person thinks about how the technology fits the individual's local specifics and own needs.	Instead of the popular Oracle Database 12c, a person decides to use MS Access for their small business.
Cognizance of alternative technologies (openness to alternative technologies)	The degree to which a person is aware of a technology's alternative options and their advantages and drawbacks.	When considering adopting IBM Cognos as a business analytics solution, a person is also aware of other alternative solutions such as Tableau and SAS.

2.2.3 Awareness of Local Contexts

Technologies are designed for specific tasks and for certain technical environments and represent certain work domains (Burton-Jones & Grange, 2013). Individuals' local specifics are often complex and include their own needs and learning ability, the availability of technical support, the focal technology's compatibility with existing technologies, and peers' reaction to it, among other issues. Individuals need to recognize these issues to achieve high alignment between the technology and their work. A less mindful adoption decision ignoring local specifics may lead to a waste of investment due to misalignments between the technology and the local context. Being aware of local contexts means that adopters think about how the technology may help their work or change the way they work. At the same time, being aware of local contexts also means that users are aware of the inconveniences the adopted technology may bring to their work.

2.2.4 Cognizance of Alternative Technologies

When being mindful in adopting a technology, a person is aware of alternative views regarding this technology (e.g., both advantages and disadvantages of it in comparison to alternative technologies). Such a balanced and flexible view about a technology helps the adopter develop realistic expectations. For example, a person may hold a belief that Oracle database is more powerful in functionality than other database management systems (DBMSs) due to Oracle's large market share and wide acceptance in organizations. However, after mindfully comparing Oracle with other DBMSs (e.g., MySQL, SQL Server, and Microsoft Access), the adopter may choose Microsoft Access, which is sufficient for the adopter's needs. After going through the process of comparing Oracle with alternate DBMSs, the person is more realistic about the pros and cons of each DBMS. As a result, the adopter will be more open to the technology alternatives and will avoid making an uncritical conclusion based on bandwagon effects (Fiol &

O'Connor, 2003). Therefore, mindfulness is important to avoid over- and underestimating a technology's advantages and disadvantages.

In this study, we conceive of MTA as a reflective second-order construct. In general, psychological states influence behavior (Ajzen & Fishbein, 1980). Thus, MTA (as a psychological state) should influence its behavioral sub-constructs. According to Jarvis, Mackenzie, Podsakoff, Mick, & Bearden (2003), such a causality means that one should model MTA as a reflective second-order construct, which means a person's behavior as captured by its four sub-constructs should reflect the person's mindful state.

MTA differs essentially from similar concepts that have been studied in IS research such as cognitive absorption and flow. In IS research, researchers have defined cognitive absorption as "a state of deep involvement with software" and viewed it as having five dimensions (temporal dissociation, focused immersion, heightened enjoyment, control, and curiosity) (Agarwal & Karahanna, 2000, p.673). Flow, on the other hand, refers to "the state in which people are so involved in an activity that nothing else seems to matter" (Csikszentmihalyi, 1990, p. 4). Both concepts have received a lot of attention in IS research (e.g., Csikszentmihalyi, 1975; Csikszentmihalyi, 1990; Ghani, 1995; Koufaris, 2002; Novak, Hoffman, & Duhachek, 2003; Novak, Hoffman, & Yung, 1998; Pace, 2004; Saade & Bahli, 2005; Zhang, Li, & Sun, 2006). Similar to mindfulness, both cognitive absorption and flow theorize about an individual's deep involvement in the present moment. However, one attribute that distinguishes mindfulness from cognitive absorption and flow is attentional breadth (Dane, 2011). Cognitive absorption and flow suggest people are deeply engaged in an event while largely ignoring environmental stimuli. Mindfulness, in contrast, proposes people are aware of a wide range of both external (environmental) and internal (intrapsychic) stimuli (Dane, 2011). Also, MTA is, by definition, an important factor in an individual's adoption decision, whereas cognitive absorption and flow are more influential during the post-adoption stage at which they require a certain level of familiarity with and control over the activity (Chen, Yen, Hung, & Huang, 2008; Ghani, Supnick, & Rooney, 1991; Lowry, Gaskin, Twyman, Hammer, & Roberts, 2013; Pace, 2004; Siekpe, 2005; Tung, Moore, & Engelland, 2006).

2.3 MTA as a State Variable

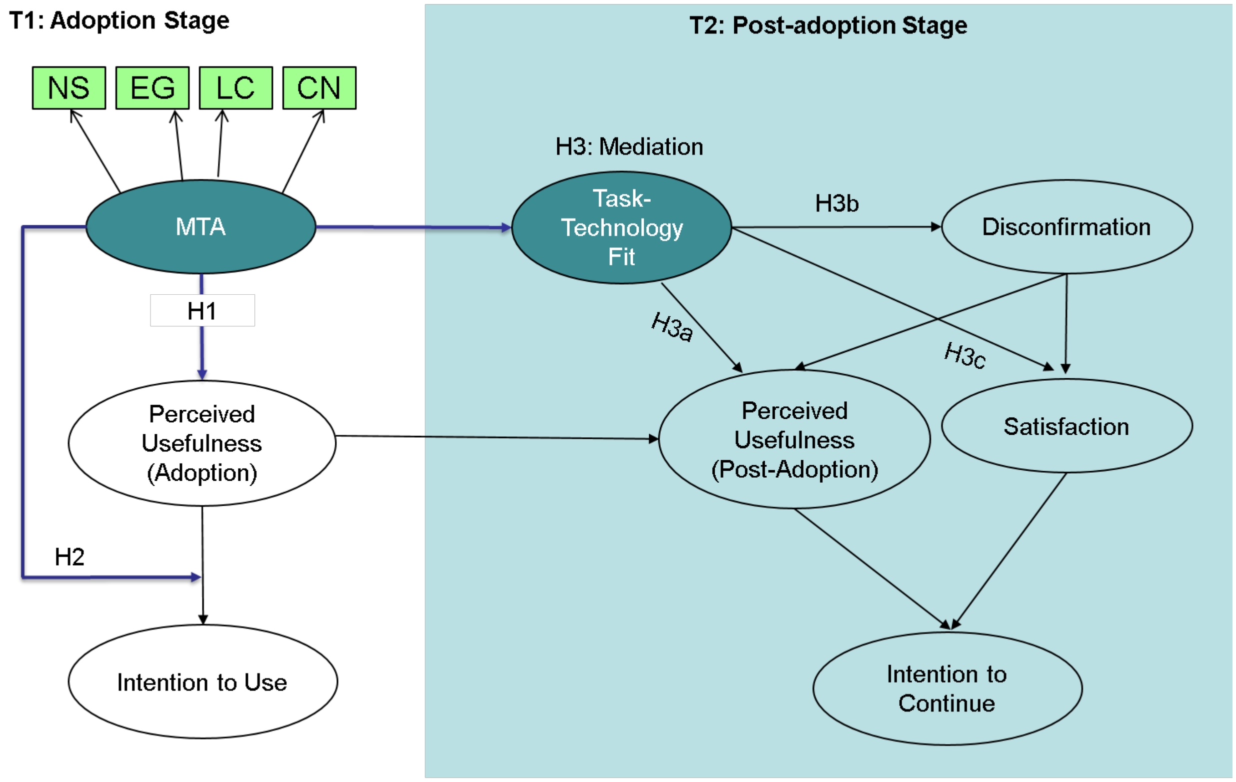
One can conceive mindfulness as both a trait and state variable (Butler & Gray, 2006; Dane, 2011). While it is surely valuable to study trait mindfulness as prior research has done (e.g., Brown & Ryan, 2003), we study MTA as a psychological state given that we focus on how mindfulness influences particular adoption decisions at a specific moment (i.e., when one adopts a technology). One often makes an adoption decision in a specific context. Hence, context-specific state variables are more relevant (Thatcher & Perrewe, 2002; Webster & Martocchio, 1992). A generally mindful person may not necessarily be mindful at the particular moment when the person makes a decision. Hence, considering a person's mindful state during decision making is more relevant to studying the influence of mindfulness on a particular decision making process. This focus is also consistent with many prior studies on decision making in uncertain environments (Dane, 2011; Fiol & O'Connor, 2003; Langer et al., 1989; Langer, 1989a).

Note that, although mindful states are temporary, they may have distal influence on later evaluations and behavior. Users' overall evaluation of a system is determined largely by their most salient past experience and the most recent experience (i.e., the peak-end rule) (Fredrickson, 2000; Kahneman, Fredrickson, Schreiber, & Redelmeier, 1993). In other words, a temporary but salient experience can later influence a person's overall evaluation. Indeed, research has reported that higher levels of mindfulness induced by training continued to influence user behavior one month later (Jensen, Dinger, Wright, & Thatcher, 2013).

3 Research Model and Hypotheses Development

3.1 Base Model: The CCM and the Mindfulness-fit Framework

We developed a research model (Figure 2) about the influence of MTA on user adoption and continued use of technology by incorporating the mindfulness-fit framework into the cognition change model (CCM) (Bhattacherjee & Premkumar, 2004). Stemmed from expectation-confirmation theory (Oliver, 1980), the CCM delineates what determines users' continued use. At the adoption stage, an individual's perceived usefulness about a technology determines the individual's intention to use it. Later, with new information and direct experience with the technology, the individual forms a post-adoptive perception, which may deviate from the prior beliefs. Such deviation (i.e., disconfirmation) will update user's perceived usefulness (post-adoption) and influence user satisfaction, which, in turn, will influence one's intention to continue to use the technology.



Note:
NS: Technological Novelty Seeking, EG: Engagement with the Technology
LC: Awareness of Local Contexts, CN: Cognizance of Alternative Technologies

Mediation:
H3a: MTA→Task-technology fit→Perceived Usefulness (Post-adoption)
H3b: MTA→Task-technology fit→Disconfirmation
H3c: MTA→Task-technology fit→Satisfaction

Control Variables: Age, Gender, Education, Internal Self-Efficacy

Figure 2. Research Model

The CCM provides an appropriate vehicle for this research for two important reasons. First, one needs the CCM's longitudinal nature to study the distal influence of MTA given that, as we emphasize earlier, it often takes time for the benefits of information technology to unfold. Second, the CCM's constructs (such as disconfirmation, perceived usefulness (post-adoption), satisfaction, and intention to continue[1] together with task-technology fit) can serve to assess whether MTA helps select an optimal technology that the user will continue to use, which is our paper's central motif.

To integrate the generic mindfulness-fit framework into the CCM, we capture a domain-specific fit concept (task-technology fit (TTF)) given that domain-specific factors tend to own more predictive power than general factors (Davis & Yi, 2012; Webster & Martocchio, 1992). Researchers have found that TTF, defined as "the degree to which a technology assists an individual in performing his or her portfolio of tasks" (Goodhue & Thompson, 1995, p. 216), is essential in explaining system use and task performance

[1] We dropped attitude from the original CCM because of its conceptual closeness to satisfaction. Satisfaction and attitude are highly correlated in Bhattacherjee and Premkumar's (2004) study. Also, removing attitude is consistent with prior research on technology acceptance. For example, Venkatesh et al. (2004) excluded attitude in their unified theory of acceptance and use of technology (UTAUT) and argued that attitude is not a significant antecedent of behavioral intention when performance expectancy and effort expectancy are present. Acknowledging that the role of attitude is important in certain environments (Venkatesh et al., 2003), we excluded attitude in this research to focus on studying mindfulness.

at both individual and team levels (e.g., Dishaw & Strong, 1996; Fuller & Dennis, 2009; Goodhue, 1998; Goodhue & Thompson, 1995; Wells, Palmer, & Patterson, 2004). It captures “correspondence between task requirements, individual abilities, and the functionality of the technology” (Goodhue & Thompson, 1995, p. 218). IS research has shown that performance is higher when technology capacity and task requirement align (Dennis, Wixom, & Vandenberg, 2001; Dishaw & Strong, 1999; Lim & Benbasat, 2000; Shaft & Vessey, 2006; Zigurs & Buckland, 1998). Because TTF in general antecedes user usefulness beliefs, use, and performance (Dishaw & Strong, 1999), we position TTF before perceived usefulness, disconfirmation, and satisfaction at the post-adoption stage.

3.2 Hypotheses Development

Drawing on the MTA-TTF framework and the CCM, we argue that MTA affects factors at both adoption and post-adoption stages. At the adoption stage, MTA influences users’ perceived usefulness belief formation and how perceived usefulness influences intention to use. At the post-adoption stage, MTA has a distal effect on post-adoption factors including perceived usefulness (post-adoption), disconfirmation, and satisfaction through TTF’s mediation.

3.2.1 Impact of Mindfulness at the Technology Adoption Stage

Consistent with the CCM, we conceptualize perceived usefulness as a user belief. We further distinguish perceived usefulness at the adoption stage (PUA) and perceived usefulness at the post-adoption stage (PUP). PUA refers to the degree to which an individual believes that using a particular technology will enhance their performance. The user technology acceptance literature understands that an individual’s perceived usefulness of a technology has a significant influence on the individual’s intention to use that technology at the adoption stage (Davis, 1989; Sun & Zhang, 2006; Venkatesh & Davis, 2000; Venkatesh, Morris, Davis, & Davis, 2003).

We posit that MTA enhances PUA in the following ways. First, a mindful person will likely explore and uncover a technology’s additional features (Hiltz & Turoff, 1981; Kay & Thomas, 1995). Such an in-depth understanding of the system can enlarge the individual’s action repertoire with regard to what the system can do for the individual’s work and, thus, enhances PUA of the system. Moreover, a mindful individual will more likely appreciate the technology’s unique value beyond what the individual achieved using existing systems. Understanding the novelty of the technology also contributes to enhancing perceived usefulness. Second, MTA can enhance PUA when one thoroughly scans and is aware of their social environment. A person’s social environment can influence their perceived usefulness of a technology (Venkatesh & Davis, 2000). Users are located in certain social environment and, thus, care about how others think about their adoption and use of a technology. Mindfulness helps individuals scan and elaborate on the environment and, accordingly, enriches their awareness of the social contexts, which, in turn, increases perceived usefulness (Moore & Benbasat, 1991; Venkatesh & Davis, 2000). Combining the above argument, we hypothesize that:

> **H1:** MTA positively relates to perceived usefulness (adoption).

In a mindful state, people will expand their information repertoire and scan from a wider variety of sources (Dane, 2011; Fiol & O'Connor, 2003). Also, mindful people are more attuned to their internal processes and states (Epstein, 1995). In this mindful state, individuals will be “back in touch with their own wisdom and vitality” (Kabat-Zinn, 1994, p. 4), which will keep them calm and open-minded so that they may be more attuned to their own thoughts, beliefs, and emotions (Dane, 2011; Kabat-Zinn, 1994; Kabat-Zinn, 2003). Scholars have applied such therapeutic introspection approaches in education to train people to maintain attention and to control their mental process to help develop confidence and self-esteem (Hyland, 2009). For example, researchers suggest applying mindfulness as a means for learning math. People often have rigid perceptions of their own mathematical ability. However, individuals in the mindful state can overcome mind rigidity and reevaluate their quantitative skills and regain confidence (Quinnell, Thompson, & LeBard, 2013).

Also, mindful people tend to be more confident in their beliefs (Langer & Imber, 1980). Such confidence will result in more weight to their beliefs about a technology when they are making the adoption decision. People give more weight to credible information when they evaluate information among various sources (Anderson, 1971; Anderson, 1981; Littlejohn, 2002). Mindful people know that they collect information via thoroughly scanning the environment and exploring the technology in question. As a result, their information about the technology will more likely be accurate and relevant to their use context. Mindful adopters also know more about how a technology differs from alternative technologies and how it may fit the task context. Such user beliefs mindfully formed will more likely carry heavier weights in influencing users' intention to use the technology (Anderson, 1981; Littlejohn, 2002). That is, mindful people tend to pay more attention to and rely on their own beliefs about a technology. Therefore, we hypothesize that:

H2: MTA positively moderates the relationship between perceived usefulness (adoption) and intention to use.

3.2.2 Impact of Mindfulness at the Post-adoption Stage

We propose that MTA influences post-adoption user behavior through TTF. By definition, both task characteristics and technology characteristics influence TTF (Dishaw & Strong, 1999; Goodhue & Thompson, 1995; Zigurs & Buckland, 1998). We can view a task as the behavior needed to achieve stated goals using available information and via some processes (Zigurs & Buckland, 1998). A technology represents certain work domains for which its design supports (Burton-Jones & Grange, 2013) and usually has a range of features as the functional building blocks that one can use to accomplish different types of tasks (Griffith & Northcraft, 1994; Jasperson, Carter, & Zmud, 2005).

Drawing on the MTA-TTF framework, we argue that MTA leads to higher TTF at the post-adoption stage through two mechanisms: context-relevant interpretation of the technology and expanded action repertoire (Figure 1). First, MTA can help overcome an individual's impulse to imitate others decision at the cost of the individual's own local context (i.e., the bandwagon effects) so that the individual can discriminate choices that best fit the individual's own circumstances (Fiol & O'Connor, 2003). Second, a mindful adopter will more likely be aware of more system features and have a wider view of the system's potential for accomplishing a variety of tasks (i.e., enlarged action repertoire). Such preparedness better equips a user to be more flexible and adaptive when encountering unexpected events (e.g., new tasks) at the post-adoption stage. In this regard, MTA leads to better alignments between the technology and the task (i.e., TTF) (Ahuja & Thatcher, 2005; Barki, Titah, & Boffo, 2007; Boudreau & Robey, 2005; Jasperson et al., 2005; Saga & Zmud, 1994).

In turn, TTF has significant effects on post-adoption factors including perceived usefulness (post-adoption) (PUP), disconfirmation, and satisfaction. First, TTF positively affects PUP. TTF allows users to accomplish their task more effectively, efficiently, or at a higher quality (Dennis et al., 2001; Goodhue & Thompson, 1995; Vessey, 1991; Vessey & Galletta, 1991; Zigurs & Buckland, 1998), so that users will more likely perceive this technology to be useful at the post-adoption stage (Davis, 1989). Researchers have widely applied this relationship and found much empirical support for it in various contexts such as e-education (D'Ambra, Wilson, & Akter, 2013; Goodhue, Klein, & March, 2000; Larsen, Sørebø, & Sørebø, 2009), software maintenance (Shaft & Vessey, 2006), group support decisions (Dennis et al., 2001; Fuller & Dennis, 2009), and healthcare (Bhargava & Mishra, 2014).

Second, TTF positively affects disconfirmation. Disconfirmation refers to "the extent to which subjects' pre-usage expectation of technology usage is contravened during actual usage experience" (Bhattacherjee & Premkumar, 2004, p. 237). The disconfirmation results from individuals' updating their initial beliefs (i.e., PUA) with new/primary information (Bhattacherjee, 2001; Sun, 2013). Positive disconfirmation refers to the degree to which a technology exceeds one's expectations; on the other hand, negative disconfirmation refers to an experience that is worse than expected (Brown, Venkatesh, & Goyal, 2014). Prior research has suggested a positive relationship between TTF and disconfirmation. For example, Lin and Wang (2012) empirically proved that a person's perceived fit of an online learning system led to a positive confirmation. The rationale is that TTF encourages a person to explore more of a technology, and, thus, that it will more likely result in beyond-expectation experience (e.g., high disconfirmation). This rationale is somewhat consistent with the existing evidence suggesting that TTF fosters system use (Fuller & Dennis, 2009; Goodhue & Thompson, 1995; Larsen et al., 2009). That is, when an individual perceives a technology to fit the task, the individual will more likely use it and have more opportunities to fully realize the system's potential. This expanded use leads to more positive confirmation of early expectations.

Third, TTF positively affects satisfaction. Satisfaction relates closely with performance; indeed, researchers have considered it a core part of performance (Benbasat & Lim, 1993; Dennis & Kinney, 1998; Dennis et al., 2001). Researchers have argued TTF to lead to satisfaction, especially when people adapt the system (Dennis et al., 2001). Task-technology fit better actualizes the technology characteristics in response to task needs, so users will evaluate the system favorably and be satisfied (Ip, Lau, Chan, Wong, Wong, & So, 2008; Kim, Chung, Lee, & Preis, 2015; Lin, 2012).

Taken together, prior research suggests that MTA can influence post-adoption user beliefs and satisfaction through TTF. Therefore, we hypothesize that:

> **H3:** TTF mediates the influence of MTA (adoption stage) on post-adoption a) perceived usefulness, b) disconfirmation, and c) satisfaction.

4 Methodology

To examine the hypothesized relationship, we conducted a longitudinal study on students' adoption and continued use of wiki systems. Students' adoption of wiki systems is an ideal context for this research. As we mention earlier, mindfulness matters when uncertainty exists. Uncertainty occurs when "a framework for interpreting a message is available, but there is a lack of information to process" (Dennis & Valacich, 1999, p. 1). In this study, student respondents knew that they could use wiki systems as a tool for individual or collaborative tasks, but they had little information about the wiki systems. Students were generally uncertain about adopting a wiki given multiple wiki systems available on the market; therefore, mindfulness should play a role in affecting their adoption decision. In addition, we designed some tasks that the subjects could complete with the wiki. Specifically, the subjects were asked to develop a personal learning wiki system to organize and manage the learning material in the courses. They could choose either PBworks or Google Sites to do so, and they were free to switch between them. Therefore, using a wiki system was critical for the subjects to accomplish the class objective, which induced mindfulness.

The study included two surveys with a four-week interval in between. We designed a one-month interval because Jensen et al. (2013) has proved that training-induced mindfulness still has influence on user behavior one month later. We administered the first survey at the adoption stage (T1) at which point we instructed students to choose between two wiki systems (PBworks and Google Sites) to complete the class assignment. Both wiki systems had similar features that allowed users to create a workspace, post text and multimedia as wikis, and invite people to the workspace for collaboration. Using two systems stimulates subjects' awareness of alternative technologies, which is essential for mindfulness. At the beginning of the survey, we measured subjects' prior experience with these two wiki systems. We then asked them to go through a list of features of PBworks and Google Sites for more background knowledge to help them decide which to adopt. In addition, we provided the URLs for both tools so that the subjects could further investigate both tools if they wanted ("engagement with the technology" of MTA). They then needed to make a decision regarding which tool they would use. Subsequently, the respondents completed the rest of the survey on their mindfulness, perceived usefulness (adoption), and intention to use. We also collected subjects' demographic data such as age, gender, and education level. We administered the second survey four weeks after the first survey (T2) to measure task-technology fit, perceived usefulness (post-adoption), disconfirmation, user satisfaction, and intention to continue. We only included respondents who used the wiki system before the second survey.

We invited students in two large information systems courses to participate in the longitudinal study. We offered bonus course credits as incentives, but the respondents could drop out from the study at any time. At T1, 204 out of 221 students participated in the study (92.31% response rate). At T2, 183 students completed the second survey (for an overall response rate of 82.81%).

After removing those who did not use PBworks or Google Sites after the first survey, the final sample contained 176 valid responses. Table 2 shows the sample's demographic characteristics. We conducted a wave analysis to test the nonresponse bias (Armstrong & Overton, 1977). The results indicated that non-response bias should not be a concern for this study.

Whenever possible, we used previously validated measures (see Appendix C for the measurement items). We adapted Kim and Malhotra's (2005a) instruments to measure perceived usefulness at the adoption and post-adoption stages. We measured intention to use, satisfaction, disconfirmation, and intention to continue with the original measures from the CCM (Bhattacherjee & Premkumar, 2004). Similarly, we revised the perceived task-technology fit measure from previous studies and adapted it to the context of this research (Larsen et al., 2009; Lin & Huang, 2008).

Because the field lacks comprehensive MTA measures, we developed an instrument for MTA following Moore and Benbasat's (1991) procedure (see Appendix B for instrument-development details). Consistent with how we conceptualized MTA, the instrument comprises 13 items for the four dimensions: technological novelty seeking (NS, three items), engagement with the technology (EG, three items), awareness of local contexts (LC, three items), and cognizance of alternative technologies (CN, four items). The four dimensions are reflective first-order constructs of the reflective second-order MTA because, again, MTA as a psychological state should influence its behavioral sub-constructs (Jarvis, MacKenzie, & Podsakoff, 2003).

Table 2. Demographic Characteristics of the Sample

		Frequency	Percentage
Age	18-20	34	19.32%
	21-25	119	67.61%
	26-30	12	6.82%
	31-35	6	3.41%
	36-45	4	2.27%
	>46	1	0.57%
Gender	Male	101	57.39%
	Female	75	42.61%
Highest education level currently pursuing	High school	1	0.57%
	Associate degree	1	0.57%
	Bachelor degree	63	35.80%
	Master degree and above	111	63.07%

5 Data Analysis and Results

We used partial least square (PLS) to accommodate the model's complexity (Chin, Marcolin, & Newsted, 2003; Fornell & Bookstein, 1982; Lohmoller, 1989). We estimated the statistical significance of the path coefficients using the bootstrapping method (Chin et al., 2003). To test the moderating effects of MTA, we referred to the product-of-sums approaches (Goodhue, Lewis, & Thompson, 2007). Specifically, we multiplied the variable scores of the moderating factor (MTA) and independent variable (PUA) to generate the interaction factor: MTA x PUA, which we then linked to the dependent variable (IU).

5.1 Measurement Model

In Table 3, we see that MTA's four dimensions had relatively large standard deviations, which suggests the effectiveness of our manipulations (i.e., allowing subjects to seek external information and choose between two wiki systems).

To assess the measurement model, we examined reliability, convergent validity, and discriminant validity. We examined the scales' reliability by composite reliability and Cronbach's Alpha; both need to be 0.70 or higher to demonstrate sufficient reliability (Bagozzi & Yi, 1988; Bearden, Netemeyer, & Mobley, 1993; Nunnally & Bernstein, 1994). Table 3 shows that all composite reliability values and Cronbach's alpha met this criterion.

To assess the convergent validity, we examined item loadings and average variance explained (AVE). Item loadings should be greater than 0.707 and AVEs larger than 0.50 (Barclay, Higgins, & Thompson, 1995; Fornell & Larcker, 1981). Appendix D shows the items loaded well on their associated factors. CN2 did not load well, and, thus, we dropped it from further analysis. Table 3 shows that all AVEs in this study were larger than 0.50, which suggests that the indicators rather than denoting measurement errors captured most variances in the constructs (Barclay et al., 1995). We examined two criteria to assess discriminant validity. First, the square root of the AVE should be greater than the variance shared among the construct and other constructs (i.e., correlations) (Compeau, Higgins, & Huff, 1999). Table 4 shows that data satisfied this criterion. Second, items should load more highly on their associated factors than on other factors. Appendix D showed that the data satisfied this criterion.

Table 3. Descriptive Statistics

Table 3. Descriptive Statistics

	No. of items	Mean	Std. dev	Composite reliability	Cronbach's alpha	Average variance extracted
Mindfulness • Technological novelty seeking	3	4.65	1.17	0.83	0.70	0.63
• Engagement with the technology	3	4.17	1.48	0.89	0.82	0.73
• Awareness of local contexts	3	5.29	1.38	0.92	0.88	0.80
• Cognizance of alternative technologies	4	4.32	1.35	0.88	0.80	0.71
Perceived usefulness (adoption)	4	5.00	1.29	0.96	0.94	0.85
Intention to use	3	5.02	1.29	0.94	0.91	0.85
Task-technology fit	5	4.70	1.09	0.92	0.89	0.70
Perceived usefulness (post-adoption)	4	4.47	1.24	0.95	0.93	0.83
Disconfirmation	4	4.56	1.04	0.94	0.91	0.79
Satisfaction	4	4.70	0.98	0.94	0.92	0.81
Intention to continue	3	4.56	1.22	0.97	0.95	0.91
Internal self-efficacy	3	5.80	2.06	0.91	0.84	0.76

Table 4. Square Roots of AVEs and Correlations

	NS	EG	LC	CN	PUA	IU	TTF	PUP	DC	SAT	IC	SE	AGE	EDU	GEN
NS	***0.79***														
EG	0.37	***0.86***													
LC	0.41	0.42	***0.89***												
CN	0.29	0.34	0.41	***0.84***											
PUA	0.42	0.35	0.62	0.26	***0.92***										
IU	0.44	0.30	0.63	0.24	0.75	***0.92***									
TTF	0.26	0.14	0.17	0.12	0.34	0.28	***0.84***								
PUP	0.32	0.29	0.37	0.32	0.44	0.42	0.66	***0.91***							
DC	0.26	0.20	0.25	0.17	0.40	0.36	0.60	0.69	***0.89***						
SAT	0.18	0.16	0.18	0.21	0.30	0.29	0.54	0.58	0.66	***0.90***					
IC	0.03	0.03	0.16	0.06	0.13	0.28	0.28	0.47	0.43	0.53	***0.95***				
SE	0.33	0.08	0.32	0.11	0.41	0.52	0.12	0.12	0.11	0.08	0.03	***0.87***			
AGE	0.21	0.19	0.11	0.17	0.12	0.10	-0.05	0.00	0.09	0.03	-0.06	0.15	***NA***		
EDU	0.22	0.22	0.40	0.24	0.31	0.41	-0.02	0.10	0.10	0.05	0.10	0.17	0.33	***NA***	
GEN	-0.17	-0.04	-0.22	-0.26	-0.16	-0.23	-0.21	-0.16	-0.21	-0.23	-0.13	0.11	0.12	-0.15	***NA***

NS: Technological novelty seeking (MTA)
EG: Engagement with the technology (MTA)
LC: Awareness of local contexts (MTA)
CN: Cognizance of alternative technologies (MTA)
PUA: Perceived usefulness (adoption)
IU: Intention to use
TTF: Task-technology fit
PUP: Perceived usefulness (post-adoption)
DC: Disconfirmation
SAT: Satisfaction
IC: Intention to continue
SE: Computer self-efficacy
EDU: Education
GEN: Gender

† The diagonal elements (in bold) are the square roots of the variance shared between the constructs and their measurement (AVE).

We observed a high correlation between perceived usefulness (adoption) and intention to use (see Table 4). Their cross-loadings were also high (Appendix D). In addition, we found uncomfortably high correlations and cross-loadings between disconfirmation and satisfaction. High correlations and cross-loadings indicate that items may measure more than one factor in the model and, thus, may threaten a study's discriminant validity. However, we did not drop any construct for several reasons. First, the high cross-loadings in this research still met Gefen and Straub's (2005) criterion of a minimum difference of .10 between item loadings and cross-loadings, and other statistics (the comparison between AVEs and correlations) were also satisfactory. Second, we drew the highly cross-loaded items from the original CCM and retained them for content validity. The new measures for mindfulness, our primary focus, did demonstrate high discriminant validity.

The research model's longitudinal nature helped overcome potential common method bias. In addition, we conducted a Harman's single-factor test[2]—one of the most widely used approaches for assessing common method bias in a single-method research design (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003)—to further assess the common method bias. This test loads all variables into an exploratory factor analysis and then examines the unrotated factor solution to determine the number of factors necessary to account for the variance in the variables. Common method bias may exist if 1) a single factor emerges from the unrotated factor solution or 2) one general factor accounts for the majority of the covariance in the variables (Podsakoff et al., 2003, p. 889). Neither occurred with our data; no single factor accounted for a majority of the covariance (the first factor only explained 30.89% of the variance), which indicates that common method bias should not be a concern for this study.

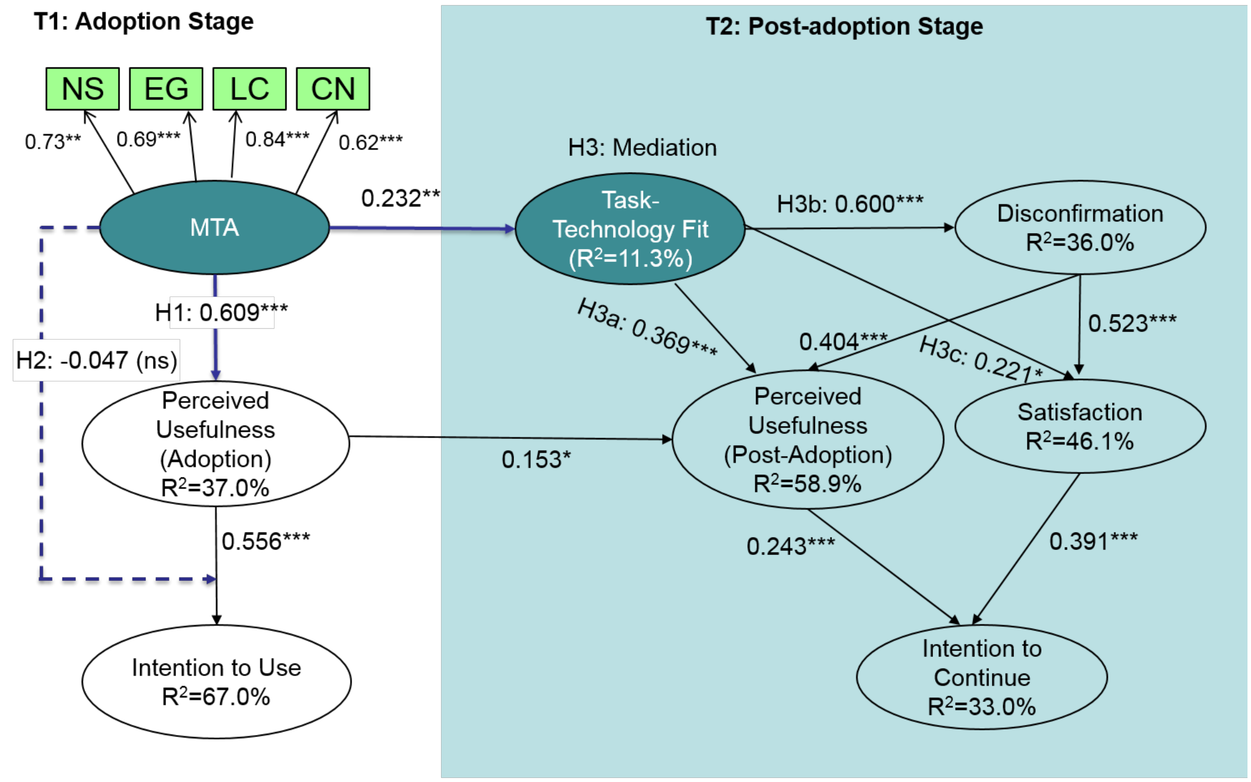
5.2 Structural Model

Figure 3 and Table 5 present the structural model's results[3]. At the adoption stage, mindfulness was positively related to perceived usefulness (H1: $b = 0.609$, $t = 12.522$, $p < 0.001$), which supports H1. The hypothesized positive moderating effect of MTA on the relationship between perceived usefulness at the adoption stage and intention to use, was non- significant ($b = -0.047$, $t = 1.726$), which supports H2.

For H3, we examined how TTF mediated the influence of mindfulness on perceived usefulness (post-adoption), disconfirmation, and satisfaction using Preacher and Hayes' (PH) (2010) approach. We employed the bias-corrected (BC) bootstrap algorithm. The BC algorithm does not impose a normal sampling distribution assumption as Sobel's test does and, thus, is suitable for small sample sizes (Preacher & Hayes, 2008). The results showed that MTA had significant total effects on perceived usefulness (post-adoption) (effect = 0.447, $t = 6.594$, $p < 0.001$), disconfirmation (effect = 0.306, $t = 4.232$, $p < 0.001$), and satisfaction (effect = 0.244, $t = 3.316$, $p<0.001$). After introducing TTF, MTA still has significant direct effects on perceived usefulness (post-adoption) (effect = 0.310, $t = 5.791$, $p < 0.001$), disconfirmation (effect = 0.176, $t = 2.877$, $p < 0.01$), and satisfaction (effect = 0.127, $t = 1.937$, $p > 0.05$). The indirect effects of MTA through TTF were 0.137 on perceived usefulness (post-adoption), 0.130 on disconfirmation, and 0.117 on satisfaction. The BC bootstrap 95 percent confidence intervals (CI) for the three indirect effects were 0.058-0.224 for perceived usefulness (post-adoption), 0.055-0.228 for disconfirmation, and 0.052-0.206 for satisfaction. Since all the three CIs did not contain zero, we concluded that the mediated effects via TTF were significant. In summary, TTF has significant partial mediating effects on perceived usefulness (post-adoption) and disconfirmation and a full mediating effect on satisfaction. These results support H3.

[2] We also checked the variance of this factor and found that responses to this factor did not co-vary.

[3] We also conducted separate analyses on the two wiki systems. The results on the Google Sites data (n = 144) were largely consistent with our results. This somewhat indicates that our results are robust. The sample size of PBworks was too small (n = 31) to conduct a meaningful analysis.



Note:
NS: Technological Novelty Seeking, EG: Engagement with the Technology
LC: Awareness of Local Contexts, CN: Cognizance of Alternative Technologies

Mediation:
H3a: MTA→Task-technology fit→Perceived Usefulness (Post-adoption)
H3b: MTA→Task-technology fit→Disconfirmation
H3c: MTA→Task-technology fit→Satisfaction

Control Variables: Age, Gender, Education, Internal Self-Efficacy

ns p>0.05, * p<0.05, ** p<0.01, *** p<0.001

Figure 3. Results of the Structural Model

All the significant hypothesized effects had path coefficients above 0.1. The extant literature suggests that path coefficients of this level are reasonable. For instance, Pedhazur (1982) recommends 0.05 for the suggested lower limit of substantive regression coefficients. Along the same line, Compeau & Higgins (1995b) indicates that path coefficients of 0.10 and above are preferable. After conducting a literature search, we found that publications in top IS journals have commonly observed significant path coefficients around 0.1, which includes some published in the last decade (e.g., Au, Ngai, & Cheng, 2008; Pavlou & Fygenson, 2006; Stewart & Gosain, 2006; Venkatesh, Brown, Maruping, & Bala, 2008; Venkatesh & Ramesh, 2006; Zhu, Kraemer, Gurbaxani, & Xu, 2006). Thus, we believe that the substantiveness of the path coefficients in our research model is quite reasonable.

The model explained a significant portion of the variance in perceived usefulness (adoption) ($R^2 = 0.370$), intention to use (0.670), perceived usefulness (post-adoption) (0.589), disconfirmation (0.360), satisfaction (0.461), and intention to continue (0.330). We noticed that TTF had a relatively small R-square (0.113). Nevertheless, it should not be a big concern for this research. After all, we did not use our model to identify a comprehensive list of predictors of TTF but to establish a reliable relationship between MTA and TTF. Prior research has suggested that technological and task characteristics are most salient predictors of TTF (Goodhue, 1995). We tested how our focal construct, MTA, influences TTF, which is crucial to our research questions. Also, the fact that we measured MTA and TTF at two points in time may also account for the relatively small R-square of TTF.

Table 6 shows the sizes of the effect of mindfulness factors (i.e., MTA and TTF) on disconfirmation, perceived usefulness (post-adoption), and satisfaction calculated using Cohen's (1988) f^2 formula. In summary, the effect sizes of MTA and TTF on perceived usefulness (post-adoption) and disconfirmation were medium, while they were small on satisfaction. The effect sizes indicate the importance of considering mindfulness factors.

Table 5. Results of the Structural Models

	Path coefficient and significance	Hypothesis confirmed?
MTA→PUA (H1)	0.609***	Y
MTA*PUA→IU (H2)	-0.047ns	N
Mediation		
MTA→TTF	0.232**	
TTF→PUP (H3a)	0.369***	Y
TTF→DC (H3b)	0.600***	Y
TTF→SAT (H3c)	0.221*	Y
Control variables		
Age→IU	-0.063*	
Age→TTF	-0.053 ns	
Age→IC	-0.101 ns	
GEN→IU	-0.138**	
GEN→TTF	-0.184*	
GEN→IC	0.029 ns	
EDU→IU	0.190***	
EDU→TTF	-0.141 ns	
EDU→IC	0.094 ns	
SE→IU	0.277***	
SE→TTF	0.097 ns	
SE→IC	-0.037 ns	
PUA: Perceived usefulness (adoption) PUP: Perceived usefulness (post-adoption) IC: Intention to continue	IU: Intention to use DC: Disconfirmation SE: Computer self-efficacy	TTF: Task-technology fit SAT: Satisfaction EDU: Education GEN: Gender
ns p>0.05, * p<0.05, ** p<0.01, *** p<0.001		

Table 6. Effect Sizes of MTA and TTF

Dependent variable	R-squared with MTA and TTF	R-squared without MTA and TTF	Effect size†
Perceived usefulness (post-adoption)	0.589	0.504	0.207 (medium)
Disconfirmation	0.360	0.160	0.313 (medium)
Satisfaction	0.461	0.430	0.058 (small)
One calculates effect size (f^2) with the formula $(R^2_{full} - R^2_{partial})/(1-R^2_{full})$. Cohen (1988) suggests 0.02, 0.15, and 0.35 as operational definitions of small, medium and large effect sizes, respectively.			

5.3 Post Hoc Analyses

As we mention above, we found uncomfortably high correlations and cross-loadings between disconfirmation and satisfaction. The lack of discriminant validity of their measures indicates that disconfirmation and satisfaction may actually relate to the same concept. Reflecting on their definitions and measures, we believe that they both reflected a positive experience using a technology. Therefore, we examined a revised model (Figure 4) as a robustness check. In this model, we re-specified disconfirmation and satisfaction following the procedure that Wetzels, Odekerken-Schroder, and Oppen (2009) outline as two reflective first-order factors of a new second-order factor, which we temporarily named "positive experience". Consistent with its components (i.e., disconfirmation and satisfaction), positive experience should be positively influenced by TTF and should positively affect intention to continue. Figure 4 summarizes the results. Both disconfirmation and satisfaction loaded well on the new positive experience construct. The relationships are generally consistent with the original research model. This finding gives more confidence in our results despite the high correlations between disconfirmation and satisfaction[4].

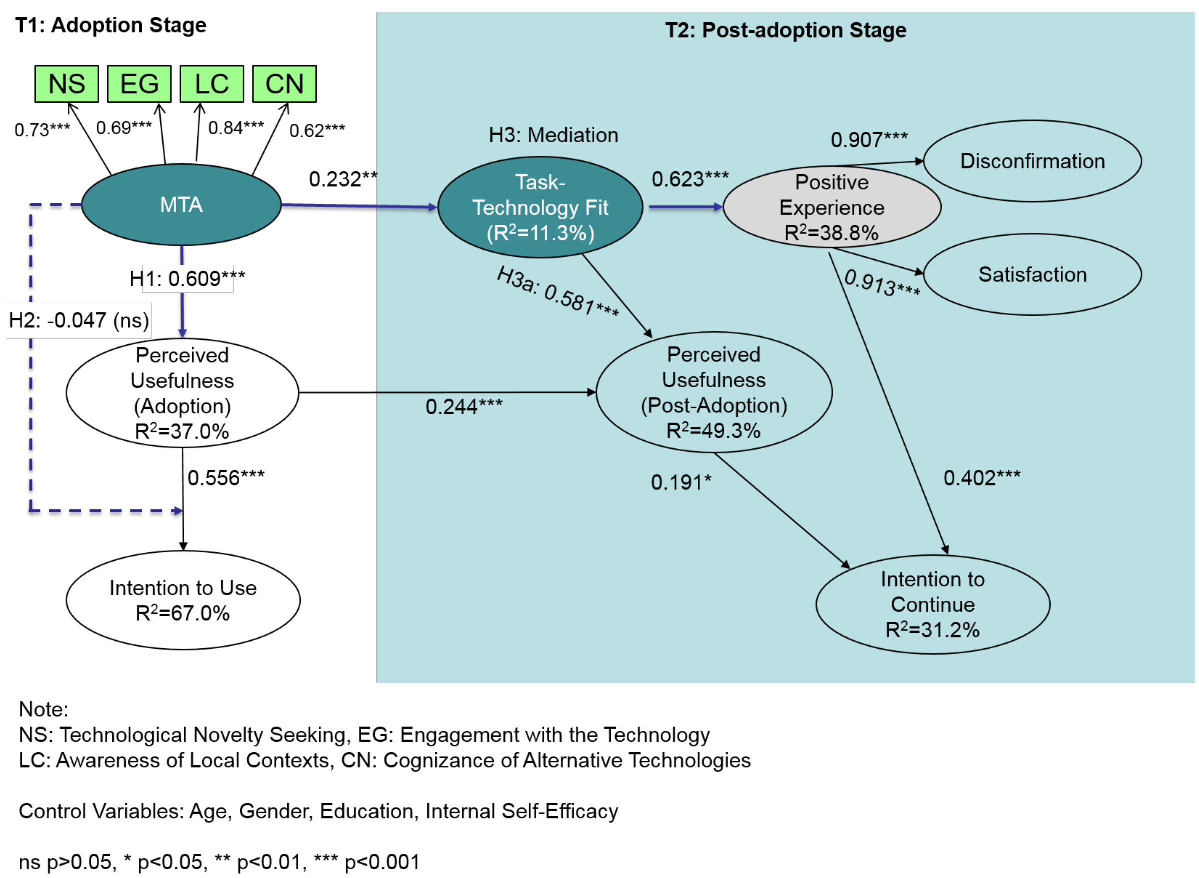


Figure 4. Results of the Post Hoc Revised Model

6 Discussion

6.1 Major Findings

Mindfulness is an important emerging topic. In this paper, we introduce the concept to the IS literature and demonstrate its utility in studying user adoption and continued use of technology. Our results indicate that MTA is influential at both the adoption stage and the post-adoption stage. At the adoption stage, our results confirmed MTA's direct impact on perceived usefulness: MTA helps enrich users' understanding of

[4] An alternative approach is to delete one of the highly correlated variables (Tucker & Chase, 1980). Therefore, we conducted two additional analyses to examine models excluding disconfirmation and satisfaction, respectively. We observed similar results, which further supports the findings.

what the technology can do for them. We did not confirm the hypothesized moderating effect of MTA on the relationship between perceived usefulness (adoption) and initial intention to use. This result may have occurred due to the ceiling effect: the main relationship between PUA and intention to use is already strong as numerous empirical studies have shown (Davis, Bagozzi, & Warshaw, 1989; Sun & Zhang, 2006; Venkatesh et al., 2003), and little room to enhance it exists. Still, we need to study moderating effect because it reveals the contingent nature of the relationship, though moderating effects are in general hard to detect and tend to be incremental (Chin et al., 2003). A larger sample (and, thus, higher statistical power) and more advanced statistical tools may be of help in future to detect MTA's moderating effects on the relationship between PUA and intention to use.

MTA has profound distal effects on factors at the post-adoption stage. As we hypothesized, MTA had a significant positive impact on users' TTF perception, which, in turn, influenced post-adoption factors including perceived usefulness, disconfirmation, and satisfaction. Our findings suggest that TTF is an important factor when studying mindfulness in that TTF mediates the influence of MTA on post-adoption perceived usefulness, disconfirmation, and satisfaction. Beyond its indirect effects through TTF, our empirical results suggest that MTA has direct influence on perceived usefulness, disconfirmation, and satisfaction. This finding indicates that MTA's effects at the post-adoption stage are more profound than the TTF mechanism. That is, MTA may influence post-adoption user behavior through other factors. For example, Dennis et al. (2001) propose user appropriation of a system to moderate TTF's effect on performance (Dennis et al., 2001). Thus, user appropriation may be a potential factor that could further clarify MTA's influence on post-adoption user behavior. MTA may induce more post-adoption user appropriation behavior such as exploring new features and repurposing features for unintended tasks (Sun, 2012), which may, in turn, increase perceived usefulness, positive disconfirmation, and, subsequently, user satisfaction with the system. In short, the empirically observed direct effects of MTA on post-adoption user behavior beyond the mediation of TTF indeed reveal promising opportunities for future research.

When examining the results carefully, we encountered a paradox in that the overall perceived usefulness (4.47) was 0.52 lower than what it was (5.00) at time 1 with an overall positive disconfirmation. According to Bhattacherjee and Premkumar (2004), perceived usefulness (post-adoption) (PUP) should be higher than perceived usefulness (adoption) (PUA) in positive disconfirmation groups and lower for negative disconfirmation groups. Our results echo an ongoing debate regarding the different approaches to measuring disconfirmation (Brown et al., 2014; Edwards, 2002; Irving & Meyer, 1999; Venkatesh & Goyal, 2010). In this research, we followed the CCM and adopted the direct measure of disconfirmation for its higher reliability and lower expectation bias (Bhattacherjee & Premkumar, 2004; Yi, 1990). We discuss this issue in detail in Appendix E.

6.2 Limitations and Future Topics

Although students are typical wiki-system users, our findings are limited to educational use of technology, which somewhat limits our findings' generalizability to other contexts such as employees' use of a complex technology (Compeau, Marcolin, Kelley, & Higgins, 2012). Showing that mindfulness can have significant effects on an adopter's post-adoption beliefs and satisfaction, this research creates an encouraging point of departure for future research to investigate mindfulness in other organizational and technological contexts.

Further, one could improve the measures we adapted from the CCM. We observed a high correlation and cross-loadings between disconfirmation and user satisfaction. Actually, original work on the cognitive change model also found similar high correlations (see Table 2 in Bhattacherjee & Premkumar, 2004). Our post hoc analysis suggests that disconfirmation and user satisfaction may reflect the same construct of positive experience. Future research could either develop better instruments for disconfirmation and user satisfaction or re-conceptualize them as two facets of the same construct.

Several future topics emerged in the course of this research. An interesting future topic would be to study mindful non-adopters or abandoners: people who decide not to adopt a technology or who abandon it after using it for a while. Also, this research stresses mindfully choosing a technology in that we allowed the respondents to choose between two systems, which differs from selecting to either adopt or not adopt a technology. It would be interesting and practically relevant to study mindful non-adopters. Non-adopters can be either mindful or mindless. A mindful person may rightly choose not to adopt a technology, or a mindless person may mistakenly decide not to adopt a technology and, accordingly, miss an opportunity to improve.

Also, individuals often find it hard to abandon a technology at the post-adoptive stage because of factors such as inertia and sunk costs (Polites & Karahanna, 2012), but mindfully abandoning a technology prevents further sunk costs and helps the user reap benefits from a better alternative technology. As such, a promising topic would be how mindfulness helps overcome user inertia and facilitates the switch from an old system to a new system.

Another future topic would be to investigate mindfulness as a personal trait. Medical and physical research (Brown & Ryan, 2003; Dane, 2011) has shown that some people are more predisposed to be mindful than others, which indicates that mindfulness could be a personal trait. As such, future research may investigate how individual factors, such as personal innovativeness in IT (Agarwal & Karahanna, 2000; Agarwal & Prasad, 1999) and computer self-efficacy (Compeau & Higgins, 1995a, 1995b), may influence mindfulness.

How to induce mindfulness is another promising topic. State mindfulness can be propagated through training or other experience as has been shown in the mindfulness literature (Langer et al., 1989; Lieberman & Langer, 1997). Langer (1989b) points out several conditions that encourage mindfulness, such as how one presents information. Lieberman et al. (1997) also show that a learner's mindfulness can be enhanced when the learner is asked to make material meaningful. In addition, prior research has argued that work-related factors can also trigger mindful thinking (Jasperson et al., 2005; Louis & Sutton, 1991). A technology's attributes are of particular interest. For example, a highly restrictive technology constrains people to specified structures of using the technology and may force individuals to use the system less mindfully (Silver, 1988; Weick et al., 1999). Such design features associated mindfulness or mindlessness should receive attention given their apparent practical implications.

Another promising future topic is mindful system use, which is essentially different from mindful adoption studied in this research. Mindfulness can be a continuous practice (Shapiro et al., 2006). Studying post-adoption mindful use may have implications for IS research on active and automatic and habitual system use (Kim, Malhotra, & Narasimhan, 2005; Limayem, Hirt, & Cheung, 2008). It may also have implications for studying the performance impact of system use. For example, Swanson and Ramiller (2004) argue that mindful organizations tend to be resilient because they "favor improvisation over planning, adaptation over routine" (p. 561). Similarly, at the individual level, mindful users may be more inclined to adapt their system use, which results in larger deviations from routine use.

6.3 Contributions

This study contributes to IS research and practice in several ways. First, we systematically conceptualize mindfulness of technology adoption (MTA). This research is one of the first attempts in IS research to systematically investigate mindfulness in the context of individual's technology adoption, a growingly important yet under-studied concept. Different from previous research (e.g., Roberts et al., 2007; Sun & Fang, 2010), we conceive MTA as a reflective high-order construct. We develop an instrument for measuring the high-order mindfulness in adopting technology and, thus, contribute to IS research methodologically.

Second, we develop a research model that integrates MTA into the CCM to delineate how MTA leads to post-adoption task-technology fit, which indicates that MTA can help select a technology that better fits local task contexts. This model adds the rational factors (i.e., MTA and TTF) to complement the CCM and, accordingly, changes the CCM's original meaning. Specifically, researchers have used the CCM to focus on the factors that influence users' intention to continue using a technology, whereas our model emphasizes how mindfulness helps to choose a fit technology or, in other words, a "right" technology.

This new model contributes to the study of post-adoption system use. Researchers have spent significant effort on studying post-adoption system use from various perspectives (e.g., Bhattacherjee, 2001; Burton-Jones & Straub, 2006; de Guinea & Markus, 2009; Jasperson et al., 2005; Kim, 2009; Kim et al., 2005; Limayem et al., 2008; Sun, 2012; Sun, 2013). It is appealing to study the connection between factors at the adoption and post-adoption stages such that we can predict post-adoption system use as early as at the adoption stage. Doing so helps prevent wasted resources and increases the likelihood of choosing the technology that most benefits the user. Previous research has suggested several mechanisms through which factors at the adoption stage influence post-adoption system use; for example, the memory processing mechanisms (Kim, 2009) and the expectation-confirmation mechanism (Bhattacherjee & Premkumar, 2004). We propose another one: the mindfulness-fit mechanism. People who make an adoption decision mindfully tend to achieve better task-technology fit at the post-adoption stage, which, in turn, leads to their continuing to use the technology.

Third, this research also contributes back to the mindfulness literature. We highlight the new mindfulness→fit framework: mindfulness increases fit through context-relevant interpretation and enlarged action repertoire. Applying this generic framework to technology adoption and diffusion context forms the MTA→TTF framework. The confirmed significant relationship between MTA and TTF suggests that the mindfulness literature can explicitly consider fit as a measurable outcome of mindfulness. Indeed, the fit concept may much enrich the contemporary mindfulness literature. For example, Dane (2011) argues that two factors (dynamics of the environment and expertise) moderate the influence of mindfulness on performance. The generic framework of mindfulness and fit suggests that Dane's model may explicitly include environment-fit and expertise-fit in the model to better explain how mindfulness influences performance.

Finally, this research contributes to practice by providing advice to technology adopters and designers. Specifically, our findings suggest adopters should to be mindful by looking for more information about the technology, seeking novel aspects of the new technology in relation to existing technologies, being aware of own needs and local use contexts, and being aware of alternatives. Designers should develop systems that can facilitate users to make mindful decisions. For instance, one can use the four aspects of mindfulness to design better decision-aid systems (Wang & Benbasat, 2009).

Acknowledgements

We thank the senior editor and the anonymous reviewers for their invaluable guidance and insightful comments. The work in this paper was supported by grants from The Hong Kong Research Grants Council (Project No. CityU 11501314) and National Science Foundation of China (71271181).

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Appendix A: Summary of the Literature Review on Mindfulness

Table A1. Summary of the Literature Review on Mindfulness

Study	Area	Definition of mindfulness or similar concepts	Major findings
Baas, Nevicka, & Velden (2014)	Individual creation activity	Adopting Brown and Ryan's (2003) definition, the authors define mindfulness as a state of conscious awareness resulting from living in the moment.	Mindfulness can foster creativity. In particular, the ability to observe and attend to various stimuli consistently and positively predicted creativity.
Brown & Ryan (2003)	General human well-being	An enhanced attention to and awareness of current experience or present reality. The authors consider mindfulness as inherently a state of consciousness.	The authors developed the mindful attention awareness scale (MAAS). Both dispositional and state mindfulness can predict self-regulated behavior and positive emotional states. In addition, increases in mindfulness over time relate to declines in mood disturbance and stress.
Butler & Gray (2006)	Using complex Information to achieve reliable performance.	Adapting Langer's (1989a) definition, the authors define mindfulness as a way of working characterized by a focus on the present, attention to operational detail, willingness to consider alternative perspectives, and an interest in investigating and understanding failures. They study mindfulness at both individual and organizational levels.	Authors argue that one should consider mindfulness when designing and implementing information systems in order to achieve reliable performance.
Dane (2011)	General management: how mindfulness influences task performance in the workplace.	A state of consciousness in which one focuses attention on present-moment phenomena occurring both externally and internally.	
Fichman (2004)	IT innovation	An organization innovates mindfully to the extent that it attends to the innovation with reasoning grounded in its own facts and specifics.	Mindful organizations will more likely make sound judgments about whether to adopt an innovation, when, and how best to manage the assimilation process.
Fiol & O'Connor (2003)	Bandwagon behavior and managerial decision making	Adopting Langer's (1989a) definition, the authors define mindfulness as a state of alertness and lively awareness that is manifested in active information processing, characterized by creating and refining categories and distinctions and being aware of multiple perspectives.	This conceptual paper argues that mindfulness can help one to better scan context-relevant information and, accordingly, make discriminating decisions in the face of bandwagons.
Gosain (2004)	Enterprise information systems	Not defined explicitly. Authors refer to mindfulness as in Weick et al.'s (1999) and Fiol and O'Connor's (2003) research.	This conceptual paper argues that organizations are prone to a lack of mindfulness. Enterprise information systems make organizations, which are prone to lack of mindfulness, acquiesce to institutional pressures.

Table A1. Summary of the Literature Review on Mindfulness

Goswami et al. (2008)	RFID adoption by organizations	Adapting Langer's (1989a) definition, the authors use managerial mindfulness to refer to a cognitive ability or cognitive style that characterizes active information processing and is reflected by openness to novelty, alertness to distinction, sensitivity to different contexts, awareness of multiple perspectives, and orientation in the present.	The findings show that managerial mindfulness can lead to recognition of learning option and recognition of staging option when making decisions to adopt RFID.
Grossman, Niemann, Schmidt, & Walach (2004)	Stress reduction and health	Mindfulness is characterized by dispassionate, non-evaluative, and sustained moment-to-moment awareness of perceptible mental states and processes.	The results of the meta-analysis suggest that mindfulness-based stress reduction helps patients and a broad range of individuals to cope with their clinical and non-clinical problems.
Hülsheger et al. (2013)	Job satisfaction at work	A state of consciousness in which individuals attend to ongoing events and experiences in a receptive and non-judgmental way.	Mindfulness can reduce emotional exhaustion and improves job satisfaction.
Langer (1989b)	Human well-being	A state of alertness and lively awareness.	Mindlessness may severely limit human performance and even have a negative impact on physical health. Mindfulness can help enhance health and task performance.
Langer et al. (1989)	Student learning	Same as Langer (1989a).	Instruction presented in an absolute manner led to mindless use of the learning information. In contrast, instruction presented in a conditional manner was better able to creatively deal with the information. Conditional instruction can provoke mindfulness.
Langer & Imber (1980)	Individual perception of deviance	A cognitively active state characterized by conscious manipulation of the elements of one's environment in which case the individual questions old categories or constructs new ones.	Mindful subjects could better detect deviant characteristics.
Levinthal & Rerup (2006)	Organizational learning	Adopted Langer‘s (1989a) and Weick et al.'s (1999) definitions.	Mindfulness complements less-mindfulness through repertories of action, processes for sustaining mindfulness, enactment of routines, and encoding of ambiguous outcomes.
Roberts et al. (2007)	System use context	Continuous refinement of expectations based on new experiences, appreciation of the subtleties of context, and identification of novel aspects of context that can improve foresight and functioning.	This paper developed a 16-item measurement for mindfulness.

Table A1. Summary of the Literature Review on Mindfulness

Swanson & Ramiller (2004)	Organizational innovation with information technology	Relying on Weick and Roberts' (1993) definition of mindfulness at the organizational level, the authors define mindfulness as "an organizational property grounded in, although not reducible to, the minds of participating individuals through a process of heedful interrelating" (p. 555).	This conceptual paper clarifies major concepts needed for understanding the role of mindfulness in organizational innovation with information technology. It discusses the various aspects such as innovation process of organizational innovation with information technology and how one can integrate mindfulness into these processes.
Shapiro (2009)	Psychotheraphy and psychoeducational settings	Mindfulness is both an outcome and a process. It is an awareness (mindful awareness as an outcome) that arises through intentionally attending in an open, accepting, and discerning way (mindful practice as a process) to whatever arises in the present moment.	A research agenda to outline future research direction on mindfulness: 1) mindfulness operationalization, 2) multidimensional mindfulness across cultures, and 3) mindfulness-based intervention mechanism.
Sternberg (2000)	Social science	Cognitive ability view: mindfulness is similar to abilities such as openness to novelty, alertness to distinction, sensitivity to different contexts awareness of multiple perspectives and orientation in the present. Personality trait view: mindfulness is similar to "openness to experience" which is one of five key characteristics in personality. Cognitive style view: the mindfulness developed by Langer (1989a) more measures cognitive styles and personality than cognitive abilities. Cognitive style is a preferred way of viewing the world in general and specific problems in particular.	Three integrated views on mindfulness: 1) cognitive ability (i.e., memory or intelligence), 2) personality trait (i.e., extraversion or neuroticism), and 3) cognitive style (preferred way of thinking). This paper concludes mindfulness is inclined to be a cognitive style although it possesses all of these three characteristics.
Sun & Fang (2010)	Technology acceptance	Mindfulness in technology acceptance (MTA): a vigilant state of mind of a person that allows the person to examine the technology being considered more comprehensively and context specifically.	Mindfulness influences people's technology adoption by reducing uncertainty and enhancing perceived usefulness of the technology; thus, people are more willing to use the technology.
Vidgen & Wang (2009)	Agile software development	Collective mindfulness (Butler & Gray, 2006): more than the sum of individual mindfulness.	Collective mindfulness helps teams to be more self-organized and self-disciplined, so it is a valued capability for agile teams.
Weick et al. (1999)	Organizational behavior in high reliability organizations	Collective mindfulness: adopts Langer's (1989b) definition and contextualizes it to be the awareness of potential catastrophe and discovery and correction of unexpected events.	Collective mindfulness creates awareness of discriminatory detail and facilitates error correction and discovery.
Weick & Roberts (1993)	Organizational behavior for organizations pursuing high operational reliability (i.e., aircraft carrier)	Collective mind: a pattern of heedful interrelations of actions in a social system.	Collective mind can help reduce organizational errors through contributing, representing, and subordinating.

Appendix B: Development of MTA Measurements

We followed Moore and Benbasat (1991) to develop the instrument for measuring mindfulness in technology adoption (MTA). Based primarily on Langer's (1989a) work, we conceptualized MTA as having four dimensions: engagement with the technology (EG), technological novelty seeking (NS), awareness of local contexts (LC), and cognizance of alternative technologies (CN). To ensure content validity, we developed fifteen new items (three for EG, three for NS, four for LC, and five for CN) to cover the four dimensions based on thoroughly reviewing the mindfulness literature.

We recruited eight Hong Kong doctoral students who had no prior exposure to this mindfulness study to do card sorting exercises. We randomly assigned each student to two groups with four people in each group. In the first round card sorting, we asked the first group to sort the fifteen items into groups and provide group labels. The group's members could also put an item in a "too ambiguous/doesn't fit" category if they were uncertain about what it meant. This step helps minimize the possibility of "interpretational confounding", which occurs when an individual assigns empirical meaning to an unobserved variable rather than estimating unknown parameters and assigning the variable deductively (Burt, 1976). The labels the group proposed were generally consistent with what we designed for the items as the overall hit ratio was 90 percent (83% for EG, 80% for CN and 100% for NS and LC). After the first round, we dropped three items that we considered ambiguous.

In the second round of card sorting, we asked the second group to sort the remaining items into five categories (four given categories plus an "N/A" category). The overall hit ratio increased to 93.75 percent (83.33% for EG, 91.67% for CN, and 100% for NS and LC) and the Cohen's Kappa (Cohen, 1960) was 0.8. Thus, we confirmed 12 items for the MTA (three for each dimension).

We tested the final 12 items with a sample of 800 doctors from Hong Kong Hospital Authority and received 135 completed responses (16.9% response rate). After screening the responses for reliability, we had 131 valid responses in total. The overall analysis result of the pilot test was satisfactory. All items loaded with their corresponding constructs. All of the loadings exceeded .90, which is far above the 0.71 threshold (Comrey, 1973). The average variance extracted (AVE) was greater than 0.50 for all constructs, which suggests satisfactory convergent validity (Fornell & Larcker, 1981), and the square root of the AVE of each construct was much larger than the correlations of the specific construct with other constructs, which suggests satisfactory discriminant validity (Chin, 1998). The Cronbach's alpha for each construct exceeded 0.90 and provided strong evidence on construct reliability.

Based on these 12 items, we further added one item (CN1 in Appendix C) for the specific adoption context. Therefore, we tested these 13 measurements (three for NS, three for EG, three for LC and four for CN) in our study.

Appendix C: Measures

We adapted and created measurements as follows: other than satisfaction, disconfirmation, and internal self-efficacy, all other factors used a seven-point Likert scale in which 1 indicated "strongly disagree, 4 indicated "neutral', and 7 indicated "strongly agree".

Measures at Time 1

Prior experience (Kim & Malhotra, 2005b)
How long have you been using PBworks/Google Sites?
(Never used it before, less than 3 months, 3 to less than 6 months, 6 to less than 12 months, 1 to less than 2 years, 2 years or more)

Mindfulness (self-developed)

Technological novelty seeking (NS):

NS1. I paid attention to differences of this new technology from any other technology I previously used.
NS2. I tended to figure out how this wiki tool was unique in relation to the tools that I am currently using (word processing tool).
NS3. I was mindful about how this wiki tool differed from similar tools (e.g., word processing tool) I had used.

Engagement with the technology (EG):

EG1. I was engaged in investigating this wiki tool when making the adoption decision.
EG2. I gathered factual information about this wiki tool before making the adoption decision.
EG3. I got involved in exploring this wiki tool before I adopted it.

Awareness of local contexts (LC)

LC1. When making the decision to adopt this wiki tool, I thought about how this wiki tool might help my study.
LC2. When making the decision to adopt this wiki tool, I thought about how this wiki tool might change the way my study was done.
LC3. When making the decision to adopt this wiki tool, I thought about how this wiki tool may be compatible with my assignment requirements.

Cognizance of alternative technologies (CN):

CN1. I attended to alternative views regarding the wiki tool before making the adoption decision.
CN2. I was aware of other tools than this wiki tool before deciding to adopt it.
CN3. I paid attention to equivalent tools to fulfill my needs before deciding to adopt this wiki tool.
CN4. I thought about alternative tools to address my demands when deciding to adopt this wiki tool.

Perceived usefulness (adoption) (PUA) (Kim & Malhotra, 2005b)

PUA1. I think this wiki tool would allow me to accomplish my study assignments more quickly.
PUA2. Using this wiki tool could help improve the quality of my study.
PUA3. This wiki tool would give me greater control over my study.
PUA4. Using this wiki tool would enhance my effectiveness in my study.

Intention to use (IU) (Bhattacherjee & Premkumar, 2004)

IU1. I plan to use this wiki tool for my study.
IU2. I intend to use this wiki tool for my future work.
IU3. It is very likely that I will use this wiki tool in the near future.

Internal self-efficacy (SE) (Thatcher, Zimmer, Gundlach, & McKnight, 2008) (measured on a 10-point Likert scale in which 1 indicated "not at all confident", 5 indicated "moderately confident", and 10 indicated "totally confident")

SE1. I could use this wiki tool to facilitate my work if there was no one around to tell me what to do.
SE2. I could use this wiki tool to facilitate my work if I had never used a wiki system like it before.
SE3. I could use this wiki tool to facilitate my work if I had only the online help for reference.

Measures at Time 2

Perceived task-technology fit (TTF) (Larsen et al., 2009; Lin & Huang, 2008)
In helping me to perform the assigned task(s),
TTF1. The functionalities of the wiki tool were very compatible with the task.
TTF2. The functionalities of the wiki tool made the task easy.
TTF3. Using the wiki tool fit with the way I work.
TTF4. Using the wiki tool fit with my educational practice.
TTF5. In general, the functionalities of the wiki tool were best fit to the task.

Perceived usefulness (post-adoption) (PUP) (Kim & Malhotra, 2005b)
PUP1. Using this wiki tool helps me accomplish tasks more quickly.
PUP2. Using this wiki tool improves the quality of the work I do.
PUP3. Using this wiki tool gives me greater control over my work.
PUP4. Using this wiki tool enhances my effectiveness in my work.

Disconfirmation (DC) (Bhattacherjee & Premkumar, 2004) (measured on a 7-point Likert scale in which 1 indicated “much worse than expected”, 4 indicated “neutral”, and 7 indicated “much better than expected”)
Compared to my initial expectations, the ability of this wiki tool _____
DC1. to improve my performance is
DC2. to increase my productivity is
DC3. to enhance my effectiveness is
DC4. to be useful for my work or study is

Satisfaction (SAT) (Bhattacherjee & Premkumar, 2004)
All things considered, I am_________ with my use of this wiki tool.
SAT1: 1 “Extremely displeased” ——— 4 “Neutral” ——— 7 “Extremely pleased”
SAT2: 1 “Extremely frustrated” ——— 4 “Neutral” ——— 7 “Extremely content”
SAT3: 1 “Extremely terrible” ——— 4 “Neutral” ——— 7 “Extremely delighted”
SAT4: 1”Extremely dissatisfied” ——— 4 “Neutral” ——— 7 “Extremely satisfied”

Intention to continue (IC) (Bhattacherjee & Premkumar, 2004)
IC1. I intend to use this wiki tool in the near future.
IC2. I plan to use this wiki tool in the near future.
IC3. I predict that I will use this wiki tool in the near future.

Appendix D: Loadings and Cross-loadings

Table D1. Loadings and Cross-loadings

	NS	*EG*	*LC*	*CN*	*PUA*	*IU*	*TTF*	*PUP*	*DC*	*SAT*	*IC*	*SE*
NS1	***0.75***	0.34	0.30	0.22	0.30	0.32	0.22	0.24	0.20	0.14	0.01	0.16
NS2	***0.84***	0.27	0.38	0.23	0.41	0.40	0.25	0.28	0.26	0.16	0.03	0.39
NS3	***0.79***	0.28	0.29	0.25	0.28	0.33	0.14	0.25	0.16	0.13	0.02	0.22
EG1	0.39	***0.87***	0.44	0.30	0.29	0.30	0.14	0.26	0.22	0.14	-0.01	0.14
EG2	0.27	***0.87***	0.38	0.32	0.35	0.28	0.11	0.25	0.17	0.16	0.05	0.02
EG3	0.28	***0.83***	0.24	0.27	0.24	0.19	0.10	0.24	0.12	0.09	0.03	0.04
LC1	0.37	0.45	***0.92***	0.41	0.58	0.56	0.17	0.35	0.26	0.20	0.16	0.27
LC2	0.40	0.41	***0.92***	0.41	0.58	0.59	0.12	0.37	0.21	0.18	0.19	0.24
LC3	0.32	0.26	***0.84***	0.26	0.50	0.55	0.17	0.25	0.20	0.09	0.06	0.36
CN1	0.26	0.38	0.40	***0.80***	0.22	0.29	0.02	0.20	0.06	0.12	0.03	0.15
CN3	0.26	0.21	0.32	***0.87***	0.25	0.21	0.11	0.30	0.19	0.20	0.06	0.10
CN4	0.22	0.26	0.31	***0.86***	0.18	0.09	0.17	0.31	0.19	0.23	0.05	0.02
PUA1	0.35	0.35	0.57	0.23	***0.92***	0.69	0.31	0.40	0.36	0.25	0.11	0.38
PUA2	0.41	0.27	0.59	0.22	***0.95***	0.73	0.37	0.45	0.38	0.30	0.15	0.43
PUA3	0.38	0.34	0.55	0.24	***0.90***	0.65	0.29	0.35	0.34	0.26	0.09	0.33
PUA4	0.41	0.32	0.60	0.27	***0.92***	0.69	0.28	0.41	0.40	0.28	0.15	0.36
IU1	0.42	0.31	0.66	0.27	0.74	***0.91***	0.23	0.37	0.32	0.28	0.21	0.47
IU2	0.41	0.30	0.54	0.21	0.70	***0.94***	0.30	0.41	0.38	0.31	0.32	0.49
IU3	0.38	0.22	0.54	0.17	0.61	***0.91***	0.23	0.36	0.30	0.19	0.24	0.47
TTF1	0.16	0.06	0.08	0.00	0.12	0.10	***0.82***	0.50	0.44	0.44	0.20	0.08
TTF2	0.20	0.16	0.10	0.12	0.25	0.11	***0.81***	0.62	0.49	0.40	0.20	0.06
TTF3	0.25	0.12	0.19	0.10	0.40	0.32	***0.87***	0.60	0.60	0.51	0.25	0.12
TTF4	0.23	0.13	0.12	0.13	0.28	0.29	***0.82***	0.46	0.46	0.39	0.24	0.14
TTF5	0.24	0.11	0.19	0.13	0.34	0.31	***0.85***	0.59	0.50	0.48	0.28	0.10
PUP1	0.31	0.35	0.32	0.31	0.37	0.37	0.58	***0.90***	0.63	0.57	0.42	0.08
PUP2	0.30	0.22	0.33	0.28	0.45	0.38	0.62	***0.91***	0.61	0.52	0.43	0.12
PUP3	0.26	0.24	0.32	0.25	0.33	0.36	0.60	***0.89***	0.58	0.47	0.43	0.10
PUP4	0.30	0.26	0.36	0.31	0.45	0.40	0.61	***0.94***	0.67	0.56	0.43	0.13
DC1	0.26	0.20	0.20	0.14	0.33	0.34	0.52	0.62	***0.88***	0.53	0.36	0.10
DC2	0.25	0.20	0.25	0.14	0.36	0.33	0.51	0.61	***0.88***	0.60	0.37	0.09
DC3	0.22	0.17	0.18	0.13	0.36	0.27	0.52	0.61	***0.91***	0.59	0.38	0.08
DC4	0.19	0.15	0.26	0.19	0.37	0.34	0.58	0.60	***0.88***	0.61	0.42	0.11
SAT1	0.18	0.15	0.21	0.19	0.28	0.28	0.49	0.54	0.62	***0.91***	0.51	0.09
SAT2	0.12	0.13	0.14	0.16	0.29	0.25	0.49	0.54	0.60	***0.90***	0.40	0.08
SAT3	0.18	0.11	0.14	0.19	0.26	0.27	0.40	0.46	0.54	***0.88***	0.51	0.09
SAT4	0.17	0.17	0.15	0.22	0.23	0.22	0.54	0.57	0.60	***0.91***	0.46	0.02
IC1	0.01	0.03	0.14	0.04	0.11	0.25	0.27	0.45	0.43	0.52	***0.95***	0.02
IC2	0.04	0.02	0.19	0.08	0.16	0.27	0.30	0.48	0.42	0.50	***0.96***	0.03
IC3	0.02	0.02	0.12	0.04	0.11	0.27	0.24	0.42	0.37	0.48	***0.94***	0.03
SE1	0.29	0.05	0.21	0.11	0.34	0.43	0.09	0.10	0.04	0.04	0.06	***0.84***
SE2	0.29	0.07	0.28	0.11	0.33	0.48	0.07	0.08	0.05	0.07	0.01	***0.91***
SE3	0.28	0.09	0.35	0.07	0.41	0.44	0.15	0.14	0.19	0.09	0.00	***0.86***

NS: Technological novelty seeking (MTA)
EG: Engagement with the technology (MTA)
LC: Awareness of local contexts (MTA)
CN: Cognizance of alternative technologies (MTA)
PUA: Perceived usefulness (Adoption)
IU: Intention to use
TTF: Task-technology fit
PUP: Perceived usefulness (post-adoption)
DC: Disconfirmation
SAT: Satisfaction
IC: Intention to continue
SE: Computer self-efficacy

We highlight the highest loadings for each measure in bold.

Appendix E: Measurement Issues of Disconfirmation

We found that the overall perceived usefulness (4.47) was 0.52 lower than what it was (5.00) at time 1 with an overall positive disconfirmation. To examine this issue, we followed Bhattacherjee and Premkumar (2004) in conducting a subgroup analysis by dividing the sample to four subgroups: 1) higher perceived usefulness (adoption) (PUA) (higher than the overall sample mean 5.00), positive disconfirmation (higher than neutral value at 4); 2) higher PUA, negative disconfirmation; 3) lower PUA, positive disconfirmation; and 4) lower PUA, negative disconfirmation. Table E1 summarizes the results of the subgroup analysis.

Table E1. Subgroup Analysis Results

	High expectation		**Overall sample**	**Low expectation**	
	Positive disconfirmation (group 1)	Negative disconfirmation (group 2)		Positive disconfirmation (group 3)	Negative disconfirmation (group 4)
Number of observations	60 (34.9%)	13 (7.6%)	172	56 (32.6%)	43 (25%)
PUA: perceived usefulness (adoption)	6.12	6.42	5.00	4.39	3.81
PUP: perceived usefulness (post-adoption)	5.21	4.44	4.47	4.67	3.23
Difference: PUP-PUA	- 0.91	- 1.98	-0.53	0.28	- 0.91
Disconfirmation	5.26	3.81	4.56	4.93	3.28
Satisfaction	5.18	4.06	4.70	4.95	3.86

According to Bhattacherjee and Premkumar (2004), the perceived usefulness (post-adoption) (PUP) should be higher than perceived usefulness (adoption) (PUA) in positive disconfirmation groups (groups 1 and 3) and lower for negative disconfirmation groups (groups 2 and 4). But, in our study, we found that group 1's PUP was unexpectedly 0.91 lower than PUA. The reason may lie in group 1's unrealistic high initial expectation (i.e., PUA mean: 6.12); thus, its PUP had little room to increase at time 2 (i.e., ceiling effect). Moreover, group 1's PUA was still the highest (5.21) across all the four groups and was well above the neutral value 4. In addition, its means for disconfirmation and satisfaction were also the highest across all four groups. Therefore, we can reasonably consider that group 1 was positively disconfirmed.

The paradox we see in this research—that a positive disconfirmation exists when later belief is lower than early belief—spurs the ongoing debate regarding how to operationalize disconfirmation (Brown et al., 2014; Edwards, 2002; Irving & Meyer, 1999; Venkatesh & Goyal, 2010). Prior research has operationalized disconfirmation using either the difference score (later beliefs - initial beliefs) or by directly measuring disconfirmation (for a detailed review, please see Brown et al. 2014). Using difference score approach may suffer from confounding and ambiguous results and oversimplifying the complex relationship between expectations and experience (Edwards, 2002). As a result, researchers have directly measured disconfirmation approach, as in the CCM and this research, to overcome the drawbacks of the difference score approach. Nevertheless, directly measuring disconfirmation also has problems such as recall bias (Brown et al., 2014; Irving & Meyer, 1999). In this research, we followed the CCM in adopting the direct measure of disconfirmation for its higher reliability and lower expectation bias (Bhattacherjee & Premkumar, 2004; Yi, 1990). The paradox we see in this research reflects the essential difference between these two approaches. We believe that the difference score approach may be over-simplistic given that disconfirmation may be more than belief differences, which is an interesting topic for future research.

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