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Successful System-use: It's not just who you are, but what you do

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ABSTRACT

Information and communication technologies are so embedded in modern society that we have arrived at the point at which learning to use technology successfully may affect our day to day lives as much as does learning to eat or exercise properly. While information systems scholars have studied interesting post-adoption constructs such as continuance intentions and IT-appropriation, research explaining and predicting successful system-use (i.e., system-use that adds value) has been scarce. A better understanding of successful system-use would benefit both research and practice – scholars' knowledge of positive outcomes of human-computer interactions would expand and practitioners could gain insights toward improving employee added-value system-use. We pursue this study by theorizing around user characteristics, adaptive behaviors, and system-use outcomes. Our findings suggest that it is not only who you are, but what you do, that drives successful system-use.

Keywords

Successful system-use, adaptive system-use, user characteristics, system success.

INTRODUCTION

Information and communication technologies (ICTs) are integral to modern-day life. It is difficult to work in any field without having to learn new ICTs. Even fields such as agriculture, waste management, and construction—which have traditionally involved minimal ICT (if any)—are finding it nearly impossible to compete without depending on new ICTs (e.g., Gaskin et al., 2011; Arebey et al., 2011; Suprem et al., 2013). Because of society's increasing dependence on ICTs in everyday life and in organizations, it is crucial to better understand how to improve outcomes of ICT use (Burton-Jones and Grange, 2008).

Even after repeated use, many users do not form effective routines to maximize desirable outcomes when using ICTs (Nan, 2011). As such, there is still much to be explained regarding what makes a user successful in their system-use. Extant literature provides a vast smorgasbord of user characteristics as well as a modicum of user behaviors that may affect outcome variables of interest. These studies often apply a handful of these characteristics or behaviors, but rarely employ them together to better understand their mutual role in driving successful system use.

In pursuit of better understanding successful system-use, we draw upon the "individual impacts" portion of the DeLone and McLean systems success model (DeLone and McLean, 1992). We conceptualize user adaptive behaviors in terms of adaptive system-use (Sun, 2012). In an effort to be parsimonious, we use self-efficacy (Bandura, 1977), personal innovativeness (Agarwal and Prasad, 1998), and problem solving strategies (Amirkhan, 1990) as representative proxies for a host of potential user characteristics. Drawing upon this literature, we develop a theory of "successful system-use" that embraces the old adage which suggests that it is not who you are, but what you do, that determines outcomes. We thus theorize user adaptive behaviors as a mediator between user characteristics and successful system-use.

This article makes a unique contribution for practitioners and for scholars. Practitioners can use our findings to better understand what characteristics and adaptive behaviors drive successful use of ICTs, and thereby inform training or hiring protocols. Since adaptive behaviors can be improved by training, our findings may help management effectively train for using new ICTs successfully. As for scholarly contributions, there are still gaps in our knowledge about what drives successful systems-use. We seek to fill some of those gaps, and by doing so, we provide new fodder for theorizing around "technology in practice" (Orlikowski, 1999; Orlikowski, 2000; Orlikowski, 2007).

A THEORY OF SUCCESSFUL SYSTEM-USE

It is the role of science to discover and develop models of what ought to be (i.e., approximations of truth) (Popper, 1960). As a relevant example of an approximate truth, decades of research have shown that motivated effort consistently beats raw intelligence in the long run (e.g., Mueller and Dweck, 1998). As was once wisely observed: "the work of the world isn't done by geniuses. It is done by ordinary people who have learned to work in an extraordinary way" (Hinckley, 2002). The proposed theoretical model is shown in Figure 1. For parsimony we theorize how ASU, as a whole, mediates the effect of each characteristic on SSU, as a whole—resulting in just three hypotheses.

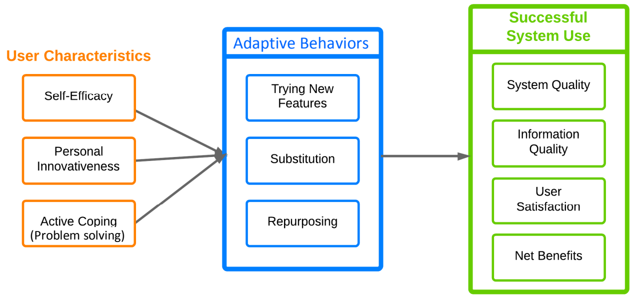


Figure 1. Proposed Theoretical Model

H1: Adaptive behaviors mediate the effect of Self-efficacy on Successful System-Use

Henry Ford, has been attributed with the adage, "Whether you think you can, or you think you can't—you're right." If a user thinks s/he will be successful (i.e., has high self-efficacy) when using an ICT, then that person is more likely to succeed (Compeau and Higgins, 1995). Increased self-efficacy improves performance because self-efficacy is an expectation, and expectations drive performance (Vroom, 1964). This effect occurs through multiple means. First, as users anticipate success, they will be more likely to try, and any attempt will have more success than no attempt at all (Mueller and Dweck, 1998). Secondly, perceived potential success (i.e., self-efficacy) increases the resilience of an individual (Benight and Cieslak, 2011). As users encounter problems, their perceived potential success will increase their ability to endure because, ultimately, they believe they will be successful. "He turns not back who is bound to a star," said Leonardo da Vinci (Richter, 1980, pp. 261), and the same applies to successful systems-use.

Furthermore, the positive effect that self-efficacy has on success can be explained, at least in part, by a user's adaptive behaviors which have been affected by their self-efficacy. Thus, it is not just being confident that drives performance, rather it is how that confidence changes behavior (Benight and Cieslak, 2011). One who is confident is more likely to engage in adaptive behaviors such as trying new features, substituting, and repurposing features because when users are confident, they are less risk-averse (Chatterjee and Hambrick, 2011), and are thus more prone to try, experiment, and explore (Jones, 1986). In turn, adaptive behaviors should drive SSU if for no other reason than that they increase the potential number of paths a user can draw upon to arrive at a successful outcome. If one set of adaptive behaviors fails, trying, substituting, and repurposing will provide other sets of interactions that may lead to success. However, if one is not confident and thus will not act adaptively when the user's known scripts (or action sets) fail, s/he will be lost and will stop. Additionally, when a user interacts with an ICT in ways that are new and unique to him/her, s/he becomes more familiar with that ICT. Truly "as a user gains more experience with an information system, he or she tends to discover unique features that it provides" (Sun, 2012, p. 456). By behaving in these ways, a user increases their mastery of the ICT and their exposure to its features. In summary, the positive effect confidence has on successful system-use is explained through adaptive system use.

H2: Adaptive behaviors mediate the effect of Personal Innovativeness on Successful System-Use

Personal innovativeness is a willingness to try new things and to explore new ways of working with an ICT (Agarwal and Prasad, 1998). Being more innovative with an ICT is likely to increase success with that ICT because users who are innovative have a tendency to explore, play, and take more risks (Magni et al., 2010; Agarwal and Prasad, 1998) which then illuminate new paths of interaction, thereby increasing the probability of successful outcomes. These kinds of adaptive behaviors lead to increased knowledge of how the system works, what kinds of adaptive behaviors lead to failure, and what kinds of adaptive behaviors enable further interaction. As observed by Kerski (2003), tinkering naturally leads to skill acquisition with ICTs, which should naturally lead to increased performance. Indeed, Bain et al. (2001) found that personal innovativeness leads to increased task performance in a research and development context.

However, the effect that personal innovativeness has on performance can be explained through the adaptive behaviors resulting from being innovative with ICTs. Innovativeness should naturally lead to more adaptive behaviors because being innovative implies a willingness to try new things (i.e., features) in new ways (i.e., substitution and repurposing) (Agarwal and Prasad, 1998). Being innovative also implies a certain disregard for potential failure (Agarwal et al., 2000; Thatcher and Perrewe, 2002), and thus, users will be more willing to try substitutions and repurposing, even if they don't know what the result may be. Thus, when innovativeness leads the user to try new features, repurpose, and substitute features, their SSU will increase for the reasons already explained in H1.

H3: Adaptive behaviors mediate the effect of Active Problem Solving on Successful System-Use

Inevitably, when using an ICT, things do not always go as planned or work the way we think they should (Pavlou and El Sawy, 2010). When users run into obstacles as they interact with ICTs, if they are active in the way that they problem solve, they face the problem instead of avoiding it (Amirkhan, 1990; Kohler et al., 2011). They also create plans of action for addressing the problem instead of acting on impulse (Amirkhan, 1990). This is similar to the concept of active thinking (Louis and Sutton, 1991) where instead of habitually responding to problems, they actively think of ways to resolve the problems. Thus by actively thinking of solutions, the user can mentally assess each approach until they find a solution that they think will work. This same concept is taught in Sun Tzu's The Art of War: "Victorious warriors win first and then go to war, while defeated warriors go to war first and then seek to win" (Tzu, 2013). In a similar way, people who exhibit active problem solving decide first that they will continue to work at a problem, and they are determined that they will win before they have to fight. Thus, active problem solving should increase the likelihood of achieving successful system-use.

However, the effect active problem solving has on SSU can be explained, at least in part, by the adaptive behaviors that result from this characteristic. Those who actively face their problems are more likely to try new features, substitute, or repurpose features when they run into a problem they cannot solve with their current knowledge (Louis and Sutton, 1991). Facing problems head-on implies a willingness to fail and try again (Amirkhan, 1990). Thus, a user who is an active problem solver will be less hesitant to engage in adaptive behaviors than someone who is a problem avoider (Amirkhan, 1990). Thus, when active problem solving leads the user to try new features, repurpose, and substitute features, their SSU will increase for the reasons already explained in H1.

STUDY PROCEDURE

We studied the use of Microsoft Excel as our information system because it is one of the most common applications for business and personal use. All of the measures we used came from extant literature, although we made minor wording adaptations to bring them into the context of using Excel. Our data came from an online survey of undergraduate students enrolled in the introduction to information systems course at a large private university in the western United States. One of the prerequisites for the intro course was to complete two half-semester courses on spreadsheet skills. Thus, all participants had similar and adequate background training in Excel. The demographics of our sample are shown in Table 1.

N=233	Min	Max	Mean	s.d.
Age (years)	18	32	22	2.86
Education	0-1	8	2.42	1.93
Experience	0-1	15	4.22	2.87
Frequency of Excel Use	almost never	multiple times daily	once per week	1.39
Gender	74% Male, 26% Female			

Table 1. Demographics of Sample

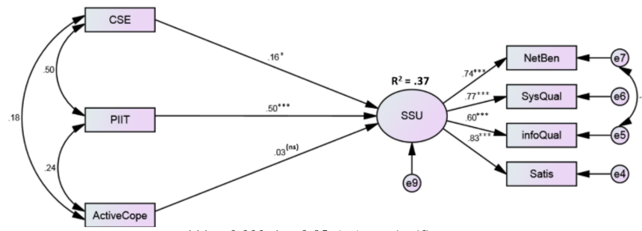
ANALYSIS

To test for mediation, we employed the Baron and Kenny (1986) approach followed by a bootstrapped analysis of indirect effects with 500 resamples. Because we hypothesized that ASU (as a whole) will mediate the effects of characteristics on SSU (as a whole), we created 2nd order reflective factors for ASU and SSU. The 2nd order factors demonstrated strong reliability (Cronbach's alpha for ASU = 0.713, SSU = 0.794), with all 1st order dimensions' indicator loadings significant.

Appropriate data screening procedures were followed and anomalies were addressed. The measurement model was assessed for validity, reliability, and goodness of fit. We met all relevant criteria and thresholds.

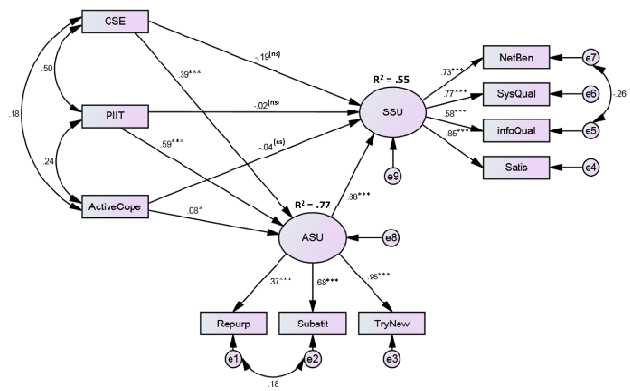
Findings from the Structural Models

To test our hypotheses, we analyzed our model with and without the mediators – see Figures 2a and 2b. For the unmediated model: R^2 = 37% for SSU. For the mediated model: R^2 = 55% for SSU, R^2 =77% for ASU. Notably, the R^2 for SSU jumps by 18 points after adding the mediator. Table 2 summarizes our findings.



****p<0.001, *p<0.05, (ns) not significant*

Figure 2a. Direct Effect without the Mediator



****p<0.001, *p<0.05, (ns) not significant*

Figure 2b. The Mediated Structural Model

Hyp.	Standardized Direct Effect	Indirect	Mediation
H1	w/o Med: 0.161* w/ Med: -0.188(ns)	0.344***	Full
H2	w/o Med: 0.502*** w/ Med: -0.015(ns)	0.520***	Full
H3	w/o Med: 0.035(ns) w/ Med: 0.080(ns)	0.071(ns)	None

****p<0.001, *p<0.05, (ns) not significant*

Table 2. Summary of Findings

DISCUSSION

In this study we have sought to extend extant literature regarding what predicts successful system-use for individual users. Through examining user characteristics and behaviors, we have found that the positive effect user attributes have on successful system-use is fully mediated by the adaptive behaviors users take when interacting with the ICT. However, while this holds up for self-efficacy and innovativeness, we found that active problem solving had no significant effect on successful system-use, whether directly or indirectly. This may indicate a different role for active problem solving – perhaps that of a moderator. For example, self-efficacy may lead to adaptive behaviors for those who are active problem solvers but might not for those who are not active problem solvers. We leave it to future research to explore this possibility.

The main insight gained from the study is that user characteristics only affect successful system-use through user adaptive behaviors. This is a critical finding because many studies place user characteristics as direct antecedents to system-use outcome variables without any intervening user-behavior variables. Thus, the theoretical relationships developed in such studies may be incomplete, and the findings may be affected because the causal relationship might actually be occurring through unaccounted for and unmeasured user-behavior variables. This possibility opens up new opportunities to extend and clarify existing theories in information systems research by adding user-behaviors (particularly adaptive behaviors) to models where they are currently absent.

An additional, and unexpected insight gained from this study is with regards to the impotence of active problem solving. Despite sound logic and also literature support for the causal relationship between active problem solving and outcome variables like task performance (Rasch and Tosi, 1992), we found that active problem solving had no real impact on successful system-use. This non-effect may be due to the population of our sample. Undergraduate students in the business school are constantly asked to tackle problems and work through them. Thus, this may be affecting our measure for problem solving while not having the same effect on SSU. As noted, this may also be due to a misplacement of the construct in our model. Perhaps rather than an antecedent, it is a moderator.

Beyond these main insights, we show that the DeLone and McLean system success model can be used effectively as a single, second-order outcome variable. Granted, we removed two components of the model (service quality and intention to use) in order to make it directly applicable to outcomes of *individual* ICT-use. Nevertheless, the second-order factor demonstrated strong reliability (Cronbach's alpha = 0.794). We similarly show that adaptive system-use can be modeled as a single, second-order construct. We also removed one component from ASU (recombining) in order to make it statistically sound. However, the loading from repurposing was particularly low (although still significant). Further analysis shows that removing repurposing from the second-order construct would actually improve reliability from a Cronbach's alpha of 0.713 to 0.778. A potentially fruitful task for future research may be to discover if there is a single set of measures that could be used to capture the spirit and intent of ASU without using the full set of measures from Sun (2012), thus resulting in a single, first-order construct, rather than a second-order construct. Such a contribution has been made before to original and complex scales, such as social desirability (Hays et al., 1989) which has dropped from a 40-item scale down to five items.

From a practical perspective, the insights from this study suggest employers should encourage their employees to explore new ICTs (i.e., try new features, substitute, and maybe repurpose features). Learning rigid scripts or routines for accomplishing a task may be less effective than learning basic principles and then exploring. However, our study was general and not specific to a particular task. Thus, adaptive behaviors may be best for some types of tasks (perhaps unstructured tasks), whereas rote scripts may be best for others (such as routine, structured tasks). It is up to future research to theorize and explore these possibilities. An experimental design would be well-suited to such an exploration. Where possible, hiring protocols may also screen for such adaptive tendencies in potential employees if the job position was conducive to adaptive behaviors – again, perhaps depending on the extent to which typical tasks are structured or unstructured.

We recommend future research explore potential moderators for the relationships in our model, such as task-type (structured vs. unstructured), and possibly active problem solving. For example, how might these mediated effects differ across job roles? This will likely follow the same logic as with task-type, as different job roles have different types of tasks. Additionally, how might a basic working knowledge of the ICT affect these relationships? Is adaptive system use only good when a foundation of skills and familiarity is already present, or is it best to explore right from the get-go? Or is it more of a bell curve where instruction is needed while unfamiliar with the ICT, then some amount of exploring can uncover new possibilities up to a certain point of mastery, at which point expert training is needed for full mastery? Additional research is needed to explore these questions more fully.

Conclusion

In this study we have sought a better understanding of the relationships between user characteristics, adaptive behaviors, and usage outcomes. We found that the effect characteristics have on outcomes is fully explained through user adaptive behaviors. This finding provides an opportunity to extend and clarify prior theorizing in the IS literature that does not account for user adaptive behaviors, and suggests that future research more carefully consider user adaptive behaviors as a key mediator of performance. Although limited in scope, the findings from this study shine light on several new opportunities to better understand successful system-use, and provide a foundation upon which others may build as we seek to find ways to understand and improve human-computer interactions.

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