# USER ADAPTATION AND INFUSION OF INFORMATION SYSTEMS

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## ABSTRACT

*Today's complex information systems can be used to varying degrees by individuals. Information system infusion captures the degree to which the system is used deeply, or to its fullest extent, for improving organizational and individual performance. Theory suggests that infusion at the individual level depends on user adaptation to an information system; however, relationship between types of user adaptation and infusion has not been examined in extant research. This study draws on the Coping Model of User Adaptation to explore how various adaptation behaviors employed by information system users influence its infusion in their work. Results indicate that problem-focused adaptation behaviors directed toward changing the work-system-self dynamic promote infusion, while avoidance-oriented emotion-focused adaptation behaviors tend to diminish infusion. Theoretical and practical implications of these findings are discussed.*

**Keywords:** Information System Infusion, Adaptation, Post-Adoptive Use, Coping

## INTRODUCTION

Empirical evidence demonstrates that the benefits of information systems (IS) often fall short of expectations or fail to materialize at all. A commonly cited reason for these failures is that IS are underutilized, thus undermining their benefits to the organization [32, 3]. Although IS use is one of the most frequently studied constructs in the IS literature [3], most extant research has examined use from a quantitative perspective, operationalizing the construct as frequency, intensity, or duration of use behaviors [10]. However, increased use quantity does not necessarily imply increased individual or organizational benefit. The growing complexity of today's organizational IS has resulted in greater user discretion over *how*, as opposed to *whether* or *how often*, an IS is used. For instance, an organization may mandate the use of a feature-rich enterprise resource planning system, yet users may still exhibit wide variance in terms of the types of system features they use and the way they use them to complete their tasks [32, 2, 57]. Hence, research must be devoted to understanding factors that shape quality or depth of use, particularly with regard to complex, mandated organizational IS [17, 50, 3, 57].

One concept that captures the qualitative notion of use is *IS infusion*, or the degree to which the IS is used within the organization to its fullest potential [17]. The concept of infusion goes beyond quantitative measures of use to convey whether the technology is fully integrated into an organization's (or individual's) work systems. Thus, infusion provides a useful framework for understanding the deeper post-adoptive utilization issues of interest to both organizations and researchers. Early theoretical work suggests that infusion occurs as the result of individuals' *adaptive efforts* to modify the system, their work tasks, or themselves to more fully integrate the IS into their work procedures. However, although the concepts of IS adaptation and infusion have been present in the literature for some time, our understanding of how specific types of adaptation lead to infusion of technology in an individual's work system remains limited. Most studies of infusion have examined its broad organizational antecedents rather than focusing on the individual-level adaptive processes by which it is attained [23, 33, 2]. More research is needed that reveals how these processes promote or detract from individual IS infusion itself [14].

The purpose of this research is to explore how different types of user adaptation contribute to or detract from IS infusion at the individual level. Drawing on theories of IS adaptation [5], we hypothesize that infusion is influenced by the degree to which individuals engage in various types of adaptation behaviors vis-à-vis the IS. The hypotheses are tested using survey data collected from an organization that implemented a large-scale enterprise system. This work contributes to extant research by integrating concepts from IS adaptation and infusion literatures that have been implied by previous work but not formally tested. For practitioners, results of this study can be used to inform ongoing training and user intervention programs that foster higher levels of infusion among IS users, ultimately helping organizations reap more benefit from their IS investments.

## THEORETICAL BACKGROUND

IS infusion has been defined as "increased organizational effectiveness . . . obtained by using the IT application to its fullest potential" [17, pp. 124-125], "the degree of [technology] integration with existing business processes" [23, p. 234], and "embedding an IT application deeply and comprehensively within an individual's or organizations work systems" [50, p. 79]. The common themes underlying these definitions are that, 1) technology may be integrated at various levels by both organizations and individuals, and, 2) that organizational and individual benefits derived from technology are contingent upon the level of this integration. Because a firm's return on its IS investment will be limited if the system is not fully utilized to fulfill its intended purpose [42, 53], there is significant theoretical and practical motivation to better understand how individual-level IS infusion is realized.

Prior research has examined infusion from two broad perspectives. The first, herein termed *infusion via organizational*

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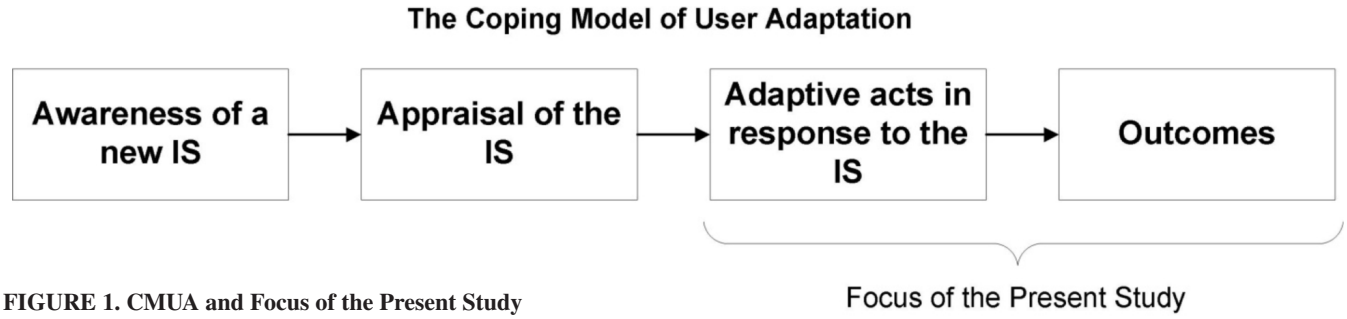


**FIGURE 1. CMUA and Focus of the Present Study**

*technology configuration*, defines and examines infusion in terms of subsets of IS features that have been implemented by an organization as a whole. Studies adopting this perspective examine socio-technical structures and technology configurations that denote IS infusion at the organizational level [35]. For example, Cooper and Zmud [17], identified five progressive levels of Material Requirements Planning system use with respect to the types of functions the system was used to perform as well as the performance outcomes that emerged, with the top three levels representing infusion. Other researchers have employed similar frameworks for studying organizational infusion of technologies such as supermarket scanners [59] and intranet technology [23]; in each case, successive levels of organizational configuration represent higher levels of use and deeper infusion of the technology in the organization.

The organizational technology configuration perspective is valuable from a macro-level, but it does not account for the individual-level processes by which infusion is realized. This perspective, termed *infusion via individual-level technology use*, conceptualizes infusion as the degree to which individual technology users employ the full range of features offered by the technology, or the degree to which they use the technology to its fullest extent. Although this type of infusion is a prerequisite for organizational infusion, studies that have adopted this perspective are relatively recent. Most have relied on theories of technology adoption [19, 56] and continuance [6, 8, 29] to explore whether infusion is influenced by such antecedents as perceived usefulness [30, 33, 58, 49, 57], facilitating conditions [33], satisfaction [30, 58, 57], and personal innovativeness [33, 57]. However, results from this work have been mixed [42], and many researchers have argued that factors leading to adoption of a technology are likely to be distinct from those leading to "extra-role" post-adoptive behaviors such as infusion [e.g., 14, 32, 42].

One important precursor to individual-level infusion that has received scant attention is user adaptation, or the degree to which the IS user proactively adapts to the IS by changing work habits, routines, and the technology itself to achieve higher levels of productivity [14, 32, 37, 43, 55, 54]. Though adaptation has been conspicuously absent from individual-level IS infusion studies[1], the literature offers abundant evidence that it is likely to be an important antecedent to infusion. Early theoretical work suggests that infusion occurs as IS use becomes frequent and as IS-enabled work processes are *re-conceptualized* and *adapted* in response to it [50]. Lassila and Brancheau [35] draw on punctuated equilibrium theory to propose four progressively deeper states of organizational technology integration characterized by increasingly adaptive levels of technology use: low-integration, standard adoption, expanding, and high-integration. In a similar vein, Orlikowski [44] proposes three types of "technology enactment" that reflect the degree to which processes, technology, and social structures are changed as a result of the technology's integration within the work system: inertia (technology is used within the existing way of doing things), application (technology is used to augment or refine the existing way of doing things), and change (technology is used to substantially alter the existing way of doing things).

The consistent message from this body of work is that infusion is brought about by users' efforts to adapt themselves and their environment to enable deeper use of the IS within a work process. However, the literature offers limited insight into how particular *types* of individual user adaptation promote or discourage IS infusion. Although user adaptation is generally seen as having positive effects, adaptive efforts can take many forms, including behaviors that may detract from deeper, infused use [5, 32]. Research that examines how infusion is enhanced or hindered by various types of individual IS adaption behaviors can help researchers and practitioners better anticipate and manage these behaviors to achieve desired IS use outcomes. To this end, we draw on recent work in the domain of IS adaptation to develop hypotheses regarding how different types of individual-level adaptation affect IS infusion.

## HYPOTHESES

To guide our inquiry, we draw on Beaudry and Pinsonneault's *Coping Model of User Adaptation* (CMUA) [5], which provides a useful theoretical basis for understanding users' adaptive reactions to an IS and their consequent outcomes. Building on coping theory [36], CMUA, frames users' responses to a new workplace IS in terms of four phases as shown in Figure 1. Initially, the user becomes aware of a new IS in her work environment. This awareness leads to appraisal of the IS, wherein the user evaluates the likely consequences of the IS (positive or negative) and her options for responding to it. Based on IS appraisal, the user then engages in various types of adaptive acts in response to the IS which, in turn, can produce both external outcomes (e.g., improved efficiency or effectiveness using the IS) and internal outcomes (e.g., restored emotional equilibrium).

The latter portion of the CMUA model (right side of Figure 1) is particularly relevant to this study because it provides theoretical groundwork for understanding how an IS-related outcome (i.e., infusion) is likely to result from certain types of user adaptation

[1] *One exception is Bhattacherjee and Harris [7], who found that work and IT adaptation influenced post-adaptive IT usage. However, this construct was operationalized as frequency/intensity/duration of use rather than deep, infused use as measured here.*

behaviors. CMUA defines adaptation behaviors as "the cognitive and behavioral efforts exerted by users to manage specific consequences associated with a significant IT event that occurs in their work environment" [5, p. 496]. Adaptation behaviors can be targeted toward any of three dimensions of the IS implementation context: the user, the technology itself, and the work task. Framing these dimensions in terms of coping theory, Beaudry and Pinsonneault propose a typology of adaptation behaviors, which, at a broad level, includes problem-focused behaviors and emotion-focused behaviors.

**Problem-Focused Adaptation Behaviors**

Problem-focused adaptation behaviors are directed at managing or altering the problem causing the distress and focus on altering the external environment [36]. Beaudry and Pinsonneault [5] describe how problem-focused adaptation behaviors in response to a new workplace IS may alter the work task, the user, or the IS itself:

> Problem-focused adaptation aims at managing the issues associated with the IT event directly by (1) adapting one's self such as adjusting personal habits to fit the requirements of the technology [55, 43], learning new skills [55], and adjusting work commitment [38]; (2) adapting the work by modifying procedures and routines [54, 52]; and/or (3) adapting the technology by changing its functionalities and features [47, 37, 15] (p. 500).

CMUA [5] posits that problem-focused adaptation behaviors will result in increased individual efficiency and effectiveness by using the IS in a more productive manner. The concept of infusion implies that the user of the IS makes changes in her environment to fully integrate its features into her work routines. This suggests that adaptation efforts geared toward changing the work task, IS, or the user herself (i.e. problem-focused adaptation behaviors) should have a positive impact on the degree to which the system becomes infused at the individual level. In other words, users who respond to the IS by actively adapting themselves, their work processes, and the IS itself should be more likely to reach higher levels of infusion than those who fail to so adapt [7, 24, 34]. This notion is supported by Saga and Zmud [50], who identify reconceptualization of work processes as a critical infusion enabler. Moreover, a growing body of IS adaptation literature has demonstrated that progressively higher levels of IS integration and individual performance occur as individuals and organizations modify their environments to take advantage of the IS's capabilities [39, 44, 35, 34] and enhance its fit with the work task [11] . We therefore hypothesize that problem-focused adaptation behaviors will lead to higher levels of individual-level IS infusion:

> *H1: Problem-focused adaptation behaviors directed toward changing the work task, the IS, and the individual will relate positively to individual-level IS infusion*

**Emotion-Focused Adaptation Behaviors**

Emotion-focused adaptation behaviors are directed at regulating emotional response to the problem [36]. Unlike problem-focused adaptation behaviors, emotion-focused behaviors are directed toward the inner self, and do not directly alter external aspects of the situation. Coping studies vary in the number and types of emotion-focused adaptation behaviors they identify. However, a synthesis of this literature [51] reveals that common emotion-focused coping behaviors include seeking social support, positive reappraisal, wishful thinking, distancing, and escape/avoidance. In the IS domain, these behaviors focus on changing or regulating the individual's affective response to the system. According to Beaudry and Pinsonneault [5]:

> Emotion-focused adaptation is oriented toward one's self and aims at changing one's perception of the consequences of the IT event or at reducing emotional distress. Emotion-focused adaptation includes self-deception and avoidance (e.g., denying that the IT affects one, acting as if the IT event had not occurred; [60]), minimization of the consequences of the IT event, selective attention (e.g. removing thoughts of the event), positive comparison (e.g. comparing oneself to other users who are more badly affected by the event; [36]), and passive acceptance (e.g. accepting the IT event as a fact of life by changing beliefs and attitudes; [55, 54]) (p. 500).

Although emotion-focused adaptation behaviors do not directly alter the external environment, their effect on IS infusion is not entirely clear. Emotion-focused behaviors have traditionally been associated with sub-optimal coping adjustment, while problem-focused behaviors have been linked to more positive results [e.g. 12, 22]. For example, behaviors such as avoidance or wishful thinking, while potentially helpful for regulating emotional response, are not likely to produce positive external outcomes. However, the restoration of emotional equilibrium afforded by some emotion-focused behaviors may establish a foundation for achieving positive coping results. Beaudry and Pinsonneault [5] observe that restoration of emotional stability may be necessary to enable a user to perform problem-focused adaptation efforts that produce increased operational efficiency and effectiveness. To illustrate, seeking social support may not only promote a sense of internal well-being, but also empower the individual to respond to a stressor in productive ways [12].

To distinguish the effects of various emotion-focused adaptation behaviors on infusion, we draw upon another well-known typology of adaptive behaviors: approach vs. avoidance.[2] Approach behaviors are oriented toward the source of stress, while avoidance behaviors are oriented away from it [48]. Ebata and Moos [22] describe approach strategies as "cognitive attempts to change ways of thinking about the problem and behavioral attempts to resolve events by dealing directly with the problem or its aftermath" (p. 34). Approach oriented emotion-focused adaptation strategies include such acts as seeking social support from others or reappraising the stressor in a positive light. In contrast, avoidance strategies are described as "cognitive attempts to deny or minimize threat, and behavioral attempts to get away

[2] *The approach/avoidance distinction is not necessarily confined to emotion-focused adaptation behaviors. For instance, an individual may alter the troubled person-environment relationship by engaging in active resistance or complete withdrawal from the situation. However, because this research focuses solely on approach oriented problem-focused adaptation behaviors as identified in CMUA, the distinction is invoked here only for emotion-focused behaviors.*

from or avoid confronting the situation. . . ." [22, p. 34], and include escape/avoidance, wishful thinking, or distancing.

Prior research has generally shown that approach-oriented behaviors produce better adjustment outcomes than do avoidance-oriented behaviors [22, 48]. In the IS domain, Beaudry and Pinsonneault [5] make a similar argument based on their observation of users who (a) achieved increasing performance benefits of deeper use sparked by positive reappraisal of the system (approach-oriented behaviors), or (b) tried to minimize their learning and use of the IS and, consequently, engaged in superficial use yielding few performance benefits (avoidance-oriented behaviors). Correspondingly, this research posits that approach emotion-focused adaptation behaviors with respect to a new workplace IS will promote deeper and more integrative IS use (i.e. infusion), while avoidance behaviors will inhibit this outcome.

*H2: Approach oriented emotion-focused adaptation behaviors will relate positively to individual-level IS infusion*

*H3: Avoidance oriented emotion-focused adaptation behaviors will relate negatively to individual-level IS infusion*

In summary, research suggests that infusion depends on user adaptation behaviors in response to it. Problem-focused and approach-oriented emotion-focused adaptation behaviors are expected to promote IS infusion, while avoidance-oriented emotion-focused adaptation behaviors are expected to detract from it. Hypotheses H1-H3 are depicted graphically in Figure 2.

## RESEARCH METHODOLOGY & DATA ANALYSIS

### Data Collection

Data collection took place at the campus health (CH) center of a large public university in the western United States. CH provides health and medical services to the university community and encompasses several integrated departments such as medicine/patient care, reception/scheduling, lab, pharmacy, radiology, and billing. CH had previously relied on paper-based medical records and stand-alone information systems to support its various departments. However, to improve efficiency and quality of medical care, CH management adopted a third-party enterprise Electronic Medical System (EMS) to manage the activities of all departments in an integrated way. Because the EMS replaced all previous systems and processes across the enterprise, its use by CH employees was mandatory. At the time of data collection most employees had been using the system for an average of approximately one year, allowing them adequate time to adapt to the system and infuse it into their work practices. Although CH is a healthcare-specific organization, its structure is similar to that of other organizations that employ both professional employees (e.g., physicians, nurses) and non-professional employees (e.g., receptionists, billing associates) who use an enterprise system. Moreover, examining IS infusion at CH is consistent with the approach of other studies that have explored general IS phenomena in the context of a healthcare organization [e.g., 1, 18, 45]. For these reasons, CH was deemed an appropriate site for studying the infusion of a complex, enterprise-wide system.

Data was collected via an online survey administered to CH employees. An online survey was chosen because it was preferred by CH management and because all CH employees had convenient access to the Internet at work. Before administering the survey, interviews were conducted with key CH personnel to ensure that survey items were clear and understandable. Because nearly all CH employees used the EMS, a census sample was then solicited via an email invitation sent from management to all employees inviting them to complete the survey. Incentive to participate was offered in the form of a gift certificate drawing to a popular online retailer. Of 65 targeted participants, a total of 57 responses were received, constituting a response rate of 87%. Survey respondents were 85% female and ranged in age from 22 to 65 years (M = 46 years). Time employed at CH ranged from 4 months to 24 years (M = 8 years), with time in current position ranging from 4 months to 23 years (M = 6.3 years). Forty-four percent of respondents had earned a bachelor's degree or higher. Approximately one third of respondents had been involved in at least one other technology deployment project besides the EMS.

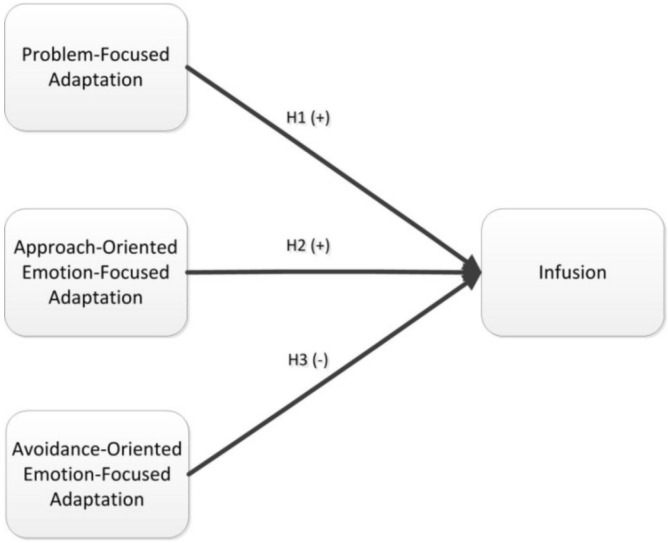


**FIGURE 2. Hypotheses**

### Measurement

Measurement scales were adapted from prior research and are shown in the Appendix. Infusion was measured using a reflective scale used in prior infusion studies [33, 53]. Problem-focused adaptation scales were taken from literature on innovation diffusion [47] and IS adaptation and use [3, 4]. These scales were selected based on the three dimensions of problem-focused adaptation identified by Beaudry and Pinsonneault [5]: work, system, and self. Emotion-focused adaptation scales were adapted from emerging IS coping research [4] and from Lazarus and Folkman's Ways of Coping Questionnaire [26, 36]. Although coping research has identified scores of potential emotion-focused adaptation behaviors [see 51 for a review], in the interest of parsimony, we focused on four commonly cited emotion-focused behaviors that are prevalent in the coping literature [51] and that have been utilized in emerging IS coping research [4]. These behaviors, defined in Table 1, include seeking social support, positive reappraisal, avoidance/wishful thinking, and distancing.

Consistent with prior research [3], problem- and emotion-focused adaptation constructs were conceptualized as formative constructs according to the criteria established by Jarvis et al.,

[31] and Petter et al., [46]. According to these criteria, a scale should be considered formative if its indicators (a) predict the construct (rather than being predicted by it), (b) are not omissible without changing the meaning of the construct (c) may not be interchangeable with other construct items, and (d) may have different antecedents and consequences. The adaptation constructs herein meet each of these criteria. For example, problem-focused adaptation is a composite of several potentially uncorrelated behaviors that together constitute an individual's efforts to change her external environment. A user may, for instance, eliminate certain tasks performed on the job after adopting an IS (work adaptation) without significantly changing the IS itself (system adaptation). However, each of these behaviors denotes a distinct, non-interchangeable dimension of problem-focused adaptation. Moreover, each of these dimensions may have different antecedents (e.g., workplace autonomy vs. computer self-efficacy), and omitting either would significantly alter the meaning of the construct. A similar argument applies to emotion-focused adaptation behaviors. For example, a user may internally engage in positive reappraisal of the IS but not seek external support from colleagues, though both of these are composite dimensions of approach-oriented emotion-focused adaptation. Thus, adaptation scales were conceptualized as formative.

**Analysis Methods**

Data analysis was conducted using Partial Least Squares (PLS: SmartPLS version 2.0.M3). PLS is a structural equation modeling (SEM) technique that allows for the simultaneous analysis of both the measurement model (relationships between latent constructs and their measurement items) and the structural model (relationships between latent constructs). PLS was chosen over covariance-based SEM because it is capable of incorporating formative constructs and it is more appropriate for predictive applications and theory building [28]. A common rule for sample size in PLS analysis is that the number of observations should not be less than 10 times the number of indicators on the most complex formative construct or the number of exogenous constructs predicting an endogenous construct, whichever is greater [28]. The most complex predictive relationship in this study contains three antecedents and the sample size is 57. Hence, the sample size requirements for testing the model using PLS are met under this standard. However, because this rule has met with some criticism [e.g., 41, 40], we also conducted a power analysis [13], which revealed acceptable power levels ($\geq$.80, $\alpha$=0.05) for detecting medium-to-large effect sizes as defined by Cohen [16]. Thus, although our modest sample size warrants some caution in interpreting non-significant results, it was deemed adequate in this exploratory study for detecting strong effects that are of most interest both practically and theoretically.

**TABLE 1. Emotion-Focused Adaptation Behaviors**

| Type | Behavior | Description |
|---|---|---|
| Approach-Oriented | Seeking Social Support | Efforts to seek informational, tangible, or emotional support associated with the IS |
| | Positive Reappraisal | Efforts to create or ascribe positive meaning to the IS |
| Avoidance-Oriented | Avoidance/ Wishful Thinking | Wishful thinking or behavioral efforts to escape or avoid the IS (contrasts with distancing, which emphasizes detachment) |
| | Distancing | Efforts to detach oneself and to minimize the significance of the IS |

**TABLE 2. Means, Standard Deviations, PLS Composite Reliabilities**

| Construct | No. of Items | Mean | SD | Composite Reliability |
|---|---|---|---|---|
| **Infusion** | 4 | 5.06 | 1.10 | 0.88 |
| **Problem-Focused Adaptation** | | | | |
| Self Adaptation | 7 | 3.99 | 0.84 | N/A |
| System Adaptation | 4 | 2.35 | 1.03 | N/A |
| Work Adaptation | 3 | 5.08 | 1.24 | N/A |
| **Approach-Oriented Emotion-Focused Adaptation** | | | | |
| Seeking Social Support | 3 | 3.18 | 1.12 | N/A |
| Positive Reappraisal | 4 | 2.96 | 1.34 | N/A |
| **Avoidance-Oriented Emotion-Focused Adaptation** | | | | |
| Avoidance | 3 | 1.18 | 0.44 | N/A |
| Distancing | 2 | 2.07 | 0.95 | N/A |

**Measurement Model**

As a first step, the measurement model was tested by evaluating construct reliability and validity. Composite reliability is a measure of a construct's internal consistency reliability and is calculated as a part of the PLS analysis. Internal consistency reliability is relevant only for reflective scales, for which items are expected to measure the same underlying latent construct [46]. This study employs one reflective scale to measure infusion. As shown in Table 2, the composite reliability score for this scale was 0.88, which exceeds the commonly cited threshold of 0.7 [27].

Multiple methods were employed to establish construct validity. For reflective scales, convergent and discriminant validity are demonstrated by examining the average variance extracted (AVE) as well as the factor loadings and cross loadings. AVE represents the percentage of variance that is attributable to the construct, and is expressed as a ratio of the sum of variance captured by the construct and measurement variance [28]. Convergent validity is demonstrated when the AVE of a construct is greater than or equal to 0.5 — i.e., that the measures contain at most 50% error variance — while discriminant validity is established when the square-root of the construct's AVE exceeds its correlations with other constructs in the model [27]. Table 3 shows that both of these criteria were met.

Validity of the reflective infusion scale was also confirmed by examining the factor loadings and cross loadings generated in the PLS analysis. A scale item possesses adequate convergent and discriminant validity if it loads at least one order of magnitude higher on its indented construct than on any other construct [27]. Table 4 shows that infusion scale items meet this criterion.

**TABLE 3. Construct AVEs and Inter-Construct Correlations (numbers on the diagonal are square-root of AVE for each construct)**

| # | Construct | AVE | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|
| 1 | Infusion | 0.658 | **0.811** | | | |
| 2 | Problem-Focused Adaptation | N/A | 0.341** | **N/A** | | |
| 3 | Approach-Oriented Emotion-Focused Adaptation | N/A | 0.116 | -0.215 | **N/A** | |
| 4 | Avoidance-Oriented Emotion-Focused Adaptation | N/A | -0.185 | 0.022 | 0.036 | **N/A** |

*: p < .05 | **: p < .01

**TABLE 4. Reflective Item-Construct Loadings and Cross Loadings***

| Item | Infusion | Problem-Focused Adaptation Behaviors | Approach Emotion-Focused Adaptation Behaviors | Avoidance Emotion-Focused Adaptation Behaviors |
|---|---|---|---|---|
| INF1 | **0.867** | 0.209 | 0.095 | -0.117 |
| INF2 | **0.795** | 0.213 | 0.054 | -0.086 |
| INF3 | **0.699** | 0.173 | 0.025 | -0.190 |
| INF4 | **0.872** | 0.405 | 0.150 | -0.185 |

* Because factor loadings are relevant only for reflective scales, loadings of formative items measuring problem- and emotion-focused adaptation are not shown. However, loadings of reflective infusion scale items on these adaptation constructs are included to substantiate convergent and discriminant validity.

As noted earlier, adaptation behaviors were measured using formative scales. Validation of formative scales differs from that of reflective scales due to the fundamental difference in the nature of their measurement [31, 9, 20]. This study followed the guidelines recommended by Petter, et al. [46] for validating formative scales. First, construct validity was assessed by examining the factor weights (as opposed to the factor loadings) produced by the PLS analysis. Items with non-significant weights can be considered for exclusion, but only if exclusion does not undermine the content validity of the construct [9]. As shown in the Appendix, weights for two items were non-significant (AWT and SYSAB); however, because prior theory has identified these items as core elements of the constructs in the model, they were retained in the analysis to preserve content validity.

Reliability for formative scales was measured by computing the variance inflation factor (VIF) of the measurement items. Unlike reflective scale items which should demonstrate unidimensionality, formative scales may be threatened by very high correlation, or multicollinearity, among the items [46]. The highest VIF score observed in our analysis was 1.87 (PR, SSS), which is well below the threshold of 3.3 recommended by Diamantopoulos and Siguaw [21]. Thus, formative scales exhibited adequate reliability for testing the structural model.

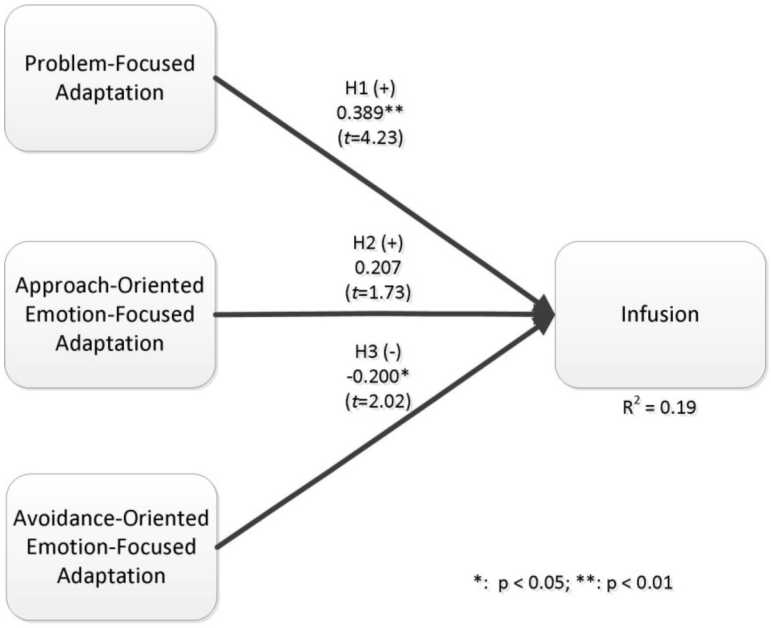


**FIGURE 3. Hypotheses Testing Results**

**Structural Model**

A bootstrapping resampling procedure (200 samples) was used to test the significance of path coefficients. To preserve statistical power, summated scales were calculated for each dimension of problem- and emotion-focused adaptation (e.g., self adaptation, work adaptation, seeking social support, avoidance, etc.) and entered into the model as formative indicators of each type of adaptation behavior. The results of the analysis are shown in Figure 3.

Hypothesis 1, which predicted a positive relationship between problem-focused adaptation behaviors and infusion, was supported ($t$ = 4.23, $\alpha$ < 0.01). The positive relationship between approach-oriented emotion-focused adaptation behaviors and infusion (H2) was nonsignificant at the $\alpha$ =0.05 level. Hypothesis 3, predicting a negative relationship between avoidance-oriented emotion-focused adaptation behaviors and infusion, was supported ($t$ = 2.02, $\alpha$ < 0.05).

## DISCUSSION & IMPLICATIONS

This study examines how various types of IS adaptation behaviors influence IS infusion at the individual level. Results of our analysis lead to several implications for research. First, infusion is more likely when users engage in problem-focused adaptation behaviors (H1), which include efforts to modify themselves, their work routines, and the system itself to better leverage its capabilities. Early infusion research posited that infusion is most dependent on users' efforts to engage in adaptive modification of the task-system-self dynamic [17, 50, 59]. In a similar vein, CMUA predicts that users who engage in problem-focused adaptation behaviors are more likely to achieve individual efficiency and effectiveness resulting from their deeper use of the system [5]. Our results confirm these hypotheses by showing that problem-focused adaptation is the single strongest predictor of infusion. This implies that problem-focused adaptation efforts should be a primary focus of continued theory building on how and why individual-level infusion occurs.

Second, our results suggest that infusion appears to be hindered by avoidance-oriented emotion focused adaptation behaviors such as avoidance and distancing (H3), but is not significantly influenced by approach-oriented emotion-focused adaptation behaviors such as seeking social support or positive reappraisal (H2). While non-significant results must be viewed with some caution due to our modest sample size, this pattern may indicate that emotion-focused adaptation behaviors have little bearing on users' behavioral outcomes unless they prompt some level of withdrawal from the system. In other words, emotion-focused behaviors such as seeking social support and positive reappraisal may help users achieve a sense of emotional equilibrium but neither enhance nor diminish their degree of system use. CMUA, which does not distinguish between approach- and avoidance-oriented emotion-focused behaviors, implies that performance outcomes such as infusion are influenced by problem-focused behaviors rather than emotion-focused behaviors [5]. Our results offer a more nuanced perspective that shows that while this may be true for approach-oriented behaviors, avoidance-oriented behaviors can lead to lower levels of individual IS infusion. This outcome highlights the theoretical importance of preserving the approach/avoidance distinction in exploring how emotion-focused behaviors influence behavioral outcomes.

Overall, prior research on individual-level infusion has largely focused on factors relating to technology adoption and continuance [30, 33, 58, 49, 57]. The current study expands the scope of this literature by examining a key theoretical antecedent of infusion — user adaptation — that has thus far received little attention in empirical infusion research. Our results suggest that future inquiry surrounding infusion should account for the divers ways that users adapt (or fail to adapt) to a new IS in the workplace.

For IS practitioners, our results suggest that managers who wish to promote IS infusion within their organizations should focus first on enhancing users' problem-focused adaptation efforts. Initiatives to this end may include ongoing user support programs that help users develop mastery of additional system features, refine their work processes, and even customize aspects of the system. However, practitioners should also be aware that certain emotional responses, namely those that lead to emotional withdrawal, avoidance, or distancing, may inhibit individual infusion. Theory suggests that users are more likely to exhibit these behaviors in cases where they feel threatened by the IS and have limited options for responding [5]. Thus, managers should focus on mitigating avoidance behaviors by helping users feel a sense of empowerment over the way they use the system in their work tasks.

## LIMITATIONS AND FUTURE RESEARCH

This study, like all research, is subject to limitations. First, the use of cross-sectional survey data does not provide definitive evidence of causal relationships. While the hypotheses tested in this study are consistent with existing theory, longitudinal studies that establish causality through temporal precedence of constructs are needed to substantiate the cause-effect relationship. A second limitation is that our modest sample size may diminish statistical power, possibly leading to failure to detect a significant effect (type II error). However power analysis [13, 16] revealed adequate power for detecting at least medium-to-large effect sizes, which are of most interest both theoretically and practically. Finally, because data was collected at a single organization, generalizability of our findings to other contexts may be limited. However, because of their broad and well-established theoretical foundation, we expect the general tenets of our model to hold across many different contexts.

Future research can build upon this study to explore several remaining questions. One critical area of investigation concerns how adaptation behaviors change over time. For example do adaptive acts occur continuously throughout the use lifecycle, or during irregular intervals of disequilibrium as suggested by other research [e.g. 55, 35]? Furthermore, how do ongoing reappraisals direct and re-direct adaptation strategies, and under what conditions do these strategies change? A longitudinal perspective will help to address questions such as these and develop stronger theory for explaining how an IS is perceived, adapted, and infused.

Another area for future research concerns the antecedents and consequents of the theoretical model explored in this study. For instance, what factors influence the type of adaptation behaviors that users employ vis-à-vis a new IS? CMUA suggests that adaptation behaviors are determined by the way an individual appraises a new IS, and research that tests these relationships is beginning to emerge [25]. However, more work is needed to substantiate and refine this segment of the nomological chain. Similarly, research should explore the outcomes associated with IS infusion, particularly at the less-probed individual level. For example, does deeper IS use always lead to better performance outcomes, or are there cases where it becomes counterproductive?

Finally, from a practical perspective, future research should investigate ways that companies can encourage (or discourage) adaptation behaviors that lead to (or detract from) desired objectives. For example, if an organization wishes to promote infusion of an IS, what should be done to stimulate problem-focused adaptation behaviors? Are certain types of training and support programs better suited to this goal than others? How can managers discover and prevent unconstructive emotional responses to the IS? Answers to these questions will help to define the theoretical and practical implications of the adaptation-infusion dynamic.

## CONCLUSION

Today's organizations rely more than ever on effective use of information systems; however, infusion of an IS into employees'

work practices remains an elusive goal for many companies. This study has sought to improve both theoretical and practical understanding of the infusion phenomenon by exploring how it is influenced by various types of user adaptation. This study both confirms and expands prior theory by showing that problem-focused adaptation behaviors positively influence infusion, while avoidance-oriented emotion-focused adaptation behaviors negatively influence infusion. Although questions remain, this work represents an initial step toward explicating the important theoretical linkage between user adaptation and individual IS infusion.

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## APPENDIX: CONSTRUCTS AND MEASURES

| **Reflective Infusion Construct and Measures** | | | |
|---|---|---|---|
| **Construct** | **Item Code** | **Item** | **PLS Factor Loading** |
| Infusion (INF) | INF1 | I am using [System] to its fullest potential for supporting my own work | 0.87** |
| | INF2 | I am using all capabilities of [System] in the best fashion to help me on the job | 0.80** |
| | INF3 | I doubt that there are any better ways for me to use [System] to support my work | 0.70** |
| | INF4 | My use of [System] has been integrated and incorporated into my work at the highest level | 0.87** |

*: $p < 0.05$; **: $p < 0.01$

| Formative Adaptation Constructs and Measures | | | | |
|---|---|---|---|---|
| **Composite Construct** | **Component Construct** | **Item Code** | **Item** | **PLS Factor Weight** |
| Problem-Focused Adaptation | Self Adaptation | SELFAB1 | I communicated with colleagues to better understand how [System] operates | 0.81** |
| | | SELFAB2 | I communicated with IT specialists to better understand how [System] operates | |
| | | SELFAB3 | I researched, on my own initiative, in order to increase my knowledge and mastery of [System] | |
| | | SELFAB4 | I explored several information sources, on my own initiative, concerning [System] | |
| | | SELFAB5 | I consulted the in-house [System] support documentation that was available to me | |
| | | SELFAB6 | I attended [System] training | |
| | | SELFAB7 | I consulted with the [System] superuser(s) in my department | |
| | Work Adaptation | WORKAB1 | I started to do things on my job that I couldn't do before [System] | 0.42* |
| | | WORKAB2 | I eliminated tasks that I had to do before but that were no longer required using [System] | |
| | | WORKAB3 | Using [System] changed my way of performing some tasks | |
| | System Adaptation | SYSAB1 | I spent time and energy making or recommending improvements to [System] functionalities (the way the system works) | 0.03 |
| | | SYSAB2 | I spent time and energy making or recommending improvements to the [System] interface (the look and feel of the system) | |
| | | SYSAB3 | I spent time and energy making or recommending improvements to the [System] hardware (the actual computer equipment you use) | |
| | | SYSAB4 | I spent time and energy making or recommending other modifications to [System] so that it better fit my task | |
| Approach-Oriented Emotion-Focused Adaptation | Seeking Social Support | SSS1 | I asked for moral support from my colleagues to help me deal with [System] | -1.26** |
| | | SSS2 | I talked about [System] with my spouse or family members | |
| | | SSS3 | I met with my supervisor to talk about [System] | |
| | Positive Reappraisal | PR1 | I repeated to myself that [System] was an opportunity to learn and develop new skills | 1.26** |
| | | PR2 | I told myself that using [System] would get better over time | |
| | | PR3 | I told myself that I had to accept [System] since there was nothing I could do about it | |
| | | PR4 | I tried to change my mind about [System] and have fun | |
| Avoidance-Oriented Emotion-Focused Adaptation | Avoidance/ Wishful Thinking | AWT1 | I considered taking a leave of absence from work for a while because of [System] | -0.25 |
| | | AWT2 | I did not want to hear about [System] | |
| | | AWT3 | I did all I could to avoid using [System] | |
| | Distancing | DIST1 | I tried not to worry about difficulties associated with using [System] | 1.07** |
| | | DIST2 | I went out to clear my mind | |

*: $p < 0.05$; **: $p < 0.01$