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Effects of cognitive and social factors on system utilization and performance outcomes

Ghiyoung Im *

Department of Computer Information Systems, College of Business, University of Louisville, Louisville, KY 40292, United States

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ABSTRACT

This study examines the effects of cognitive and social factors on system utilization and performance outcomes. The literature has paid considerable attention to social influence as a determinant of individual behavior. We combine the concept of task-technology fit with concepts from adaptive structuration theory to elucidate social influence. In our model, we propose that support from a proper social construction in addition to task-technology fit leads in performance improvement in individuals. Empirical data from 317 individuals across 43 teams in ten companies are used to assess the theoretical model. Our theoretical model is supported by the data.

1. Introduction

Investigating the factors that influence individuals' use of technology is of fundamental interest to information systems researchers (e.g., DeLone and McLean [12]; Venkatesh et al. [53]; Jasperson et al. [31]). It is generally acknowledged that individuals' cognition plays a key role in determining their reactions to using information technology (IT), as indicated by the dominant roles of cognition-related constructs in the following representative theories in the field: task-technology fit theory [24], expectation-confirmation theory [7], and the unified theory of acceptance and use of technology (UTAUT) [53].

In addition, we also need to take into account the social environments that surround individuals and their influences on individuals' cognition and technology use behavior, as individual behavior "occurs in a very social world which is far from neutral in its effects" [18: p. 117]. Furthermore, individuals are recognized as social actors "whose interactions are simultaneously enabled and constrained by the socio-technical affiliations and environments of the firm, its members, and its industry" [34: p. 218].

While assuming an active and influential social context, the information systems (IS) literature employs various approaches to specify social processes. One theoretical approach (e.g., Thompson et al. [50], Taylor and Todd [49]) employs the "subjective norm" construct, which is based on the theory of reasoned action and the theory of planned behavior [2]. Subjective norms are known to influence use intentions in a manner similar to attitudes and perceived behavioral control [33]. An extension of the technology acceptance model (TAM) also includes subjective norms as an additional determinant of the intention to use in the context of mandatory technology use [52].

A second approach follows the tradition of social information theory [44]. Its primary emphasis lies in individuals' social networks that influence their technology-related attitudes and behavior. Specifically, the literature identifies salient others (e.g., work group, ego network, and supervisor) [17] and referent others (e.g., departmental peers, informal circle, professional peers, supervisor, and senior leader) [36] as important sources of social influence.

A third approach applies the framework of structuration theory to explain the mutual influence of IT and social processes [21]. In her duality of technology model, Orlikowski [38] depicts human agents as intertwined with institutional properties and technology. In their adaptive structuration theory (AST), DeSanctis and Poole [14] explain that human actions are socially constructed as people interact with technology.

In this study, we investigate the additional roles of social influences on the behavior of technology users beyond what we observe through cognitive factors. Such an investigation is important because social processes can produce patterns of behavior that arise from forces well beyond cognitive factors. Specifically, we take Goodhue and Thompson's task-technology fit (TTF) concept [24] as the fundamental cognitive element and combine it with concepts from AST to explain system utilization

* Tel.: +1 5028524794.
E-mail address: ghiyoung.im@louisville.edu

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and performance outcomes.[1] Our model identifies the importance of social structures surrounding IT and their impacts on technology utilization and individual performance. Specifically, we examine the relationships of social construction (i.e., faithfulness of appropriation and consensus on appropriation) with fit, system utilization, and individual performance outcomes.

This study employs a variance approach for theory development and testing (interested readers can refer to the table on p. 162 for the detailed steps) [51]. Survey methodology was used for data collection. Empirical data from 317 individuals across 43 teams in ten companies was used to assess the theoretical model. A hierarchical data structure (i.e., individuals within teams) was warranted in order to test the impacts of social construction at the group level (i.e., level 2) on individual behaviors (i.e., level 1). Hierarchical linear modeling (HLM) was used to test a cross-level effect of a level 2 predictor on a level 1 criterion. If data are analyzed at the individual level, which neglects testing individuals within an organizational team, the estimated standard errors will be too small, and the risk of type I errors is inflated.

2. Background

2.1. Task-technology fit

We employ the TTF concept, which explains the impacts of IT at the individual level, as the fundamental cognitive element of our model [24]. This concept is a combination of utilization and fit-focused research that overcomes the limitations of both streams of research. Task-technology fit is defined as the correspondence between task requirements, individual characteristics, and the functionality of technology. It measures an individual's beliefs about the extent to which systems meet the requirements of a user's tasks and assists an individual in performing his or her tasks. The basic tenets of the TTF concept are that "for an information technology to have a positive impact on individual performance, the technology *must be utilized*, and the technology *must be a good fit with the tasks it supports*" (p. 213; italics original). TTF recognizes that utilization or fit alone cannot adequately explain performance impacts from technology. Models based on utilization alone do not explain that when system utilization is not voluntary, individual performance may hinge on fit rather than utilization. In addition, system utilization may not enhance individual performance if the technology does not fit to the task. Similarly, models based on fit alone do not take into account that systems should be used to lead to performance impacts.

2.2. Adaptive structuration theory

Attempts to view technology in a broader social system have resulted in various research streams. Foremost is the stream concerning technology in the organizational context [17] that is described by researchers with social constructivist thinking. Researchers treat technology as a social rather than a physical object that is capable of triggering dynamics that may result in unintended and unanticipated consequences (e.g., Barley [6]). Weick [54] describes how technology emerges from relations among a diverse set of elements. Technologies challenge how one makes sense of things because they are not stable but are constantly redesigned and reinterpreted according to specific social contexts during deployment and acceptance. Poole and DeSanctis [41] emphasize that individuals shape patterns of shared cognition and behavior through the joint production and reproduction of structure and action while interacting with communication technology.

Adaptive structuration theory extends such social constructivist thinking and explains the mutual influence among IT, social structures, and social interaction [14]. In particular, AST focuses on the influence of social structures (technology, task, environment, rules, resources, and the group's internal system) on social interaction (appropriation of structures), which, in turn, affects decision outcomes (efficiency, quality, consensus, and commitment). The *social structures* offered by IT include technology features and the spirit of such features. Exemplar technology features in group support systems (GSSs) are idea keeping systems and various voting systems. Spirit is what the IT intends to accomplish with the provided features. Social interaction occurs when technology structures are appropriated as a technology is used. *Appropriation of structures* is determined not only by technology features but also by people who actively select the proper features for the given tasks. Specifically, it is affected by the degree of (1) appropriation moves (how people use a technology differently), (2) faithfulness of appropriation, (3) instrumental uses (use of the technology for different instrumental purposes), and (4) attitudes.

2.2.1. Consensus on appropriation and faithfulness of appropriation

Among various aspects of social structures and appropriation of structures, we focus on the group's internal system (consensus on appropriation) and faithfulness of appropriation, respectively. A group's internal system concerns the internal mechanisms of interacting and job processing inside the group [14]. A group's internal system is likely to be a salient factor for social interaction because individuals in an organization are working together inside the group and are directly subject to the group's norms, practices, and routines. *Consensus on appropriation (COA)* is a major element of social structures and may influence people's appropriation of available structures. Consensus on appropriation is defined as "the extent to which group members agree about how to use the technology" [45: p. 92]. If individual users do not reach agreement, they cannot effectively appropriate the technology. Lack of agreement will result in uncertainty, ambiguity, and conflict among individuals and promote the unexpected, inconsistent, or improvisational use of the technology. This agreement may exist a priori or develop as users adopt and use the technology [45]. The consensus may be less dependent on the technology's qualities but rather be a function of interaction between the technology and a group of users.

Faithfulness of appropriation (FOA) is a major element of appropriation of structures and partially subsumes other aspects mentioned earlier that affect appropriation of structures. Faithfulness of appropriation is defined as the use of a technology's structures that is consistent with "the original design intent of the system developers" [11: p. 348]. Degrees of appropriation may be characterized on a range from faithful to unfaithful. Faithful (unfaithful) appropriation occurs when a technology is used in a manner consistent (inconsistent) with its intended design purposes. Assessment of faithfulness can be best accomplished by focusing on the subjective, internally defined technology, rather than the objective, externally presented one, because it is actually the subjective spirit that matters in the mind of the individual [11].

Faithful appropriations are important to facilitate the successful fulfillment of the given tasks and satisfactory outcomes. For example, while procuring a product in SAP, users follow the process of purchase requisition, purchase order, vendor notification, vendor shipment, goods receipt, invoice receipt, and payment to vendor. Customizing this process or skipping necessary steps for the process may require double the amount of great effort or lead to inconsistencies among different

[1] Utilization is defined as "the behavior of employing the technology in completing tasks" [24: p. 218]. In this paper, we use the term "utilization" as an umbrella term that subsumes different types of technology usage, namely, faithfulness, frequency, and extent. Frequency and extent of use are representative elements of system usage [9].

technology users. Unfaithful appropriations need to be carefully examined because they can explain why a technology does not bring about the results that a company intended. Unfaithful appropriations are not always bad because they can lead to an innovative use of a technology by revealing useful but not well-known technology structures [11].

2.2.2. Application of AST to a non-GSS context

Adaptive structuration theory has been applied to many domains in IT, but most of the focus has been on GSSs and computer-mediated communication (see Jones and Karsten [32] for review). Researchers typically employ the theory to test what features of a GSS affect how much and in what way it is used (e.g., Gopal et al. [25]). Researchers also examine the roles of group attitudes on the performance impacts of GSSs [25,46,47].

Group support systems are a type of electronic brain storming system that are designed to support group decision making by facilitating idea generation, idea evaluation, and problem solving among the discussion participants [14]. The users of a GSS are provided with a computer terminal and keyboard in a meeting room, and a typical system provides useful features for decision making, such as voting, idea keeping, and comment aggregating, as well as decision models. It is conceivable that GSSs are an ideal technology to observe the social structures and social interaction involved in technology use.

In this study, we apply AST to incorporate social structures and processes into the TTF concept in non-GSS contexts. We believe that the social structures and processes emphasized by DeSanctis and Poole are equally important in non-GSS contexts. Individuals are not only users of systems but also social actors who accomplish goals collaboratively while interacting with other people. The social structures are also enacted while the rules and resources from a non-GSS are brought into action during an individual's interaction with others. We believe that these social structures, in the context of non-GSSs, influence individual-level technology adoption and use. Salisbury et al. [45] recognize that "no individual is an island; adoption and use of technologies ... are influenced by relevant others" (p. 100). They also suggest that "the kind of social construction of reality reflected by consensus on appropriation ... is also relevant to individual adoption and use of technologies in other, non-group technology contexts" (p. 93). Take an intranet as an example. An intranet supports communication and collaboration among an organization's members and requires a critical mass of users who agree on the ways in which the system is used. This agreement (or consensus) forms while an individual interacts with other group members and leads to specific patterns of technology use. Individuals are greatly influenced by the social processes and structures enacted during this interaction while using the system.

3. Research model and hypotheses

Fig. 1 depicts our theoretical model. We recognize both cognitive (i.e., TTF) and social (i.e., consensus on appropriation and faithfulness of appropriation) elements in our model of system utilization and performance outcomes [40]. Our model incorporates the specific elements of social construction derived from AST, which provide additional insights into the system utilization and performance outcomes of individuals who typically use technology in a work group environment. Overall, our model complements the TTF concept by providing an explanation for the behaviors that arise from forces well beyond tasks, technology, and individuals. Practically, our model reflects on the reality of individuals in an organization in which their system utilization patterns are likely to be shaped by the environment that surrounds them, specifically the team.

We believe that TTF influences appropriation of structures (i.e., FOA) [13]. Structure of technology affects people toward a certain mode of appropriation. At the same time, other sources of technology structure (e.g., task and environment) influence how people appropriate the technology [14]. Thus, given a certain task, it is eventually people who assess how a technology fits a task and decide how technology structures are used. If people find a good fit between a technology and a task, they will be motivated to exploit the technology consistent with its spirit.

We also expect COA to influence FOA. Consensus on appropriation reduces uncertainty about which structures of the ICT intervention are appropriate for a given task [14]. Consensus on appropriation is also associated with less ambiguity and conflict over technology utilization patterns. A lack of consensus may make it difficult for individuals to coordinate effectively through the proper use of a technology [45]. Thus, greater COA should lead to faithful appropriation of a technology [42]. This leads to our first hypothesis:

H1. Individuals' faithfulness of appropriation will vary depending on task-technology fit and consensus on appropriation.

We expect COA to have more explanatory power than TTF in predicting individuals' technology usage beyond that which TTF can provide. First, consensus may work as a social pressure among the individuals in a group that fosters greater use of the system to fulfill the group's tasks [18]. Second, individuals are exposed to vicarious learning opportunities by observing others' experiences [5]. When the system usage leads to positive results, other members of the group are likely to mimic that behavior if there is strong consensus among the group. Lastly, if individuals experience less uncertainty and ambiguity concerning appropriations, they are likely to develop their own patterns of system usage in performing their tasks.

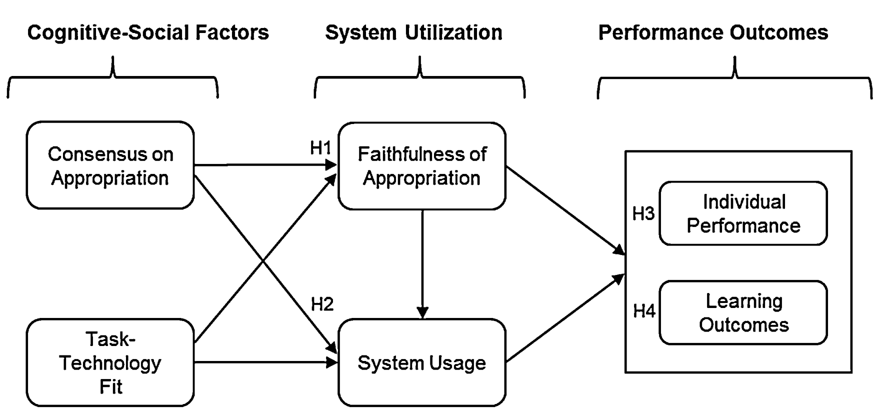

Fig. 1. Research model.

We also expect FOA to have additional explanatory power in explaining individuals' technology usage. First, when individuals use a technology as intended, they will spend less time learning and realizing what is possible with the technology. Thus, they can devote more time to completing tasks with the available features of the technology. Second, individuals will have more confidence in fulfilling tasks, and such confidence will lead to more trust in the system [14]. As such, they are more likely to explore the different features of the system, leading to enhanced system usage. Thus, our second hypothesis is as follows:

H2. Consensus on appropriation and faithfulness of appropriation will have additional explanatory power in predicting individual technology usage beyond that explained by task-technology fit.

We argue that individuals' performance will be affected by FOA and system usage. System usage is expected to lead to improved performance by facilitating the completion of individuals' tasks [24]. They can improve their job performance and productivity by relying on the systems for data storage, retrieval, and processing. In addition, systems foster coordination among individuals via common databases and standardized work procedures, leading to better decision making.

Furthermore, this performance impact is likely to be achieved by faithful appropriation of the technology [13]. If individuals use the technology's selected structures faithfully, their performance will be enhanced because they can streamline their task procedures using existing features and do not need to develop additional procedures to do the same work. Unfaithful appropriation of the technology will generate suboptimal performance impacts because individuals will need to make additional efforts to coordinate and complete their tasks. Thus, our third hypothesis is as follows:

H3. Individuals' performances will vary depending on faithfulness of appropriation and system usage.

We expect FOA and system usage to determine individuals' learning outcomes. Learning outcomes are defined as improvement in individuals' cognitive structures [26]. Cognitive structures are individuals' mental models that provide organized knowledge pertaining to tasks. Two types of learning outcomes are considered in this study: cognitive replication and cognitive adaptation. Cognitive replication focuses on improvement in individuals' cognitive structures, whereas cognitive adaptation concerns the adjustment of individuals' cognitive structures according to the development of work. Both learning outcomes are aligned with an exploitation type of leaning in that they seek to improve existing cognitive structures, processes, and tasks [29,37].

System utilization (i.e., FOA and system usage) is expected to improve learning outcomes for two reasons [26]. First, systems help individuals make better sense of processes and task outcomes. Systems allow individuals to keep better track of tasks and to better predict the outcomes of individuals' work-related behaviors. Therefore, individuals should have a much better understanding of the right way to complete tasks. Second, systems will help individuals make better decisions. Systems provide current, appropriate, and comprehensive data, which expand an individual's thinking horizon for decision making, facilitating individuals' ability to revise and adapt knowledge and keep up with work-related changes. As a result, an individual's cognitive structures are improved and adjusted according to task demands. This leads to our final hypothesis:

H4. Individuals' learning outcomes will vary depending on faithfulness of appropriation and system usage.

4. Method

4.1. Sample

Data were collected from ten large organizations in South Korea across a variety of industries, including construction, iron and steel, chemicals, and software integration, as well as Korean government agencies. The participating teams were randomly selected in each organization. Each organization was asked to distribute the survey to all individuals within each team. At each organization, the study contact collected the completed surveys and returned them to the researcher.

The survey was sent to 346 individuals, and 327 surveys were collected (Table 1). Of these, ten surveys were dropped because they were completed by individuals who were not associated with a team. The overall study response rate was 95 percent, with 317 usable surveys. The average age of the respondents was 35 years, and 75 percent were male. The respondents had an average of ten years of total work experience, an average of eight years with their organization, and an average of three years of team tenure. The surveys were collected from 43 teams with an average team size of 7.4 people.

To ensure the selection of the right target system, we asked each organization to select a system that (1) was essential to the day-to-day operation of individuals' tasks and (2) was leveraged to fulfill the teams' tasks. Most organizations selected their intranet, which is the corporate portal with a wide range of resources, including financial, accounting, human resources, and document/knowledge management modules. The teams that were selected for the survey have been using the system for various purposes, including personnel management, R&D management, document management, strategy planning, and communication.

To check whether the selected systems met our selection criteria, we included three questions in the survey: (1) this system is very important for users compared to other systems in the organization, (2) this system is very important for performing our team's tasks, and (3) most of a user's tasks are supported by the system. The average scores were 5.33 (s.d. = 0.97), 5.47 (s.d. = 1.01), and 5.07 (s.d. = 1.16), respectively, on a seven-point

Table 1
Sample profile.

Organization	Industry	No. of respondents	No. of teams	Average team size
1	Construction	42	4	10.5
2	Iron & Steel	41	4	10.3
3	Construction	42	4	10.5
4	Chemical	39	8	4.9
5	S/W integration	17	2	8.5
6	S/W integration	21	3	7.0
7	Public – water	41	4	10.3
8	Public – investment	38	4	9.5
9	Public – R&D	23	7	3.3
10	Public – defense	13	3	4.3
Total		317	43	7.4

scale. These scores were deemed appropriate to conclude that the selected systems were essential for the teams and therefore adequate for this study.

4.2. Instrument development

This study uses a survey method. We developed the questionnaire using standard recommended procedures [48]. Based on an extensive review of previous research, we developed a preliminary version of the questionnaire. Items were developed based on existing instruments and adapted to the research context. The preliminary version was refined via two pilot tests using part-time working students at the graduate and advanced undergraduate levels at a major university in the southeastern United States. Refined items were also reviewed by colleagues. The results of the pilot tests were used to corroborate the clarity of the instructions, appropriateness of terminology and wording of items, and response formats and scales. The completed English version of the questionnaire was translated into Korean. To ensure that the meaning of the original items was preserved, we followed an iterative approach in which the materials were translated into Korean and back-translated into English. The author performed the Korean translation, and an independent translator back-translated the Korean version into English. Original and back-translated items were then compared, and another round of translation and back-translation was conducted whereupon both translators agreed that the meaning had been preserved in the both versions.

4.3. Measures

We operationalized the key variables in our conceptual framework using multi-item reflective scales. Appendix A contains a description of the specific items for each scale. All items were measured based on a seven-point Likert scale ranging from (1) "Strongly Disagree" to (7) "Strongly Agree." Team size was specified as a control.

4.3.1. Performance

Performance was measured using two subjective items that asked the respondents about the perceived performance impacts of their information system. This approach is appropriate in this study because objective measures of individual performance were not available across organizations and the measures would not be comparable across teams and organizations with different tasks and organizational characteristics.

4.3.2. Learning outcomes

We refined measures for cognitive replication and cognitive adaptation developed by Gray and Meister [26]. As discussed earlier, cognitive replication focuses on the improvement of cognitive structures, whereas cognitive adaptation focuses on the adjustment of cognitive structures.

4.3.3. System usage

System usage can be best measured by calculating actual use through the examination of system logs or by recording the connection time. However, this approach was not uniformly applicable across different organizations in this field study. Thus, we adopted a perceived measure of usage by asking individuals about the frequency and extent of their system use. We refined two items developed by Hartwick and Barki [27]—extent and frequency [9].

4.3.4. Task-technology fit

After synthesizing various dimensions suggested by Goodhue and his colleague [22–24], we included the following ten dimensions in this study: currency, right data, right level of detail, accuracy, compatibility, meaning, locatability, presentation, authorization, and training. Four dimensions (right data, accuracy, presentation, and training) were dropped during the measurement purification process.

4.3.5. FOA and COA

Faithfulness of appropriation and consensus on appropriation were selected as the key dimensions of social construction from AST. We refined measures developed by Chin et al. [11] for FOA and measures developed by Salisbury et al. [45] for COA. Faithfulness of appropriation is conceptualized as an individual-level construct, whereas COA is identified as a shared team-level construct. Faithfulness of appropriation scales focus on the subjective spirit encountered by individuals rather than an objective reality, and can be best measured at the individual level [11]. Measuring FOA at the individual level allows us to meet the requirement of the employed analytical tool HLM that demands that researchers specify the criterion at the lowest level [10].

5. Results

The research model was tested using regression and HLM. Hierarchical linear modeling 6.0 [43] was used for multilevel analysis. Regression was selected in preference to structural equation modeling because HLM is a multilevel regression technique.

5.1. Measurement model

Collected measures were validated using SPSS 13 and LISREL 8. The measures were validated using confirmatory factor analysis. First, the results suggested that the measurement model provided a good fit for the data. The fit indices exceeded the levels suggested by Hu and Bentler [28] ($\chi^2 = 585.42$, $df = 386$, root mean square error of approximation [RMSEA] = 0.04, comparative fit index [CFI] = 0.98, and standardized root mean square residual [SRMR] = 0.044). Second, we calculated the reliability of the measures. The composite reliability and average variance extracted for each construct were calculated according to the procedure outlined in the literature [16,20]. The composite reliability and average variance extracted for each construct all exceeded a minimum of 0.70 and 0.5 [16], respectively (Table 2). The parameter estimates and their associated t-values were all significant. Cronbach's alpha for each of the measures was above the suggested value of 0.70.

We lastly assessed discriminant validity via two tests. We compared the average variance extracted for each construct with the shared variance between all possible pairs of constructs [16]. The average variance extracted for each construct was higher than the squared correlation between the construct pairs. We also

Table 2
Parameters for measurement model.

Construct	Cronbach's alpha	Composite reliability	Average variance extracted
Performance	0.92	0.88	0.82
Cognitive replication	0.93	0.96	0.93
Cognitive adaptation	0.82	0.92	0.85
Usage	0.93	0.90	0.85
Currency	0.81	0.72	0.66
Right level	0.90	0.89	0.83
Compatibility	0.81	0.73	0.66
Meaning	0.84	0.80	0.73
Locatability	0.79	0.71	0.65
Authority	0.83	0.81	0.74
FOA	0.84	0.78	0.60
COA	0.91	0.88	0.72

assessed discriminant validity via pairs of constructs in a series of two-factor confirmatory models [4]. We freely estimated the correlation between the constructs and then constrained the correlation to unity [3]. We conducted different χ^2 tests for the constrained and unconstrained models. For each investigated model, the χ^2 values for the unconstrained models were significantly lower than the χ^2 values for the constrained models. Overall, the self-report measurement instruments showed sufficiently strong psychometric properties, supporting the valid testing of the proposed research model.

5.1.1. Aggregation

We found that COA is indeed a shared team-level construct, showing greater between-team variance than within-team variance and thus allowing teams to be differentiated reliably using scores that were averaged by team [8]. ICC(1) measures the proportion of variance in the dependent variable that is accounted for by teams. ICC(2) indicates the reliability of team means—or the extent to which teams could be reliably differentiated.[2] ICCs associated with COA – ICC(1) = 0.09, ICC(2) = 0.42; $F(42, 274) = 1.716$, $p < 0.05$, indicated that individual-level responses differ significantly by team. The ICC(1) was within the range of its typical values, between 0.05 and 0.20 [8]. The average $r_{wg(j)}$ value using a rectangular distribution was 0.923, demonstrating good within-group agreement and further justifying the aggregation of collective responses at the group level [30].

5.2. Hierarchical linear models

We employed HLM to test the cross-level models (H1 and H2) and employed ordinary least squares (OLS) regression to test the individual-level models (H3 and H4). H1 and H2 were tested using the following cross-level equations. The equations are expressed in mixed models consisting of fixed effects (γs) and random effects (u and r).

Mixed model for H1

$$\begin{aligned}\text{FOA}_{ij} = {} & \gamma_{00} + \gamma_{01}{*}\text{COA}_j + \gamma_{10}{*}\text{Currency}_{ij} + \gamma_{20}{*}\text{Right level}_{ij} \\ & + \gamma_{30}{*}\text{Compatibility}_{ij} + \gamma_{40}{*}\text{Meaning}_{ij} \\ & + \gamma_{50}{*}\text{Locatability}_{ij} + \gamma_{60}{*}\text{Authority}_{ij} + u_{0j} + r_{ij}\end{aligned}$$

Mixed model for H2

$$\begin{aligned}\text{Usage}_{ij} = {} & \gamma_{00} + \gamma_{01}{*}\text{COA}_j + \gamma_{10}{*}\text{Currency}_{ij} + \gamma_{20}{*}\text{Right level}_{ij} \\ & + \gamma_{30}{*}\text{Compatibility}_{ij} + \gamma_{40}{*}\text{Meaning}_{ij} \\ & + \gamma_{50}{*}\text{Locatability}_{ij} + \gamma_{60}{*}\text{Authority}_{ij} + u_{0j} + r_{ij}\end{aligned}$$

5.3. Hypothesis tests

To examine the presence of common method bias in our data, we used Harman's post hoc one factor test [39]. The result of the maximum likelihood factor analysis revealed that the first factor does not account for the majority of the variance (it only accounts for 26 percent). Therefore, we conclude that common method bias is not a problem in our data. Tables 3–5 present the model estimation results.

Hypothesis 1 suggested that individuals' FOA varies depending on TTF and COA. We tested this hypothesis by examining a hierarchical linear model with FOA as the criterion. Strong support would demand that at least some variables of TTF and COA are significant predictors. The results suggest that right level, compatibility, and authority have positive effects on FOA (see Table 3). At the group level, COA has a positive effect on FOA. We also tested whether COA has additional explanatory power in predicting FOA. Model comparison in HLM can be conducted by examining the difference of the deviances from each model, which is distributed as a χ^2 statistic with degrees of freedom equal to the difference in the number of parameters estimated in each model [43]. The model comparison shows that COA leads to a significant increase in the proportion of variance explained (1635.98–1630.78 = 5.20, $df = 1$, $p < 0.05$). Overall, the effects provide support for H1.

Hypothesis 2 predicted that COA and FOA have additional explanatory power in predicting individuals' use of technology beyond that explained by TTF alone. This hypothesis can be examined by comparing two adjacent models with or without COA/FOA. The results in Table 4 show that the deviance is significant (1201.99–1186.83 = 15.16, $df = 1$, $p < 0.01$; 1186.83–1171.26 = 15.57, $df = 1$, $p < 0.01$), suggesting that Model 4 with COA provides a better fit to the data than does Model 3. The same is true for Model 5 with FOA over Models 3 and 4. Thus, the effects provide support for H2.

Hypotheses 3 and 4 suggested that FOA and TTF determine individuals' performance and learning outcomes, respectively. We tested these hypotheses by including FOA and TTF as independent

Table 3
Results for H1 using hierarchical linear modeling (DV = FOA).

	Model 1	Model 2
Intercept (γ_{00})	7.83** (0.92)	2.97 (2.44)
COA (γ_{01})		0.28* (0.13)
TTF		
Currency (γ_{10})	0.11 (0.10)	0.07 (0.10)
Right Level (γ_{20})	0.35** (0.13)	0.32** (0.12)
Compatibility (γ_{30})	0.65** (0.09)	0.67** (0.09)
Meaning (γ_{40})	0.03 (0.13)	0.02 (0.13)
Locatability (γ_{50})	−0.01 (0.11)	−0.01 (0.11)
Authority (γ_{60})	0.33** (0.08)	0.32** (0.08)
Deviance	1635.98	1630.78
Deviance difference		5.20*
Parameters	9	10

Note: Standardized coefficients (standard errors) are shown. One-tailed tests.
$^{+}p < 0.10$.
$^{*}p < 0.05$.
$^{**}p < 0.01$.

Table 4
Results for H2 using hierarchical linear modeling (DV = system usage).

	Model 3	Model 4	Model 5
Intercept (γ_{00})	9.89** (0.57)	3.04* (1.48)	2.64* (1.53)
COA (γ_{01})		0.36** (0.07)	0.34** (0.07)
TTF			
Currency (γ_{10})	0.07 (0.06)	0.06 (0.06)	0.05 (0.05)
Right level (γ_{20})	0.16** (0.06)	0.14* (0.06)	0.10* (0.05)
Compatibility (γ_{30})	0.07* (0.03)	0.06* (0.03)	−0.01 (0.04)
Meaning (γ_{40})	−0.01 (0.06)	−0.01 (0.06)	−0.02 (0.06)
Locatability (γ_{50})	−0.05 (0.04)	−0.04 (0.04)	−0.04 (0.05)
Authority (γ_{60})	−0.01 (0.04)	0.01 (0.03)	−0.04 (0.04)
FOA (γ_{70})			0.11** (0.03)
Deviance	1201.99	1186.83	1171.26
Deviance difference		15.16**	15.57**
Parameters	9	10	11

Note: Standardized coefficients (standard errors) are shown. One-tailed tests.
$^{+}p < 0.10$.
$^{*}p < 0.05$.
$^{**}p < 0.01$.

[2] Intraclass correlations (ICCs) were calculated using the following formulae [8]: $\text{ICC}(1) = [\text{MSB} - \text{MSW}]/[\text{MSB} + (k-1) \times \text{MSW}] \leq$ $\text{ICC}(2) = [\text{MSB} - \text{MSW}]/\text{MSB}$, where MSB is the mean square between groups, MSW is the mean square within groups, and k is the average number of members within groups. MSB and MSW were obtained by conducting one-way analyses of variance.

Table 5
Results for H3 and H4 using regression.

	Model 6 (DV = Perf.)	Model 7 (DV = Cog. replication)	Model 8 (DV = Cog. adaptation)
Usage	0.46** (0.05)	0.24** (0.06)	0.24** (0.05)
FOA	0.07+ (0.05)	0.16** (0.06)	0.15** (0.05)
Adjusted R^2	0.23	0.10	0.10

Note: Standardized coefficients (standard errors) are presented. One-tailed tests.
+ $p < 0.10$.
*$p < 0.05$.
** $p < 0.01$.

variables and changing the dependent variable as necessary. Model 6 in Table 5 shows significance for system usage only. Models 7 and 8, however, show significance for both independent variables. These results partially support H3 and fully support H4.

6. Discussion

We proposed an initial attempt to fill an important gap in the literature by expanding our view of social influence on system utilization and performance and by exploring some of its effects with systematic quantitative data.

6.1. Implications

One of this study's important contributions is an integrated explanation of the impacts of social construction on individual behaviors in the IT context. Drawing on advancements in AST, we systematically applied key constructs of AST in an integrated framework of TTF and AST. We confirm the importance of social construction by empirically examining the effects of FOA and COA on system utilization and performance.

Another contribution is that this study demonstrated the applicability of AST to a non-GSS context. Despite the recognition of a wider applicability of AST [45], no study has systematically applied AST in a non-GSS context. Furthermore, our study overcomes some of the limitations of the AST literature by employing a multi-level approach to the theory, which has been designed to explain group-level phenomena. It is essential that the level at which data are analyzed is congruent to the focal unit of the theory [19]. A lack of congruence may result in underestimated standard errors, which will inflate the findings. Thus, maintaining congruence in AST studies is crucial to ensure the trustworthiness of the results.

From testing H1, we found that the appropriation of structures (i.e., FOA) is determined by TTF as well as a group's internal system (i.e., COA). The results show that TTF (e.g., right level, compatibility, and authority) has positive effects on the appropriation of structures. This finding indicates that appropriation is affected by a set of salient beliefs about TTF. DeSanctis and Poole [14] do not take the effects of individuals' beliefs on appropriation into account. However, in non-GSS contexts, it is important to note that individuals are also affected by their own beliefs in their decisions about appropriation. Overall, the results extend the thinking of AST into the realm of individual-level beliefs in non-GSS contexts.

The results also showed a positive effect of the group's internal system on appropriation. This finding indicates that achieving consensus at the group level is important for proper appropriation at the individual level. The influence of COA on appropriation is likely to occur through internalization and compliance [35]. Internalization concerns "individuals' private acceptance of group messages and the incorporation of group meanings and attitudes into their own constructions of reality," while compliance concerns "individual behavior that conforms to perceived group pressures" [17: p. 924]. Consensus of appropriation is conducive to internalization and compliance, which will produce convergence of interpretations, attitudes, meanings, and behaviors between an individual and a group. Since COA entails proper appropriation of structures, individuals will subscribe to this agreement on appropriation via internalization and compliance.

The results of H2 showed that COA and FOA have additional explanatory power in predicting individuals' use of technology beyond that explained by TTF. This finding augments previous work focusing only on fit to explain the usage behavior of individuals. Our results support the importance of COA and FOA in fostering the extended use of a technology. The literature shows that the effects of social influence can vary with the volitional versus non-volitional nature of technology use and with the stage of system adoption [1]. Our results do not explain whether the effects of COA and FOA vary with these contingencies, warranting further research.

The results of H3 and H4 showed that system utilization significantly predicts performance outcomes (i.e., individual performance and learning outcomes). Our model uses two constructs to measure system utilization: FOA and system usage. Faithfulness of appropriation captures the evaluation of the appropriateness of usage and can be considered to reflect the *quality* of usage. System usage measures the frequency and extent of usage, i.e., the *quantity* of usage. The results in Table 5 show the strong positive effect of system usage on individual performance, whereas the effect becomes marginal with FOA (Model 4). These results confirm one critical finding from technology adoption research: the performance benefits derived from a technology are maximized by fostering extended use of the technology (e.g., Agarwal [1]; Devaraj and Kohli [15]). Our results strongly support this suggestion to encourage people to use more technology.

From testing H4, we found that individuals' learning outcomes are influenced by faithfulness of appropriation and system usage. Therefore, system utilization facilitates the improvement and adjustment of individuals' cognitive structures according to the changing requirements of tasks. This finding is consistent with prior research that recognizes the positive roles of IT in the exploitation and refinement of existing tasks, procedures, and routines (e.g., Im and Rai [29]).

6.2. Limitations and future research

The findings should be interpreted in light of a few limitations. First, data should be collected in a longitudinal study to fully understand the production and reproduction of social processes and structures over the course of time as the rules and resources of IT are appropriated in a given context. This study incorporates appropriation and a group's internal system at a certain period of time and does not consider the feedback loops among the constructs in the model. Next, the results of this study need to be validated with a qualitative study. A qualitative study may elucidate the inner mechanisms of social factors through in-depth interviews. Such richness will provide additional details supporting the results from the quantitative data.

There are also other issues that should be addressed in future research. The effects of FOA and COA on technology adoption and use should be examined in the context of the volitional versus non-volitional nature of technology use and during different stages of system adoption. The literature shows equivocal results regarding the effects of social influence in different contexts of technology adoption (see Agarwal [1] for details). Future research should investigate whether the constructs lead to consistent results across contexts.

7. Conclusion

User-centered information studies have provided explanations for individual-level technology adoption and use that rely on individualistic, cognitive models. In many respects, these studies have contributed to our understanding of the factors that influence individuals' technology adoption and use. However, our understanding is somewhat limited based on individualistic, cognitive models alone [34]. Information systems researchers have extended individualistic approaches by incorporating the social context (e.g., [52]), but their theoretical models are somewhat simplistic.

In this study, we attempted to develop a richer theoretical model that incorporates individuals as social actors. We used social construction phenomena to provide more explanatory power in the TTF model. We found that system utilization varies depending on TTF and COA. Consensus on appropriation provides additional explanatory power in predicting individuals' use of technology beyond that explained by TTF. Moreover, FOA significantly contributes to system usage beyond that explained by COA and TTF. System utilization significantly predicts performance outcomes. Overall, our model augments TTF with the social construction of behaviors that arise from forces well beyond tasks, technology, and individuals. The results show that when organizations are promoting the use of a system, they need to help teams find the right system structures in which they can develop consensus and facilitate faithful appropriations.

Appendix A. Survey instruments

Performance

- The information system has improved my job performance.
- The information system has enhanced my productivity at work.

Cognitive replication

- I now have a much better understanding of the right way to do my work than I did a year ago.
- Compared to a year ago, I now know much more about proven methods and procedures for my job.

Cognitive adaptation

- I have been revising and adapting my knowledge to keep up with changes at the current company over this past year.
- Over the past year, new developments at work have caused me to revisit and update my work-related knowledge.

System usage

- I frequently use the system.
- I am currently a heavy user of the system.

Currency

- The data reflect the current status of my work.
- The data are up-to-date enough for my purposes.
- I cannot get data current enough to meet my work needs.*

Right data*

- The computer systems that are available to me are missing critical data that would be very useful to me in my job.
- The data that are maintained by the corporation or division are exactly what I need to carry out my tasks.

Right level of detail

- The system maintains information at an appropriate level of detail for my tasks.
- The system has sufficiently detailed data for my purposes.

Accuracy*

- The data that I use or want to use are accurate enough for my purposes.
- There are accuracy problems in the data that I use or need.

Compatibility

- There are times when supposedly equivalent data from two different sources are inconsistent.
- Sometimes, it is difficult or impossible to compare or aggregate data from two different sources because the data are defined differently.

Meaning

- On the reports or systems I deal with, the exact meaning of data elements is either obvious or easy to find.
- The exact definition of data fields relating to my tasks is easy to find.
- Data dictionaries or data directories are useful to me in locating or understanding the meaning of corporate or divisional data.

Locatability

- It is easy to locate corporate or divisional data on a particular issue, even if I have not used that data before.
- It is easy to find what data the corporation maintains on a given subject.

Presentation*

- The data that I need are displayed in a readable and understandable format.
- The data are presented in a readable and useful format.

Authorization

- Data that would be useful to me are unavailable because I do not have the right authorization.
- Getting authorization to access data that would be useful in my job is time consuming and difficult.

Training*

- There is not enough training on how to find, understand, access, or use corporate or divisional data.
- I am getting the training that I need to be able to use corporate or divisional data effectively in my job.

Faithfulness of appropriation

- The developers of the system would disagree with how our group uses the system.
- Our group probably uses the system improperly.
- The original developers of the system would view our group's use of the system as inappropriate.
- We do not use the system in the most appropriate fashion.

Consensus on appropriation

- Our group members were able to reach consensus on how to apply the system to our task.

- Overall, members of our group agreed on how we should use the system for our work.
- Our group reached mutual understanding on how we should use the system to perform our task.
- Our group was able to reach consensus on how we should use the system to perform our task.

* Items or constructs dropped due to low loadings or construct validity concerns.

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Ghiyoung Im is an Assistant Professor in the Department of Computer Information Systems at the University of Louisville. He received his Ph.D. from Georgia State University and a M.S. from NYU Stern School of Business. His research interests center on IT-enabled organizational learning, knowledge management, and coordination in interorganizational relationships, and their implications for firm strategy and supply chain management. His research has appeared in *MIS Quarterly*, *Information Systems Research*, *Management Science*, *Journal of the Association for Information Systems*, among others.