The psychological origins of perceived usefulness and ease-of-use

M. Basha, S. Leelashyam, M Venkataratnam
Associate Professor[1], Assistant Professor[2,3]

Department of ECE,

mbasha.ece@anurag.ac.in, vleelashyam.ece@anurag.ac.in, mvenkataratnam.ece@anurag.ac.in

Anurag Engineering College, Kodada, Telangana

Abstract

The technology acceptance model has identified the role of the perceived usefulness and perceived ease-of-use constructs in the information technology adoption process. Whereas past research has been valuable in explaining how such beliefs lead to system use, it has not explored how and why these beliefs develop.

To extend the theory of technology acceptance, this paper offers an explanation for the psychological origins of usefulness and ease-of-use. Based on social presence theory, social influence theory, and Triandis' modifications to the theory of reasoned action, causal relationships between the proposed antecedents and perceived usefulness and perceived ease-of-use are examined.

To test the theory, data were gathered from 100 users of an E-mail system and tested using LISREL. Findings indicate that system use is affected by perceptions of the medium's usefulness which are, in turn, affected by perceptions of the ease-of-useof the medium, the degree of social influence exerted by supervisors, and perceptions of the social presence of the medium. Accessibility of the medium influences perceptions of the ease-of-use of the medium. Surprisingly, facilitating conditions such as the availability of training and support for the use of information technology had no impact on perceptions of ease-of-use or usefulness of E-mail. © 1999 Elsevier Science B.V. All rights reserved.

Introduction

The investment in new information technology (IT) is a key decision for both managers and highly skilled knowledge workers, and it is crucial that insight about the bases for this decision is forthcoming in IS

research. However, theoretically-based comprehen- sive planning is often missing in implementing infor- mation systems. Fortunately, robust theoretical frameworks for the rational component of IT adoption have emerged within the last ten years. These frame- works provide managers with careful reasoning argu- ments and enable them to better influence the evaluation, adoption and usage processes.

Although there is little doubt that technological developments will occur at a fast rate, it is not immediately obvious that individual users of thenew technology will be able to adopt and use new

technological artifacts at the same pace. As a conse- quence, information technology (IT) acceptance and usage represent central concerns in recent information systems research.

Specifically, IS research has theorized about the roleof:

perceived usefulness; and

perceived ease-of-use in IT use and adoption.

Such beliefs about the task-value and user-friendlinessof new information systems form the basis for the emerging theory of

technology acceptance [16]. Although this work has been extremely valuable in explaining first-order effects, there has been little empirical research on how and why these beliefs start to form in the first place [72]. What, for example, explains how a user comes to believe that a system is useful in his or her job? What would be the presum- ably different psychological antecedents for a belief that a system is simple or difficult to use?

From a theoretical perspective, the theory of tech- nology acceptance needs to be extended to incorporate these aspects of the user acceptance process. The present study offers an extension of technology accep- tance theory by proposing antecedents or psycholo- gical origins for the constructs of perceived usefulness and perceived ease-of-use for electronic communica- tion technologies. The theory bases that provide insights into antecedent formulation are:

social presence theory;

social influence theory; and

Triandis' [71] modifications to the theory of rea- soned action.

By combining these socio-psychological theories with the technology acceptance theory, we further our understanding of how social contexts create percep- tions of usefulness and ease-of-use and enhance our ability to influence the process in desirable directions. Based on data gathered from randomly selected users of a worldwide transportation company's E-mail system, the findings of the study suggest how the theory of technology acceptance can be extended. The results of the study also have practical implica- tions in that decision-makers and managers need to understand the origins of these constructs in order to better utilize the social system to influence technology perceptions and acceptance, to provide users with better access to IT, and to design training programs that truly address the underlying motivations of users.

2. Theoretical model

The IS literature is replete with models of factors associated with information technology (IT) use or acceptance [28] by knowledge workers, decision- makers, and managers. Lately, a theoretically based model with good predictive validity has been derived and tested. The technology acceptance model pro- posed by Davis [16] is based on constructs and relationships in the theory of reasoned action [19]. It posits that usage of an IT is determined by beliefs a user holds about its perceived usefulness (PU) and its perceived ease-of-use (PEU).[3] PU is defined as the degree to which a person believes that use of a system would improve his or her performance. PEU refers to the degree to which a person believes that using a particular system would be effortless. Even though both, PU and PEU were significantly correlated with usage, Davis' findings suggest that PU mediates the effect of PEU on usage. The model was shown to have good predictive validity for the use of several infor- mation technologies including E-mail.

Since Davis' elucidation of these constructs, numer-

ous researchers have discovered that technology acceptance theory yields consistently high explained variance for why users choose to utilize systems [2, 36,42, 70]. What is more, researchers working with the theory base of innovation diffusion have discovered a similar relationship between the two constructs, namely relative advantage and compatibility, on the one hand, and IT adoption, on the other. Relative advantage is the incremental benefit to be gained by the use of one innovation over its alternatives, whereas compatibility is the extent to which an innovation is compatible with the user's prior experiences [56]. The linkages among these variables, clearly reminiscent of the constructs PU and PEU and relationships in tech- nology acceptance theory, have been empirically ver- ified in the IS literature. Brancheau [8] and Brancheau

and Wetherbe [9], for example, discovered a strong linkage between relative advantage and compatibility and adoption of spreadsheet software across a variety of industries while Hoffer and Alexander [27] found them in the diffusion of database machines. Moore

[37] and Moore and Benbasat [38] discovered these same causal connections in the domain of PC adop- tion. Recently, Karahanna [30] has also found support for the influence of relative advantage and compat-ibility on the intentions of users to adopt Windows software.

This research stream has been important in explain-ing first-order effects for how such beliefs about systems lead users to:

positive attitudes toward systems;

intentions to use these systems; and

system use.

However, little explanation of the psychological ori- gins of the belief sets of perceived usefulness and ease- of-use has been

forthcoming in the IS literature. For example, on a theoretical level, Davis [15] and Davis et al. [17] suggest self-efficacy perceptions as an explanation of the effect of PEU on behavior. Venka-tesh and Davis [72] empirically test this notion by examining how computer self-efficacy affects percep- tions of ease-of-use. Davis [15] tested the effects of expected enjoyment and output quality, and Davis et al. [17] the effect of accessibility. Even though these studies have focused primarily on PEU antecedents, they are an important step in understanding the origins of usefulness and ease-of-use perceptions. The present study attempts to further theory in a similar vein by bringing to bear more social contexts from the media choice literature to the specific measures of perceived usefulness and perceived ease-of-use.

2.1. Extending the theory of technology acceptance

To understand the relationship between PU, PEU, and their antecedents, we first turn to the theory of reasoned action [19], which describes how beliefs about and attitudes toward using 'objects' such as computer-based systems lead to behavior. According to this theory, cognitive beliefs about using an object, beliefs such as PU and PEU, immediately affect attitudes toward using that object and, ultimately, intentions to use and eventual use of that object. Exogenous, external variables such as system features or training and support, i.e., variables other than cognitive and normative beliefs, affect behavior only through their impact on beliefs (e.g. PU and PEU). Consistent with this point of view, we propose that variables hypothesized to affect use of computer- based systems will do so through their effect on PU and PEU.

Much of the prior work on technology acceptance theory has concentrated on computer-based commu- nications, such as E-mail [2, 15, 16], therefore the present study extends the theory by studying E-mail usage and employing the organizational communica- tions field as a reference discipline for applicable theories and constructs. Within this literature, fre- quently called the 'media choice' literature, there are several theory bases that are relevant to the ques-tion of why users perceive a computer-based commu-nications media to be useful or not; these include the theories of social presence, social influence, and social information processing.

The first factor to be derived from these theory bases is hypothesized to affect beliefs about both, computer-based and traditional media usefulness. Social pre- rence (SP) is the degree to which a medium conveys the psychological presence of the message sender. It is ''the capacity [of a medium] to transmit information about facial expression, direction of looking, posture, dress and non-verbal cues" ([61], p. 65). By this definition, media like face-to-face communication would be characterized as having high social presence whereas electronic media and paper-based mail would be characterized as having low social presence. Even though the objective or intrinsic social presence of a medium is important, subjective impressions, i.e. per- ceived social presence, will be more important when the individual assesses the appropriateness of a med-ium for a communication task [20].

Social presence theory (and the related information
richness theory [14]) suggests that performance will improve if the social presence of the medium is matched to the communication requirements of the task. For example, media perceived high in social presence would be more appropriate for socio-emo- tional communication and equivocal tasks (e.g. influ- ence attempts, conflict resolution, social or personal communications). Media perceived low in social presence would be more appropriate for less socio-
emotional and analyzable tasks (e.g. information exchange and asking questions) [46, 60, 64]. Newer empirical evidence, however, has shown face-to-face, telephone, and meetings (i.e. media high in social presence) to be preferred for both high- and low-social presence tasks (including information exchange) over media low in social presence [54], whereas low-social presence media were preferred for low-social presence tasks, primarily information exchange. As a result, we can posit that media perceived as being higher in social presence will be viewed as being more useful for a wider range of communication tasks, and, there- fore, will be more heavily used across communica- tions tasks.[4]

The second factor hypothesized to affect beliefs about media is social influence (SI). Social informa-tion processing theory [57] posits that communication attitudes and behaviors are determined by social con- text. According to this theory, perceptions of media characteristics, the communication task requirements, and attitudes toward communication media are influ- enced by social norms, by actions and statements of significant supervisors and peers, and by past attitudes and prior use [5, 10, 21, 22, 49, 50]. Aydin and Rice [5], for example, found that occupational and depart- mental social worlds are important predictors of atti-tudes toward medical information systems. Schmitz
[58] found that supervisor usage patterns explained approximately 20 percent of the variation in usage patterns by subordinates. In fact, Rice and Aydin [50] found that one's supervisor is a primary source of social information. Schmitz and Fulk [59] discovered that co-worker use of E-mail and supervisors' percep- tions of usefulness of the medium had a

significant effect on PU, which in turn influenced usage of E- mail.

Empirical studies of the effect of social influence onthe adoption and usage of technology, however, have yielded contradictory results. This is partly due to the different mechanisms by which social influence can beapplied in one's social context [49, 55]. In this study,we examine one critical aspect of social influence and

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[4]An explanation for the fitting process that occurs when individuals attempt to match a technology to the task they are assigned is found in task-technology fit theory, as articulated in [23, 24, 25]. See also [39]. For an extensive discussion and empirical tests of task-fit theory as it applies to communications media, see [52]. its relationship to perceptions about E-mail. Consis-tent with Schmidt [58], we examine how supervisoryuse of E-mail to communicate with subordinates affects subordinates' use of the medium. One's posi- tional supervisor can be considered the source of downward vertical organizationally proximate social influence [50]. We, therefore, posit that the super- visor's E-mail usage level to communicate with the subordinate, will positively affect the subordinate's perceptions of usefulness of the medium. Clearly, social influence can affect both, user perceptions ofusefulness and ease of use. However, the specific dimension of social influence we are examining in this study relates solely to the PU belief.

Perceived accerribility (ACC) of IT is anotherbelief that has been found to be related to technologyuse in both, the organizational communication and ISliterature [3, 11, 12, 18, 48, 68, 69]. ACC is acknowl-edged to be a highly important characteristic of allinteractive computer systems [33]. Accessibility is amulti-dimensional construct encompassing both phy-sical access to the terminal and information systemand the ability to use the system successfully [11].This study focuses on perceived physical (i.e. work-station) accessibility of E-mail. ACC is considered tobe critical because physical access is a necessarycondition for use of a technology. The more accessiblean information system is, the less effort is needed touse it. Therefore, we hypothesize that physical acces-sibility will directly affect perceptions of ease-of-use.Similarly, the availability of urer training and rupport (SUPP) (e.g. one-on-one consultations orhelpline made available through the central informa-tion systems department, information center, or func-tional area technology experts) is believed to facilitate system use [34, 56]. According to Triandis [71],modifications to the theory of reasoned action, beha-vior such as usage cannot occur in the absence of'facilitating conditions', which he defines as ''objec-tive factors, 'out there' in the environment, that several judges or observers can agree make an act easy to do''(p. 205). With respect to IT, availability of training andsupport for end-users is likely to be such a facilitatingcondition impacting system use [70]. According to[10], support can affect one's computer self-efficacyand outcome expectations which will, in turn, affectusage. Consonant with the   theory   of   reasoned   action,   we   postulate   that   training   and   support   for   ITwill   affect
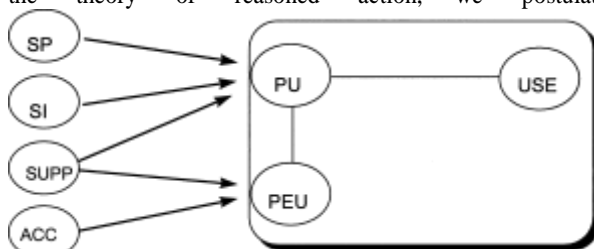

Fig. 1. Extended research model.

usage only through its effects on beliefs about the usefulness and ease-of-use of IT. As end-users gain experience in different ITs, their perceptions of howeasy it is to use are likely to ameliorate. Similarly, training may increase awareness of potential applica- tions of the ITand thereby perceptions of usefulness ofthe technology in accomplishing tasks.

The extended research model for this study is shown in Fig. 1. All hypothesized relationships in the modelare positive.

Methodology

To test the extended theoretical model, data was gathered from questionnaires sent to 180 employees of a Fortune 500 transportation company with worldwideinterests. The mailed sample was randomly selected from 2800 users of the company's E-mail system,[5] resulting in 100 responses, for a return rate of 55 percent. Respondents were, on average, company veterans

with six or more years of experience and with a mean age in the early 30s. Relatively balanced between sexes, respondents were generally well edu-cated (63% had a bachelor, master's, or doctorate degree).

Data gathered from a single source controls numer-ous exogenous variables that may confound results in a multi-company survey. The surveyed group has similar communication options available, including similar system features [51]. Organizational culture is

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[5]The E-mail system used in this organization is IBM's professional office system (PROFS). PROFS allows users to send and receive messages and prepare and distribute documents (eventhough its word processing capabilities are limited). In addition, it provides a calendaring function where individuals can keep their appointment calendars on the system. These calendars are then accessible to other users and can be used to schedule meetings.

also not as likely to vary from division to division within a single organization, as between firms. In the case of the sampled firm, departments were introduced to E-mail over the last six years, with a critical mass[6]of users for three or more years [35]. Since use of electronic media was not mandated by departments, individuals could choose to use the electronic media or not. This organizational characteristic of voluntary usage behavior is an important underlying assumption of the theory of reasoned action [19].

Non-response bias was assessed by treating ques-tionnaires received after the deadline as representative of non-respondents. T-tests showed no significant differences between respondents and non-respondents on both, the dependent and the independent variables.

Pre-terting of the rerearch inrtrument

The instrument was pre-tested before being admi- nistered to the sample group in order to qualitatively assess content, construct validity, and reliability of measures, as suggested by [65]. Interviews were con-ducted with 24 knowledge workers in 10 different organizations across a broad organizational spectrum.Cooperating organizations came from manufacturing and financial services firms, state government, non- profit firms, and education. The purpose of these semi-structured interviews was to refine constructs and develop measures for each construct on the question- naire. Likert scales were pre-tested for measuring key independent and dependent variables. Previously vali-dated social presence scales were used for SP [61]. The constructs used in this study and their measures are presented in Table 1 and descriptive statistics in Table 2. Cronbech alphas indicate that the scales for the constructs are highly reliable [40].

To test the extended theoretical model presented in Fig. 1, data was analyzed through LInear StructuralRELations modeling (LISREL).

Use of structural-equation modeling analysis pro- vides researchers with a comprehensive means of

[6]Critical mass was two-thirds of all knowledge and data workers in the organization.

Table 1

Constructs and measures

Construct	Item content	Source/Reference
Perceived usefulness (PU)	communicate easily communicate quickly	Davis (1989)
Perceived ease-of-use (PEU)	comfortable using E-mail	Davis (1989)
Social presence (SP)	personal/impersonal sociable/unsociable warm/cold sensitive/insensitive	Short et al. (1976)
Social influence (SI)	use of E-mail by boss for communication with respondent	Schmitz (1987)
Physical accessibility (ACC)	degree of medium availability	Culnan (1984)

Support (SUPP)	training sessions	Thompson et al. (1991)
	one-on-one consultations or helpline	and Rogers (1983)
	support for trial use of IT	
System use	number of messages sent/week	Davis (1989)

Table 2
Descriptive statistics

Construct	Mean	S.D.	Range [a]	Cronbach 2
Perceived usefulness (PU)	9.3	1.8	1–11	0.86
Perceived ease-of-use (PEU)	6.1	1.3	1–7	——
Social presence (SP)	4.4	1.3	1–7	0.83
Social influence (SI)	5.7	1.8	1–7	——
Physical accessibility (ACC)	4.8	0.6	1–5	——
Support (SUPP)	2.51	0.7	1–5	0.87
System use	28.0	28.6	——	

[a] Responses covered the full range of the Likert scales for all items.

assessing and modifying theoretical models and, therefore, it offers a great potential for furthering development of theory [4]. Structural equation modeling allows the testing of a theoretical model as a whole, as well as comparisons among compet- ing theoretical specifications [6]. Anderson and Gerbing [4] recommend assessing the theoretical model of interest (the structural model) by estimat- ing a series of five-nested models that represent alternative plausible specifications. A model M_2 is said to be nested within a model M_1 if its set of freely estimated parameters are a subset of those estimated in M_1. This can be denoted as $M_2 < M_1$.

Usually, the constrained parameters in M_2 are fixed at zero.

The five nested models suggested by [4] are:

the raturated model (M_s) in which all the parameters linking the constructs to one another are estimated;

the null model M_n in which all parameters linking the constructs to one another are fixed at zero (i.e. there are no posited relationships between constructs);

the theoretical model M_t, which is the theoretical model of interest;

the conrtrained model M_c in which one or more parameters estimated in M_t are constrained. This represents the next most likely constrained alter- native model from a theoretical perspective; and

the unconrtrained model M_u in which one or more parameters constrained in M_t are estimated. This represents the next most likely unconstrained alter-native model from a theoretical perspective.

Therefore, these five structural models can be repre- sented in the following nested sequence: $M_n < M_c < M_t < M_u < M_s$.

Given that comparisons with null and saturated models are usually satisfied by statistical rather than theoretical criteria, it is sufficient to compare the constrained, theoretical, and unconstrained models[4]. To test these models, one employs a set of

sequential χ-squared difference tests (SCDT), which

are asymptotically independent [63], each testing the

null hypothesis of no significant difference between two nested structural models. The difference between

the χ-squares for two nested models is itself asymp- totically distributed as χ-square, with the degrees of freedom equal to the difference in the degrees of

freedom for the two models [4]. The value of the SCDTs, however, is directly dependent on sample size and, as a result, significant values may be obtained in the case of large samples, even where there is only a trivial difference between two nested structural mod- els [4, 7]. In small samples, various competing models may be equally acceptable. Therefore, a normed fit index – 'delta' – is proposed by Bentler and Bonett [7] to be used in conjunction with the SCDTs. The delta index provides information about practical signifi- cance so that a statistically significant effect can be evaluated according to its practical usefulness in explaining the data. This fit index ranges from 0 to 1, and represents the increment in fit obtained in evaluating two hierarchical step-up models. Even if the SCDT between the theoretical model and the unconstrained model is significant, a researcher may accept the theoretical model if delta$_{tu}$ is practically insignificant. That is, from a practical point of view, the more parsimonious model is preferred because it provides an adequate explanation of the data [4].
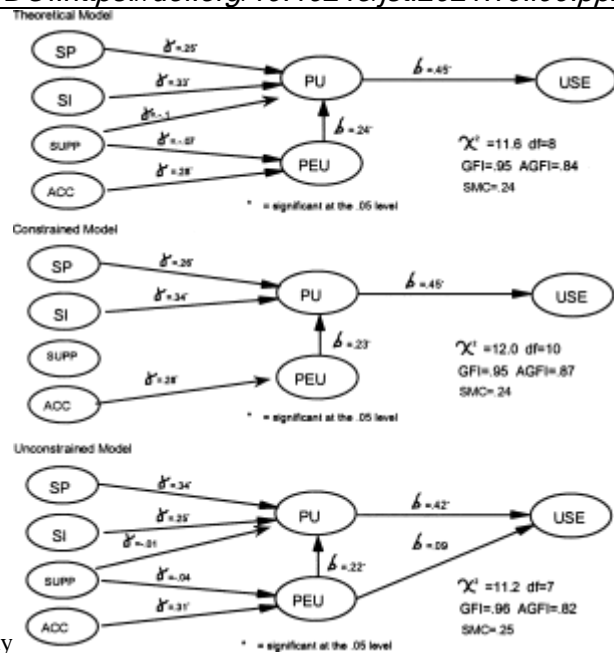
The theoretical model of interest, M_t, has already been presented in Fig. 1. Based on the results of the stepwise multiple regressions, the constrained model,

Fig. 2. Results of testing LISREL nested models.

M_c, was specified by removing the SUPP variable. For the unconstrained model, M_u, an additional plausible path has been postulated. The path between PEU and usage has been added based on Davis' [16] findings that in some situations PEU had a direct effect on usage (see Fig. 2).

LISREL7 [26, 29] was used to analyze the data. Through structural equations, LISREL generates causal coefficients that best model the fit between con- structs.[7] Results are presented in Fig. 2.

Table 3 shows the χ-square and fit indices (GFI and

AGFI) for the null, constrained, theoretical, and unconstrained models. The significant χ-square obtained for the null model implies that this model,

which postulates that there are no relationships among any of the constructs, is a poor fit to the data. The other three models, which have non-significant χ-square

values, represent acceptable fits to the data.

Fig. 2 shows that the path between the SUPP con- struct and the PEU and PU constructs is not significant as indicated by both, the χ-square and the delta statistics.[8] However, the improvement in fit between

the constrained model and the theoretical and uncon- strained models is neither statistically nor practically significant. As a result, the most parsimonious model that fits the data, i.e. the constrained specification, is preferred.

The constrained model fits the covariance in the data fairly well, as demonstrated by a GFI of 0.95, where 1.00 is a perfect fit. The squared multiple correlations (SMC) for the structural equations were:

0.078 for PEU, 0.225 for PU, and 0.205 for E-mail usage. These may be interpreted to mean that 7.8, 22.5, and 20.5 percent of the variance in PEU, PU, and E-mail usage, respectively, are explained by the con- strained model. The overall explained variance of the model was 24 percent. This is in line with the explained variances obtained in other TAM studies (e.g. Ref. [2]).

. Discussion

The purpose of this investigation was to determine the antecedents or psychological origins of perceived

[8]For a statistically significant improvement, the improvement in χ-square should compensate for the degrees of freedom lost by estimating the additional parameters.

usefulness and perceived ease-of-use. The resulting theoretical model (Fig. 1) contends that computer- based media usage will be determined by perceptions of the usefulness of the medium in communicating (PU) as well as by perceptions of how easy the medium is to use (PEU). Because Davis [16] found that PEU affects usage only indirectly through PU, we have specified the theoretical model in this way. In incorporating the media choice literature, we extended Davis' model with the hypotheses that perceptions of usefulness of E-mail would be affected by perceptions of the social presence of the medium as well as by the social influence exerted by one's supervisor with respect to usage of a particular medium. Furthermore, we hypothesized that PEU would be affected by the physical accessibility of the medium as well as by the availability of training and support by the IS depart-ment and functional area technology experts.

The model, tested with LISREL structural equation

modeling, found general support in the analyses, with one exception. Availability of training and support from the IS department and functional area experts had no effect on any of the variables of the model. One possible explanation for this non-significant result could lie in the operational definition of this construct. The items on the questionnaire measuring the con-

struct were phrased in terms of IS and functional area support with respect to IT in general and not speci- fically with respect to E-mail. According to the theory of reasoned action, better explanatory power is achieved if the measures are specific with respect to the target object at which the behavior is directed – in this case, the availability of training and support for E-mail. Another possibility may be that training and support have no effect on use of a system or percep- tions of ease-of-use and usefulness. This interpretation was corroborated by Thompson [70], who also found a non-significant link between training and technical support and usage. It is also suggested by analyses in Ref. [73], where no association between training and computer literacy was found. The latter, one could argue, is related to how easy users find a system to use. Finally, it is conceivable that training and support affect perceptions and usage during initial usage of the technology, but their importance declines with continued use of the technology.

The relationship between training, support, and

other facilitating conditions [71] and perceived use- fulness and perceived ease-of-use, thus, is still unclear and calls for research that takes a longer term per- spective. Longitudinal work can help us understand what can be reasonably expected of IT training and support.

Consistent with Davis' [16] findings, the only sta- tistically significant predictor of E-mail usage was perceived usefulness. PU, in turn, was found to be determined, in order of importance, by the social influence exerted by one's supervisor with respect to E-mail usage, PEU, and SP. Social influence on the formation of job-related beliefs, attitudes, and behaviors can be exerted in a myriad of ways by a variety of reference groups [57]. For example, peers and supervisors may ''contribute to perceptions by establishing criteria for media assessment, directing attention to salient media characteristics, and guiding interpretation of objective characteristics relative to those criteria'' (Ref. [21], p. 537). In this study, we

more referent groups and influencing behaviors seems to be a promising research direction. For example, Schmitz and Fulk [59] found that use by peers and supervisors' perceptions of the usefulness of E-mail influences subordinates' perceptions of the usefulness of E-mail. Contrary to the results of the current study, they found that supervisor usage had no effect on PU but had a direct effect on usage. In our study, a supervisor's use of the medium to communicate with a subordinate affects usage only through its effects on PU.

These apparently contradictory findings can be better understood through looking at evidence in the literature, which suggests that it is possible for SI to affect usage in two ways: directly through compliance, or indirectly through its effect on beliefs and attitude due to internalization and identification processes [31].[9] In the latter case, supervisors' use of E-mail influence the acquisition of positive evaluative beliefs (such as PU) about the medium [57]. What might be fruitful in future research is to examine the conditions that might determine the avenue (direct or indirect) through which social influence affects behavior.

In the present study, the lack of a direct relationship between supervisors' use of E-mail and subordinates' use of E-mail, and the existence of a strong relation- ship via PU (a cognitive belief), suggests that social influence might be operating via the process of inter- nalization which, it is thought, produces the most enduring form of attitude change [43]. In other words, the fact that individuals were often unable to perform their jobs or were left out of the communication loop when their supervisor

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used E-mail to communicate with them and they did not, reinforced their belief in the usefulness of E-mail – a belief that persisted over time. Initially, it is possible that both, compliance and internalization processes were occurring. However, as PU about E-mail became integrated into one's own cognitive belief system, the influence of compliance might have become insignificant over time. Several anecdotes from our field work illustrate how use of

examined how usage of E-mail by one's supervisor in

communicating with his or her subordinates affects subordinates' perceptions of the usefulness of the medium. Even though this is only one facet of the social influence construct, it explained about 16 per- cent of the variance in PU, indicating that exploring the social influence construct more fully by including[9]According to Ref. [32], internalization results from accepting information from expert sources and integrating this information into one's cognitive system. Identification results from feeling some bond with an attractive or likable source and persists for as long as the likable source is still salient. Finally, compliance is produced by a powerful source having control over the message recipient in the form of rewards and punishments.

E-mail by supervisors affects beliefs about using E-mail. One knowledge worker expressed her feelings in this way:

''As a result of [the director of my office] using his terminal and E-mail, there are other people in the office who might not have been so inclined to use their terminals [who] now log in fairly regularly to check their mail and correspond.

''.. .Some of the VPs may say they want electronic mail and they get electronic mail in and you may have a lonely manager out there who really hasn't gotten into the system yet and all of a sudden they're being notified of meetings, they are being notified of crucial information as part of their job function and because they haven't signed on [E-mail] they're left out of the loop, the inner loop... [Not because they don't have an account but] because they aren't checking."

PEU, consistent with the results obtained by Davis

[16] and Mathieson [36], had no direct effect on usage but rather an indirect effect through PU. Citing Radner and Rothschild [44], Davis [16] suggests that a plau- sible explanation may be as follows: all else being equal, the easier the system is to interact with, the less effort will be needed to use it and, therefore, the more time and effort one can allocate to other activities. SP had a positive relationship with PU as hypothe- sized. It was posited that the higher the perceived social presence of E-mail, the more users would deem it appropriate for a wider range of communication tasks. A factor that emerged through our interviews, as being a determinant of the social presence of E-mail for communicating, was the relationship a user has with the intended recipient of the message. Therefore, it is possible that perceptions of the social presence of E-mail will vary depending on the type of relationship one has with the recipient of the message. Two anecdotes from our interviews illustrate this point.

''.. .What I can say is that E-mail doesn't allow the personal thing, but there's still a sense of human contact with your friends because you can still sort of picture what they're looking and what they are saying so there's a sense of human contact."

''E-mail.. .is.. .straight business with people you don't know, in which case it is the same as a letter...If it is with friends, you do get the feed-back.. .within a matter of hours, whenever they read their mail."

The relationship between accessibility and PEU is positive and significant, as hypothesized. Davis et al.[17], contrary to prior research, found no significant effect between accessibility of IT and usage. They posited that accessibility may not be important when the IT is universally accessible. However, as our results indicate, another plausible explanation may be that accessibility may also affect usage indirectly, through its effect on PEU.

б. Limitations and theoretical implications

The present study posits an extension to technology acceptance theory for electronic communication media. Several issues are raised by the study including generalizability of the results to other settings and information technologies and operationalization of the study's constructs.

The theoretical model of the study was tested in one knowledge worker setting. Even though the choice of a single organization controls for the effect of organiza- tional level variables, such as institutional constraints and infrastructure arrangements, on usage behavior, results of the study may be idiosyncratic to the parti- cular setting. Clearly, replication of this work in other settings and sample groups will be necessary to under- stand how well these findings generalize.

In addition, the model has been developed specifi- cally for electronic communication media. However, with the exception of the social presence construct which is unique to communication technologies, all other constructs are applicable to other types of IT. We would, therefore, expect results of the study (excluding social presence) to generalize across different

information technologies. Certainly, replica- tion of the work to other classes of information technology is necessary to assess generalizability across technologies.

The level of analysis is also a limiting factor. Since we studied media choices acrorr tasks and commu-nication recipients, it is not possible to generalize findings to strictly task-dependent situations. The relationship between these phenomena is very inter- esting, however, and suggests directions for further research.

The present study has examined the effect of per- ceptions of social presence, social influence, accessi- bility, and training on perceived usefulness and perceived ease of use and the effect of these on self-reported usage of E-mail. Several issues arise from this operationalization of the study's constructs. First, we have measured port ure evaluations of PU and PEU and their effect on usage. A longitudinal study, measuring prior expectationr and not post-use evaluations of these constructs, would increase the theoretical validity of the model.

Second, the choice of self-reported, perceptual measures versus objective measures of the constructs has important implications for theory. In the current study, we were interested in user perceptionr of the constructs and their effect on self-reported usage. Results may be different if objective measures of the constructs are used [48]. For example, different results may be obtained if, instead of measuring social influence by asking users about the extent to which their boss uses E-mail to communicate with them (i.e. their social projections of this behavior [53]), we measured social influence using the computer- recorded number of messages sent by the boss to the user. This is because social projections of specific others' attitude and behavior are not necessarily cor- related with specific others' actual attitudes and beha-vior [50, 53]. In fact, Rice and Aydin [50] found that one's attitude is only slightly influenced by specific others' actual attitude, but it is significantly related to the individual's rocial projection of these attitudes.

Further, we only used one measure of social influ-

ence. However, social influence can be exerted by a number of different mechanisms. Network analysis

[49] and network-based proximity mechanisms for social influence, such as relational proximity, posi- tional proximity, and spatial proximity [50], would provide a more comprehensive measure of how one's structural context influences one's perceptions and behavior.

Furthermore, since measures of usage employed in this study as well as in Ref. [16] were self-reported measures, further research is needed to investigate whether the same pattern of results will remain using alternative, objective measures of usage. Some initial evidence suggests that while TAM explains self- reported usage well, it does poorly in explaining computer-recorded objective levels of usage [62,

67]. It is possible that antecedents and consequents of subjective measures of behavior are different from antecedents and consequents of objective measures of behavior.

In terms of theory, a contribution of this research has been the extension of Davis' [16] findings to include factors identified by the media choice litera-ture in order to explain usage of a key electronic communications medium, E-mail. Additional vari-ables influencing PU, PEU, and usage should be identified and studied. In particular, further research on social information processing is necessary to inves-tigate the effects of additional referent groups, such as peers, and additional influencing behaviors on user beliefs about the use of E-mail. Examining the effects of informational accessibility [11], in addition to physical accessibility, may also provide some insight as to the ways this multi-dimensional concept affects beliefs and behavior.

Besides extending theory, this study has also inte-

grated heretofore diverse and unrelated research streams on media choice. In spite of the fact that IS has had a high profile stream of research on the use of E-mail and the new media since 1986 [2, 15, 16, 17,41], this work is generally not linked to important work on media choice [45, 47, 52], which is thought to be one of the most 'vibrant areas of inquiry' in organizational communications [22]. Further IS research in communication-support technologies should look at the literature in this highly related field for rich sources of insight.

Managerial implications

One of the objectives of this study has been to identify viable antecedents to PU and PEU in order to facilitate managerial interventions and enhance diffu- sion of electronic media in organizations. The research identified three significant factors that work through perceptions of the ease-of-use and usefulness of E- mail to influence usage of that medium. Use of E-mail by supervisors to communicate with their subordi- nates, physical accessibility of E-mail, and percep- tions of E-mail as a

warm medium all encourage usage of E-mail. In addition, since both PU and PEU are important determinants of use, managers should aim at increasing user awareness of how tasks can besupported by the technology and at reducing apprehensions about the complexity of the technology.

Technological innovation occurs at a swift pace, and managers are increasingly confronted with the task of diffusing new technologies throughout the organization [1]. Unfortunately, rate of technological change does not necessarily imply the same rate of adoption, since adoption and usage of technology aredependent on the psychology of user acceptance. Forinstance, users have resisted switching from Windows'95 to Windows '98 since the usefulness of this changeis not immediately apparent. Knowing the antecedentsof usefulness perceptions gives managers tools topresent the case for new technology more effectively and convincingly. Toward this end, the current study presents empirical evidence to suggest a number of such viable antecedents, under managerial control, that shape these perceptions.

Forecasts predict that communications technologies

– generalized software/hardware products and ser- vices that enhance human communications – will be critical for organizational success in the 1990s [66]. If these forecasts are accurate, technologies such as E-mail can be instrumental in achieving new levels of organizational effectiveness [13]. But successfully managing these 'new' media technologies is a complex process, and organizations in transition will be confronted with major challenges. One such challenge is planning and executing management interventions that will encourage the appropriate use of E-mail. Study results here suggest that managers, both by their own example in actively using the mediumand by indicating to users which set of tasks constitute acceptable use of E-mail, can enhance the infusion ofthe electronic media in organizations [22].

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