MIS Quarterly

RESEARCH ARTICLE

# TIME FLIES WHEN YOU'RE HAVING FUN: COGNITIVE ABSORPTION AND BELIEFS ABOUT INFORMATION TECHNOLOGY USAGE[1]

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## Abstract

*Extant explanations of why users behave in particular ways toward information technologies have tended to focus predominantly on instrumental beliefs as drivers of individual usage intentions. Prior work in individual psychology, however, suggests that holistic experiences with technology as captured in constructs such as enjoyment and flow are potentially important explanatory variables in technology acceptance theories. In this paper, we describe a multi-dimensional construct labeled cognitive absorption and defined as a state of deep involvement with software. Cognitive absorption, theorized as being exhibited through the five dimensions of temporal dissociation, focused immersion, heightened enjoyment, control, and curiosity, is posited to be a proximal antecedent of two important beliefs about technology use: perceived usefulness and perceived ease of use. In addition, we propose that the individual traits of playfulness and personal innovativeness are important determinants of cognitive absorption. Based on the conceptual definition of this construct, operational measures for each dimension are developed. Using the World Wide Web as the target technology, scale validation indicates that the operational measures have acceptable psychometric properties and confirmatory factor analysis supports the proposed multi-dimensional structure. Structural equation analysis provides evidence for the theorized nomological net of cognitive absorption. Theoretical and practical implications are offered.*

**Keywords:** User beliefs, cognitive absorption, world-wide web, user behavior toward information technology

**ISRL Categories:** GB01, GB02, GB03, AA01, AI04

## Introduction

In today's increasingly global, digital, and networked economy (Tapscott 1996), information

[1]Cynthia Beath was the accepting senior editor for this paper.

technology (IT) represents a substantial investment for most corporations and constitutes a significant aspect of organizational work. However, its value is realized only when information systems are utilized by their intended users in a manner that contributes to the strategic and operational goals of the firm. Not surprisingly, researchers and practitioners alike are concerned with the issue of understanding and managing user reactions to information technologies. In response to this concern, several theoretical models have been proposed to better understand and explain individual attitudes and behaviors toward new IT: innovation diffusion theory (Brancheau and Wetherbe 1990; Rogers 1995), the technology acceptance model (TAM; Davis 1989; Davis et al. 1989), the theory of reasoned action (TRA; Ajzen and Fishbein 1980; Fishbein and Ajzen 1975) and the theory of planned behavior (TPB; Ajzen 1985, 1988; Ajzen and Madden 1986). Despite differences among these models regarding the specific constructs and relationships posited, there is some convergence among them that individual's *beliefs* about or perceptions of IT have a significant influence on usage behavior. In general, beliefs are important not only because they influence subsequent behavior, but also because they are amenable to strategic managerial manipulation through appropriate interventions such as system design (Davis 1993) and training (Venkatesh 1999).

Whereas prior research has focused considerable attention on the centrality of beliefs in several key outcomes such as attitudes and usage, less emphasis has been placed on *how* such beliefs are formed. A few notable exceptions here are studies by Agarwal and Prasad (1999), Davis (1993), Davis et al. (1992), Compeau and Higgins (1995a, 1995b), and Venkatesh and Davis (1996). Each of these studies examines different influences on the formation of beliefs about the usefulness and ease of use of an information technology, including perceived enjoyment (Davis et al. 1992), self-efficacy (Compeau and Higgins 1995a, 1995b; Venkatesh and Davis 1996), system design characteristics (Davis 1993), and a variety of individual and situational influences (Agarwal and Prasad 1999). Given the recurrence of beliefs in theoretical models of user behavior toward information technologies, additional work that examines their determinants is necessary. An understanding of what causes individuals to hold certain beliefs about the target information technology would be of value not only to practitioners responsible for the implementation and deployment of IT, but also to researchers interested in explicating the paths through which technology use behavior is manifested.

A dominant emphasis in much of the research focused on user behaviors toward information technology has been on notions of instrumentality. For example, the technology acceptance model posits that usage behavior is driven by instrumentality and cognitive complexity beliefs. In contrast, an alternative stream of research, which derives its theoretical bases from individual psychology, posits that individual behavior toward new information technologies is shaped by their holistic experiences with the technology (e.g., Trevino and Webster 1992). In this tradition, constructs such as the state of flow described by Csikszentmihalyi (1990), which captures an individual's subjective enjoyment of the interaction with the technology, have been empirically confirmed to be significant predictors of several important outcomes related to technology use, such as attitudes and extent of use (Trevino and Webster 1992).

Motivated by a need to further examine and incorporate holistic experiences with technology in our understanding of technology users, in this paper we describe a conceptual construct labeled **cognitive absorption (CA)**. This construct derives its theoretical bases from work in individual psychology, notably, research related to a trait dimension called absorption (Tellegen 1982; Tellegen and Atkinson 1974), the state of flow (Csikszentmihalyi 1990), and the notion of cognitive engagement (Webster and Ho 1997). We posit that cognitive absorption, an intrinsic motivation related variable, is important to the study of technology use behavior because it serves as a key antecedent to salient beliefs about an information technology.

Several central characteristics of contemporary IT underscore the need to pay close attention to non-instrumental variables. Contemporary information technologies tend to utilize multiple media and richer, graphical interfaces. As a result, individual interaction with the technology becomes an increasingly riveting and engaging experience. Consider, for example, anecdotal reports describing incidents of addiction to the internet (e.g., Dern 1996; Nash 1997) and to video games (Sinha 1999). While these articles highlight the negative aspects of addiction, other work such as Csikszentmihalyi (1990) and Ghani and Deshpande (1994) suggests that there may be positive outcomes associated with this type of engagement, such as more positive attitudes toward the target behavior and greater exploratory use of the technology.

We begin by reviewing relevant prior work in psychology and the information systems research literature that frames the concept of cognitive absorption. This is followed by arguments supporting the hypothesized relationship between CA and salient cognitive beliefs about the instrumentality and ease of use of an information technology, together with individual trait factors that serve as antecedents of CA. An operational definition of the multidimensional CA construct is then developed. The hypothesized effects of CA on salient technology beliefs are empirically examined in a study of over 250 users of the World Wide Web using partial least squares as an analytical tool. Results of the study, which support the theorized relationships, are presented and practical and theoretical implications offered.

## Theoretical Background: The Domain of Cognitive Absorption

The theoretical bases for CA derive from three closely inter-related streams of research: the personality trait dimension of absorption, the state of flow, and the notion of cognitive engagement. A brief review of relevant prior research in each stream follows.

### *The Trait of Absorption*

Often one reads about situations and experiences that result in a state of deep attention and engagement—i.e., the individual is perceptually engrossed with the experience. Prior research suggests that some individuals are more likely to exhibit a more marked propensity to experience such a state than others. Tellegen and Atkinson (1974) offered one of the earliest conceptualizations of this notion of absorption. Absorption was defined as an individual disposition or *trait*, i.e., an intrinsic dimension of personality, that led to episodes of total attention where all of an individual's attentional resources were consumed by the object of attention. As noted by Roche and McConkey (1990), the original conceptualization of absorption contained elements of a "readiness for experiences of deep involvement, a heightened sense of the reality of the attentional object, an imperviousness to normally distracting events, and an appraisal of information in unconventional and idiosyncratic ways" (p. 91).

In a substantial body of work, Tellegen and colleagues (e.g., Tellegen 1981, 1982; Tellegen and Atkinson 1974) developed and refined the conceptual and operational definition of this trait variable, resulting in a widely used measure called the Tellegen Absorption scale or TAS. The TAS consists of nine content clusters: responsiveness to engaging stimuli, responsiveness to inductive stimuli, thinking in images, an ability to summon vivid and suggestive images, a tendency to have "cross-modal" experiences, an ability to become absorbed in one's own thoughts and imaginings, a tendency to have episodes of expanded awareness, an ability to experience altered states of consciousness, and an ability to re-experience the past. There is substantial agreement in the literature that TAS represents a useful and adequate measure of the trait of absorption. Indeed, several additional studies that utilized this scale collectively pointed to the importance of absorption as a key element in understanding an individual's total experience with an object (see Dixon et al. 1996). For example, this propensity for deep involvement has been shown to be highly correlated with significant psychological constructs such as hypnotizability, imagery, day-dreaming, and consciousness (for a summary of recent work, see Roche and McConkey 1990).

Whereas Tellegen and Atkinson conceived of absorption as a multi-dimensional trait that is a relatively stable descriptor of individuals, researchers have argued that it is useful conceptually and empirically to distinguish between *state* and *trait* notions of absorption (Dixon et al. 1996; Kumar et al. 1996). The former class of variables captures the essence of subjective experience and could be an outcome of a particular configuration of individual and situational factors. Causally, the trait of absorption is hypothesized to be a proximate antecedent of the state of absorption. Additionally, following Bandura's (1986) notion of reciprocal determinism, Kumar et al. argue that certain states might imply the presence of particular traits. Thus, absorption has been conceptualized as both a state variable and a trait variable, although valid measures for the state aspects of absorption for the domain of information technology use experiences have not been developed.

## The State of Flow

Recent work has noted the conceptual similarity between the state of absorption and Csikszentmihalyi's (1990) account of the flow experience (Wild et al. 1995). Citing examples of absorbed attention during activities where individuals appear to enjoy themselves intensely, Csikszentmihalyi developed a theory of flow: "the state in which people are so involved in an activity that nothing else seems to matter" (p. 4). Dimensions of flow included intense concentration, a sense of being in control, a loss of self-consciousness, and a transformation of time. Cskiszentmihalyi characterizes flow as a state of optimal experience that can occur not only in the pursuit of physical activities, but also in interactions with symbolic systems such as mathematics and computer languages.

Building upon the work of Csikszentmihalyi, Trevino and Webster (1992) presented arguments suggesting that the notion of flow is an important element of understanding human-technology interactions, and indeed, an important antecedent of attitudes toward technologies. Trevino and Webster described four dimensions of the flow experience in the context of information technologies: (1) a control dimension, capturing the individual's perception that she exercises control over the interaction with the technology; (2) an attention focus, where the individual's attention is limited to the narrow stimulus represented by the technology; (3) a curiosity dimension, suggesting that during a flow experience, there is a heightened arousal of sensory and cognitive curiosity; and (4) an intrinsic interest dimension, implying that the individual's interaction with the technology extends beyond mere instrumentality to be pleasurable and enjoyable as an end in itself.

In subsequent work Webster et al. (1993) developed multi-item scales to measure the four dimensions of flow. They argued that flow would be associated with specific characteristics of the software (specifically, perceptions of flexibility and modifiability) and with certain technology use behaviors (experimentation and future voluntary computer interactions). Using correlational analysis applied to data gathered from MBA students, they found support for the relationships posited. In a second study reported in the same article, Webster et al. hypothesized that flow would be associated with actual technology use and with perceived communication quantity and effectiveness. Data gathered from 43 e-mail users in one organization provided empirical support for their hypotheses. In this study, however, Webster et al. were unable to empirically distinguish between the two flow dimensions of intrinsic interest and curiosity, perhaps due to sample size limitations. They, therefore, recommended that flow be conceptualized as consisting of three rather than four dimensions, with the third dimension representing a combination of intrinsic interest and curiosity.

Other conceptualizations of the flow experience in human-computer interactions include those by Ghani and Deshpande (1994), Ghani et al. (1991), and Hoffman and Novak (1996). Ghani and Deshpande argued that "two key characteristics of flow are (a) total concentration in an activity and (b) the enjoyment one derives from an activity" (p. 382). They modeled perceived control and challenge as antecedents of this definition of flow. A significantly more complex version of flow was described by Hoffman and Novak. Examining the role of marketing in hypermedia computer-mediated environments (CME) such as those offered by the World Wide Web, Hoffman and

Novak argued that the dimensions of control, curiosity, intrinsic interest, and attention focus were antecedents to flow rather than its core dimensions. Their model included several other antecedents of flow such as the perceived congruence of skills and challenges and the telepresence of the medium. Hoffman and Novak further theorized that flow would result in several outcomes such as a positive subjective experience, increased learning, and perceived behavioral control; however, they did not provide a specific measurement scale for flow, simply noting that, "A comprehensive measurement procedure for a CME must include measures of the antecedent conditions, consequences, and variables related to the psychological experience of flow" (1996, p. 60).

Hoffman et al. (1999) tested their proposed conceptual model of flow with a sample of over 1,600 respondents. Rather than a multi-dimensional construct, here flow was operationalized as a criterion measure following a narrative description of the flow experience. This measure included items such as "Do you think you have ever experienced flow on the Web?' and "Most of the time I use the Web, I feel that I am in flow." Significant effects were found for the hypothesized antecedents of skill and control, challenge and arousal. As opposed to a hypothesized direct effect, focused attention was found to exhibit an influence on flow that was mediated by telepresence and time distortion.

Extending the notion of flow as described by Trevino and Webster, Agarwal et al. (1997) described a new construct called cognitive absorption in the context of individual behavior toward new information technologies. In this work, cognitive absorption was viewed as encapsulating the four dimensions of flow presented by Trevino and Webster, of computer playfulness (Webster and Martochhio 1992), and of ease of use (Davis et al. 1989). Empirical results presented by Agarwal et al. suggested that CA is an important predictor of beliefs about usefulness. However, as is evident from the definition, their conceptualization included state, trait, and attitudinal variables in this single construct.

In summary, prior work related to the state of flow with information technologies has adopted one of two views of this phenomenon: flow is treated as a multi-dimensional construct in some studies (e.g., Webster et al. 1993; Ghani and Deshpande 1994), and as a uni-dimensional central component in a complex network of relationships in others (e.g., Hoffman and Novak 1996). These alternative conceptualizations notwithstanding, these studies collectively affirm the key role played by the flow experience in shaping individual attitudes and behaviors towards the target information technology.

## The Concept of Cognitive Engagement

In recent work, Webster and Ho (1997) described a construct labeled cognitive engagement. Arguing that engagement relates to the state of playfulness, and that the state of playfulness is identical to the flow experience, Webster and Ho presented engagement as flow without the notion of control. Thus, engagement was posited to be multi-dimensional, but only encompassing the dimensions of intrinsic interest, curiosity, and attention focus. Webster and Ho note that although their measure for engagement exhibited good psychometric properties, there is a need for future work investigating whether flow and engagement are the same constructs or whether they are conceptually and empirically distinct. In other work Webster and Hackley (1997) posited that cognitive engagement would be a significant learning outcome in technology-mediated distance learning. Cognitive engagement in this study was found to be significantly and positively affected by the perceived richness of the medium, the level of interactivity in the instructor's teaching style, and classmates' attitudes toward the technology used in distance learning.

## The State of Cognitive Absorption

The review of prior work presented above highlights the attention accorded in recent literature to variables capturing holistic experiences with technology. Table 1 summarizes the relevant literature that has provided operational definitions and empirical tests of such variables. Despite differences in conceptualization, there appears to

Table 1. Summary of Select Empirical Research on Related Constructs

| Authors | Construct | Dimensions | Antecedents | Consequences |
|---|---|---|---|---|
| 1. Ghani and Deshpande (1994) | Flow | Concentration<br>Enjoyment | Control<br>Challenge | Exploratory use |
| 2. Ghani, Supnick, and Rooney (1991) | Flow | Concentration<br>Enjoyment | Individual skills<br>Control<br>Challenge | |
| 3. Trevino and Webster (1992) | Flow | Control<br>Attention focus<br>Curiosity<br>Intrinsic interest | Computer skill<br>Technology type<br>Ease of use | Attitudes<br>Effectiveness<br>Quantity<br>Barrier reduction |
| 4. Webster, Trevino, and Ryan (1993) | Flow | Control<br>Attention focus<br>Curiosity<br>Intrinsic interest | Perceived flexibility[a]<br>Perceived modifiability<br>Experimentation<br>Future voluntary use<br>Actual use<br>Perceived communication quantity<br>Perceived communication effectiveness | |
| 5. Hoffman and Novak (1996) | Flow | Not specified | Skills/challenges<br>Focused attention<br>Telepresence<br>Interactivity | Learning<br>Perceived behavioral control<br>Positive subjective experience<br>Distortion in time perception |

Table 1. Continued

| | | | | |
|---|---|---|---|---|
| 6. Webster and Ho (1997) | Engagement | Attention focus<br>Curiosity<br>Intrinsic interest | Challenge<br>Feedback<br>Control<br>Variety | |
| 7. Webster and Hackley (1997) | Cognitive engagement | Attention focus<br>Curiosity<br>Intrinsic interest | Technology characteristics (reliability, quality, richness)<br>Instructor attitudes<br>Teaching style<br>Instructor control<br>Number of student locations<br>Student comfort with having image displayed<br>Classmates' attitudes | |
| 8. Agarwal, Sambamurthy, and Stair (1997) | Cognitive absorption | Control<br>Attention focus<br>Curiosity<br>Intrinsic interest<br>Computer playfulness<br>Ease of use | | Perceived usefulness |

[a]Correlational rather than causal relationships posited.

Table 2. The Dimensions of CA and of Related Constructs

| | CA (current study) | Related Constructs | | | | | |
|---|---|---|---|---|---|---|---|
| | | Flow (Csikszentmihalyi 1990) | Flow (Ghani and Deshpande 1994; Ghani et al. 1991) | Flow (Trevino and Webster 1992; Webster et al. 1993) | Engagement (Webster & Ho 1997; Webster and Hackley 1997) | Flow Network (Novak et al. 1999) | Cognitive Absorption (Agarwal et al. 1997) |
| DIMENSIONS | Temporal Dissociation | "transformation of time" | | | | Telepresence/ time distortion (*antecedent to flow*) | |
| | Focused Immersion | "attention is completely absorbed by the activity" "nothing else matters" | Concentration | Attention focus | Attention focus | Focused attention (*antecedent to flow*) | Attention focus |
| | Heightened Enjoyment | "pleasure and enjoyment" | Enjoyment | Intrinsic interest | Intrinsic interest | | Intrinsic interest |
| | Control | "involving a sense of control" | | Control | | Skill/control (*antecedent to flow*) | Control |
| | Curiosity | | | Curiosity | Curiosity | | Curiosity |

be considerable overlap in the studies. In general, all of these variables represent different forms of intrinsic motivation (Deci and Ryan 1985; Vallerand 1997), where "a behavior is performed for itself, in order to experience pleasure and satisfaction inherent in the activity" (Vallerand 1997, p. 271). In contrast to extrinsic motivation that is typically associated with the expectation of greater rewards or other instrumental outcomes, intrinsic motivators result in activities becoming autotelic or "an end in themselves" (Csikszentmihalyi 1990). In the domain of IT specifically Davis et al. (1992) drew a dichotomy between perceived usefulness, an extrinsic motivator, and perceived enjoyment, which they characterized as an intrinsic motivator. Empirical results showed that enjoyment explained additional variance in usage intentions over and above that accounted for by perceived usefulness.

The synopsis of prior work in psychology as well as individual interactions with information technology suggest that holistic experiences with technology, as manifest in absorption and flow, are important explanatory variables in theories about behavior. Our specific focus is on the *state* aspects of absorption and the role it plays in informing understanding of user behaviors with information technology. The review presented above indicates that while researchers acknowledge the importance of this state, no specific definition of the construct has been offered, although several dimensions proposed do appear to be important facets of this state. Consistent with prior research that compellingly argues for a multi-dimensional conceptualization of this construct (e.g., Kumar et al. 1996; Nelson 1995), we define cognitive absorption as "a state of deep involvement with software" that is exhibited through five dimensions:

(1) temporal dissociation, or the inability to register the passage of time while engaged in interaction;
(2) focused immersion, or the experience of total engagement where other attentional demands are, in essence, ignored;
(3) heightened enjoyment, capturing the pleasurable aspects of the interaction;
(4) control, representing the user's perception of being in charge of the interaction; and
(5) curiosity, tapping into the extent the experience arouses an individual's sensory and cognitive curiosity (Malone 1981).

In essence, CA represents a situational intrinsic motivator (Vallerand 1997). As is evident, the state of cognitive absorption draws extensively upon prior theorizing, but differs in several key respects. Table 2 maps the posited dimensions of CA to the related constructs discussed previously. With regard to similarities, CA incorporates the control, curiosity, and focused attention dimensions of flow as articulated by Trevino and Webster and by Webster et al. The heightened enjoyment dimension represents a synthesis of the intrinsic interest dimension of flow (Webster et al. 1993), and perceived enjoyment (Davis et al. 1992). Although Trevino and Webster and subsequently Webster et al. utilized the label intrinsic interest, the conceptual definition offered by them, "meaning they are involved in the activity for the pleasure and enjoyment it provides" (Trevino and Webster 1992, p. 543), has strong overtones of perceived enjoyment. Moreover, although Webster et al. provided a rich conceptualization of flow, which has considerable relevance for the state of cognitive absorption, there is at least one important point of divergence. Their definition of flow does not include the notion of temporal dissociation, a key element of Csikszentmihalyi's description of the flow experience. While Hoffman et al.'s (1999) work pays attention to a related concept of time distortion, they treat it as an antecedent rather than a core component of flow. Csikszentmihalyi's notion that flow represents experiential involvement where the autotelic nature of the activity results in individuals losing track of time has considerable intuitive appeal. Thus, the explicit inclusion of this dimension as an important element of cognitive absorption, and the development of an operational measure for it represents a contribution of our work. Theorized antecedents and consequences of CA are presented next.

## The Nomological Net of Cognitive Absorption

In order to establish the role played by CA in extending our understanding of users' reactions to

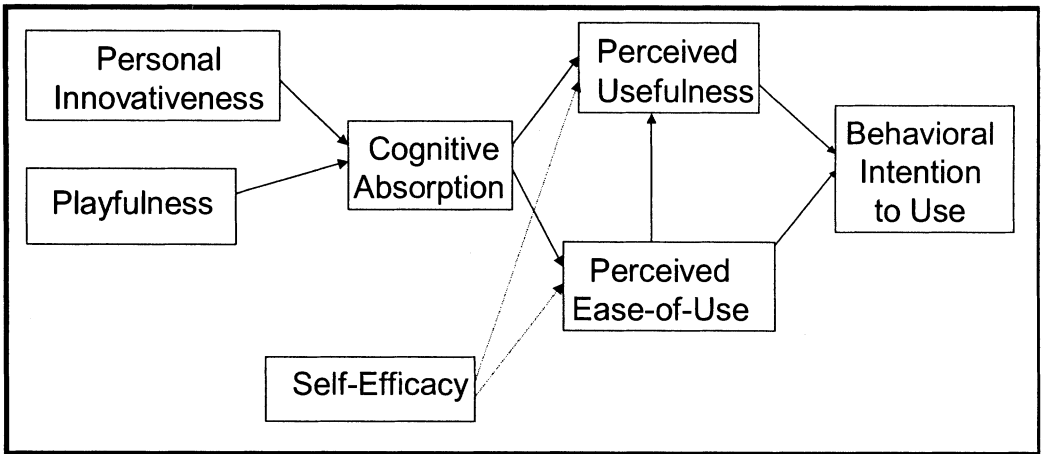


Figure 1. Theoretical Model

information technology, it is necessary to situate the construct within a nomological net. Figure 1 presents one plausible network of relationships for CA. While others might propose alternative causal pathways, we present theoretical arguments below supporting the proposed paths and subsequently present data from a cross-sectional study in support of these relationships. Thus, our goal is not theory testing per se to establish whether one model is more powerful than another; rather, we seek to examine possible antecedents and consequences of CA.

### *Beliefs and Intentions*

The research model shown in Figure 1 hypothesizes that cognitive absorption is an underlying determinant of the perceived usefulness and perceived ease of use of an information technology, which, in turn, influence behavioral intentions to use the technology. The right hand side of the research model represents the constructs and relationships of the technology acceptance model (Davis 1989; Davis et al. 1989). Drawing on belief-attitude-behavior models as exemplified by the theory of reasoned action from social psychology (Ajzen and Fishbein 1980), Davis et al. (1989) suggested that technology use intentions are predicted by perceived usefulness and perceived ease of use. Although the original formulation of TAM included attitude as a construct mediating the effects of beliefs on intentions (Davis 1989), subsequently attitude was dropped from the specification of TAM (Davis et al. 1989).

Perceived ease of use is an individual's assessment that technology interaction will be relatively free of cognitive burden, i.e., ease of use reflects the facility with which the individual is able to interact with a particular software artifact. It has been shown that individuals are more likely to interact with new technologies if they perceive that relatively little cognitive effort will be expended during the interaction (Adams et al. 1992). According to Davis (1989), perceived ease of use represents an intrinsically motivating aspect of human-computer interactions. Perceived usefulness is defined as the "degree to which a person believes that using a particular system would enhance his or her job performance" (Davis 1989, p. 320). Perceived usefulness has been found to have a significant influence upon system utilization because of a user's belief in the existence of a use-performance relationship. Davis argues that the theoretical foundations for perceived usefulness as a predictor of usage behavior derive from several diverse research streams, including self-efficacy theory, a cost-benefit paradigm, and adoption of innovations research. Perceived ease of use is posited to influence behavioral intentions to use through two causal pathways: a direct effect as well as an indirect effect through perceived usefulness. The latter relationship is supported by the notion that to the extent the lower cognitive burden imposed by a technology frees up attentional resources to focus on other matters, it serves the instrumental ends of a user (Davis et al. 1989).

Collectively, several empirical studies affirm the significance of perceived usefulness and ease of use beliefs in predicting intentions. For instance, Davis et al. (1989) found that usefulness was a highly significant predictor of attitude as well as behavioral intentions to use the new technology at two different time periods in the context of word-processing software. These results were replicated by Mathieson (1991) in a study of intentions to use spreadsheet software; and by Adams et al. in a series of studies using different end-user productivity software. More recently, Szajna (1996) proposed and found empirical support for a minor revision of the technology acceptance model; despite some differences in this model from the original conceptualization of TAM, the salience of perceived usefulness in data collected both pre- as well as post-information technology implementation was again supported. Drawing upon this literature we test:

H1: Perceived usefulness of an information technology has a positive effect on behavioral intention to use the information technology.

H2: Perceived ease of use of an information technology has a positive effect on behavioral intention to use the information technology.

H3: Perceived ease of use of an information technology has a positive effect on the perceived usefulness of the information technology.

## The Consequences of CA

We next consider how CA fits into the constructs and relationships underlying TAM. Cognitive absorption is expected to exhibit a positive influence on ease of use beliefs through all of its five dimensions. While experiencing temporal dissociation, the individual perceives herself as possessing ample time to complete a task, contributing to the ease of use of the technology. Focused immersion suggests that all of the attentional resources of an individual are focused on the particular task, thereby reducing the level of cognitive burden associated with task performance. This results in amplification of perceived ease of use. Similar arguments may also be found in the concept of mental workload (Evaristo and Karahanna 1998), where mental workload is characterized as the difference between cognitive resources allocated for task performance and those utilized by the task. In so far as cognitive absorption reflects total attention, the mental workload associated with technology use should be lower since more cognitive resources are allocated to the task. Amplified curiosity suggests that the act of interacting with the software invokes excitement about available possibilities (Webster et al. 1993). Such excitement should serve to reduce the perceived cognitive burden associated with the interaction. A sense of being in charge and exercising control over software interaction should, again, reduce the perceived difficulty in task performance. Finally, the heightened enjoyment dimension of CA contributes to perceived ease of use in that enjoyable activities are viewed as being less taxing (Csikszentmihalyi 1990).

It is important to note that some prior work has proposed that perceived ease of use is an antecedent rather than an outcome of a subset of the dimensions of CA. In particular, Trevino and Webster (1992) posited that perceived ease of use would amplify the flow experience, while Davis et al. (1992) posited a similar relationship between perceived ease of use and enjoyment. However, other work, notably Venkatesh (1999), suggests that a state of intrinsic motivation will *amplify* ease of use beliefs. Venkatesh presents empirical results comparing a "traditional" training environment with a game-based training environment, where the latter was constructed so as to be more enjoyable. As posited, ease of use perceptions were higher with the game-based training group than with the traditional training group. Our theorizing adopts a similar stance: in essence, we argue that the intrinsically motivating state of cognitive absorption creates perceptions of a lower cognitive burden because the individual is experiencing pleasure from the activity and is willing to expend more effort on it (Deci 1975).

In order to establish the relevance of CA as a predictor of perceived ease of use, attention needs to be focused also on other key determinants of this belief. Although there is limited prior work examining the determinants of ease of use beliefs, in a recent study Venkatesh and Davis (1996) postulated and presented empirical support for self-efficacy as a key antecedent. Self-efficacy, an individual characteristic, is reflective of confidence in one's ability to perform a particular task (Bandura 1997). While acknowledging self-efficacy as a predictor of ease of use, we suggest that CA is an additional salient influence. In other words, confidence and a state in which an individual is intrinsically motivated will together heighten perceptions of a lower cognitive burden. Therefore, we hypothesize:

> H4: After controlling for self-efficacy perceptions, cognitive absorption with an information technology has a positive effect on the perceived ease of use of the information technology.

The proposed relationship between CA and perceived usefulness derives its foundations from innate human tendencies to justify behavior. Self-perception theory (Bem 1972) argues that individuals will seek to rationalize their actions and reduce cognitive dissonance (Festinger 1976). Cognitive dissonance as a psychological state arises when an individual holds two inconsistent cognitive structures at the same time. While in a state of cognitive absorption, the individual is experiencing gratification and pleasure from the task of software interaction. To the extent that a majority of social environments reward instrumental outcomes, cognitive dissonance arises. Therefore, there is likely to be a natural propensity to overlook the hedonistic or pleasurable aspects of an activity and to account for the time spent on the activity by attributing instrumental value. Thus, through the heightened enjoyment dimension, a state of cognitive absorption is expected to positively influence perceived usefulness. In essence, the individual rationalizes "I am voluntarily spending a lot of time on this and enjoying it, therefore, it must be useful."

What other factors influence perceived usefulness? As with perceived ease of use, self-efficacy has been proposed and has accumulated empirical support as an important antecedent of perceived usefulness. Drawing upon Bandura's (1977) social cognitive theory, Compeau and Higgins (1995a, 1995b) and Compeau et al. (1999) posited that self-efficacy would exhibit a positive influence on individual expectancies about the consequences of performing a specific behavior. Such outcome expectancies have been widely equated with the notion of perceived usefulness (e.g., Davis 1989; Venkatesh 1999). Therefore, in order to establish CA as an additional important predictor of perceived usefulness, we test the hypothesis:

> H5: After controlling for self-efficacy perceptions, cognitive absorption with an information technology has a positive effect on the perceived usefulness of the information technology.

The core formulation of TRA (Ajzen and Fishbein 1980) argues that the effects of all external variables (such as the state of CA) are mediated by an individual's cognitive beliefs. Consistent with this theory, we posit that the effects of CA on technology use intentions are mediated by beliefs, i.e., such beliefs are the most proximal outcomes of CA. Empirical research in information technology domains has provided evidence of such mediation, albeit not in the context of state variables. For example, a few studies (e.g., Davis 1993; Venkatesh and Davis 1996) have shown full mediation by beliefs of the effects of systems variables on technology use. Agarwal and Prasad (1999), in a study examining the effects of several individual difference factors on beliefs and attitude, found further support for full mediation by beliefs. In our conceptualization, cognitive absorption is a *state* resulting from a combination of individual and situational factors. The theoretical formulation of TRA would then suggest that beliefs mediate the effects of CA. However, to the extent that CA represents an intrinsically motivating state, it is also plausible that it has a direct effect on intentions. Given our limited empirical understanding of CA's nomological net, we adopt a conservative stance and depict the effects of CA on intentions as being fully mediated by perceived ease of use and perceived usefulness. This expectation is subsequently tested in supplemental analyses.

### Predicting the State of CA

What determines the extent to which an individual is likely to experience a state of cognitive absorption? Prior research provides some insights into the antecedents of CA. For instance, it has been recurrently noted (e.g., Roche and McConkey 1990; Wild et al. 1995) that individual traits are likely to have an effect on experiential states. This expectation echoes Bandura's (1997) notion of triadic reciprocity where individual factors (the person), situational factors (the environment), and behaviors interact and are reciprocally determined. Webster and Martochhio (1995) argued the individual trait of cognitive playfulness (CPS) defined as "the degree of cognitive spontaneity in microcomputer interactions" (Webster and Martocchio 1992, p. 204), would be a significant antecedent of the state of flow. This expectation was supported by empirical data in the context of a training environment. In light of the fact that the state of CA encapsulates at least three key dimensions of flow as described by Webster and Martocchio (1995), it is reasonable to expect that playfulness will explain some variance in CA. In addition to the individual trait of playfulness, we theorize that another salient predictor of CA is personal innovativeness in the domain of information technology (PIIT; Agarwal and Prasad 1998). PIIT is conceptualized as an individual trait reflecting a willingness to try out any new technology. Based on this definition, it is likely that PIIT influences CA in that individuals who have an innate propensity to be more innovative with computers are likely to be more predisposed to experience episodes of cognitive absorption. Thus, we test:

H6: Computer playfulness has a positive effect on cognitive absorption with an information technology.

H7: Personal innovativeness has a positive effect on cognitive absorption with an information technology.

In summary, consistent with considerable recent literature that alludes to the effects of state variables on cognition, affect, and behavior, we have defined a conceptual construct labeled cognitive absorption. We expect CA to play a pivotal role in our understanding of users and their behaviors toward information technology via its effects on individual beliefs about the technology. CA was theorized to be influenced by two key individual traits, which have been shown to be highly salient in information technology related behavioral and cognitive outcomes. The operationalization of this construct as well as empirical tests of hypothesized relationships are discussed next.

## Methodology

### Study Context and Sample

The overall approach taken to empirically test the relationships implied by the research model and the research hypotheses was a field study using a survey methodology for data collection. We collected data from student subjects enrolled at a large state university. Given the nature of the sample, we chose the World Wide Web as the target innovation. Besides being widely in use by students, this technology is appropriate for at least two other reasons: one, it is a volitional technology in the sense that students use it of their own accord and not from any mandate, and two, the technology exemplifies the characteristics of contemporary IT that underscore the importance of notions of cognitive absorption. Moreover, the technology is widely available from a number of locations on campus, thus, access is not an inhibitor to technology usage.

Students enrolled in a junior level statistics class in the college of business were surveyed. This course is required of all college of business juniors and, thus, it represents a cross-section of all the majors in the college. Students were instructed to respond to the survey as candidly as possible, that there were no right or wrong answers, and that we were interested primarily in their perceptions about the Web. A total of 288 completed surveys were returned, representing all students who were present in class on the day data were collected.

## Operationalization of Research Variables

All research variables were measured using multi-item scales (see the appendix). Scales for perceived usefulness and ease of use were adapted from those developed and rigorously validated by Davis (1989), while behavioral intention was measured following the recommendations of Ajzen and Fishbein (1980). Self-efficacy was assessed using the 10-item scale developed and validated by Compeau and Higgins (1995b), while PIIT was measured using the four-item scale proposed by Agarwal and Prasad (1998). Finally, for CPS we used Webster and Martocchio's (1992) seven-item scale.

Scales to measure cognitive absorption were developed using a multi-stage iterative procedure. First, existing scales were reviewed to ascertain their fit with the conceptual definitions of the five dimensions of CA. Next, an initial set of items was constructed, drawing upon prior work and our underlying conceptualization. These scales were pilot-tested twice using samples of 73 and 210 respondents for the first and second pilot studies respectively. Results of each pilot test led to further refinement to establish convergent and discriminant validity. The final scales used in the study reported here consisted of five items capturing temporal dissociation, five items measuring focused immersion, four statements tapping into heightened enjoyment, three items measuring control (from Webster et al. 1993), and three items measuring curiosity (from Webster et al. 1993). The heightened enjoyment statements were based on Davis et al.'s (1992) perceived enjoyment items, Webster et al.'s (1993) intrinsic interest items, and some new items. One of the Webster et al. items ("using the Web is intrinsically interesting") was not used in the final scale because in the pilot studies it had a high cross-loading in the factor analysis on the curiosity dimension. The specific items in each scale are listed in the appendix. Throughout the scale development process, considerable effort was made to ensure that each statement captured the intended meaning of a specific sub-dimension of cognitive absorption.

Sample characteristics are shown in Table 3. On average, the sample includes individuals who have a reasonable level of experience with computing technology and the web and are thus likely to possess well-formed beliefs about information technologies in general. Slightly over half the sample is comprised of males, which is typical of the college of business student body at this university.

## Results

To establish the nomological validity of cognitive absorption, we used PLS, a latent structural equations modeling technique that utilizes a component-based approach to estimation. Because of this, it places minimal demands on sample size and residual distributions (Chin 1998a, 1998b; Fornell and Bookstein 1982; Lohmoller 1989). The analysis strategy involved a two-stage approach because the measure for CA consisted of second order factors. The psychometric properties of all scales were first assessed through confirmatory factor analysis. The structural relationships were examined next, using factor scores for the second order factors of CA.

## Measurement Model

Descriptive statistics for the research constructs are shown in Table 4. The psychometric properties of the scales are assessed in terms of item loadings, discriminant validity, and internal consistency. Item loadings and internal consistencies greater than .70 are considered acceptable (Fornell and Larcker 1981). As can be seen from the Confirmatory Factor Analysis (CFA) results in Table 5[2] and composite reliability scores (Werts et al. 1974) in Table 6, scales used in the study largely meet these guidelines. All items except for one item in control (CO2) and two items in Self Efficacy (SE6 and SE9) exhibit high loadings (> .70) on their respective constructs. Further-

[2]To perform CFA in PLS, the following procedure was followed: PLS provides the loadings for the construct's own indicators. To calculate cross-loadings, a factor score for each construct was calculated based on the weighted sum (using the weights PLS provides when running the measurement model) of the construct's indicators. Then these factor scores were correlated with all other indicators to calculate cross loadings of other indicators on the construct.

**Table 3. Sample Characteristics**

| | Mean | Standard Deviation | Missing |
|---|---|---|---|
| Age | 22.9 | 4.14 | 0 |
| PC Experience | 7.27 | 3.45 | 5 |
| Web Experience | 3.76 | 1.54 | 2 |
| Work Experience | 5.38 | 4.25 | 14 |
| Gender | Male | 153 | 18 |
| | Female | 117 | |

Notes: Age, PC Experience, Web Experience, and Work Experience are number of years.

**Table 4. Descriptive Statistics**

| Construct | Mean | S.D. |
|---|---|---|
| Behavioral Intention (BI) | 6.35 | 1.07 |
| Perceived Usefulness (PU) | 5.43 | 1.01 |
| Ease of Use (PEOU) | 5.34 | 1.03 |
| Self Efficacy (SE) | 7.32 | 1.70 |
| Playfulness (CPS) | 4.69 | 1.04 |
| Personal Innovativeness (PIIT) | 4.87 | 1.07 |
| CA: Temporal Dissociation (TD) | 5.36 | 1.18 |
| CA: Focused Immersion (FI) | 4.76 | 0.98 |
| CA: Heightened Enjoyment (HE) | 5.15 | 1.06 |
| CA: Control (CO) | 5.33 | 0.93 |
| CA: Curiosity (CU) | 4.93 | 1.04 |

Notes: All constructs except Self Efficacy are seven-point scales with the anchors 1 = Strongly disagree, 4 = Neutral, 7 = Strongly agree. Self Efficacy is a 10-point scale with anchors 1 = Not at all confident, 10 = Very confident.

more, all constructs in the model exhibit good internal consistency as evidenced by their composite reliability scores. The composite reliability coefficients of the five cognitive absorption dimensions are more than adequate, ranging from .83 for control to .88 for focused immersion and .93 for curiosity, heightened enjoyment, and temporal dissociation.

To assess discriminant validity (Chin 1998b), (1) indicators should load more strongly on their corresponding construct than on other constructs in the model (i.e., loadings should be higher than cross-loadings) and (2) the square root of the average variance extracted (AVE) should be larger than the inter-construct correlations (i.e., the average variance shared between the construct and its indicators should be larger than the variance shared between the construct and other constructs). As can be seen by the CFA results in Table 5, without exception, all indicators load more highly on their own construct than on other constructs. Furthermore, as shown by comparing the inter-construct correlations and AVE (shaded leading diagonal) in Table 6, all constructs share more variance with their indicators

**Table 5. Results of Factor Analysis**

| | TD | FI | HE | CO | CU | PIIT | CPS | SE | PU | PEOU | BI |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TD1 | .87 | .46 | .53 | .17 | .51 | .24 | .32 | .05 | .34 | .27 | .38 |
| TD2 | .84 | .42 | .56 | .24 | .49 | .27 | .33 | .13 | .42 | .32 | .47 |
| TD3 | .90 | .48 | .60 | .24 | .55 | .28 | .34 | .07 | .39 | .33 | .43 |
| TD4 | .80 | .39 | .36 | .13 | .37 | .21 | .17 | .03 | .26 | .21 | .39 |
| TD5 | .84 | .34 | .41 | .17 | .40 | .19 | .21 | .02 | .29 | .20 | .39 |
| FI1 | .29 | .82 | .42 | .36 | .41 | .31 | .29 | .13 | .29 | .34 | .30 |
| FI2 | .52 | .74 | .54 | .16 | .52 | .31 | .35 | .10 | .29 | .26 | .27 |
| FI3 | .51 | .79 | .55 | .34 | .52 | .42 | .38 | .04 | .37 | .39 | .35 |
| FI4R | .18 | .72 | .34 | .23 | .20 | .26 | .14 | .12 | .18 | .24 | .17 |
| FI5 | .34 | .81 | .38 | .25 | .43 | .32 | .25 | .14 | .23 | .29 | .14 |
| HE1 | .55 | .53 | .90 | .44 | .61 | .49 | .47 | .18 | .55 | .59 | .54 |
| HE2 | .49 | .49 | .83 | .24 | .58 | .39 | .39 | .17 | .47 | .33 | .37 |
| HE3 | .55 | .53 | .91 | .39 | .62 | .45 | .46 | .12 | .55 | .53 | .56 |
| HE4 | .44 | .44 | .86 | .40 | .52 | .42 | .39 | .18 | .48 | .46 | .51 |
| CO1 | .25 | .36 | .40 | .87 | .37 | .36 | .26 | .25 | .51 | .64 | .43 |
| CO2R | -.01 | .07 | .17 | .58 | .12 | .15 | .03 | .20 | .26 | .31 | .31 |
| CO3 | .24 | .34 | .39 | .88 | .34 | .33 | .25 | .18 | .49 | .61 | .48 |
| CU1 | .52 | .52 | .61 | .33 | .91 | .47 | .51 | .18 | .49 | .37 | .37 |
| CU2 | .51 | .45 | .62 | .35 | .90 | .49 | .48 | .16 | .52 | .44 | .47 |
| CU3 | .45 | .48 | .56 | .31 | .88 | .40 | .51 | .18 | .47 | .34 | .31 |
| PIIT1 | .28 | .31 | .41 | .28 | .44 | .83 | .34 | .26 | .36 | .36 | .41 |
| PIIT2R | .22 | .32 | .41 | .33 | .28 | .77 | .32 | .30 | .34 | .45 | .31 |
| PIIT3 | .08 | .29 | .31 | .17 | .29 | .70 | .25 | .34 | .21 | .32 | .02 |
| PIIT4 | .30 | .41 | .47 | .38 | .49 | .88 | .42 | .33 | .50 | .51 | .36 |

**Table 5. Continued**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| CPS1 | .30 | .31 | .42 | .19 | .48 | .39 | .76 | .20 | .35 | .31 | .27 |
| CPS2 | .27 | .34 | .41 | .21 | .56 | .37 | .87 | .10 | .37 | .29 | .26 |
| CPS3 | .31 | .38 | .44 | .29 | .42 | .27 | .75 | .16 | .39 | .38 | .29 |
| CPS4 | .27 | .34 | .41 | .19 | .51 | .37 | .91 | .12 | .37 | .25 | .24 |
| CPS5 | .33 | .31 | .42 | .10 | .45 | .36 | .80 | .15 | .27 | .24 | .17 |
| CPS6 | .25 | .32 | .37 | .22 | .38 | .35 | .83 | .14 | .28 | .32 | .20 |
| CPS7 | .18 | .24 | .34 | .23 | .41 | .34 | .84 | .16 | .33 | .31 | .23 |
| SE1 | .03 | .10 | .10 | .19 | .14 | .32 | .08 | .74 | .14 | .27 | .09 |
| SE2 | .05 | .06 | .07 | .14 | .16 | .29 | .10 | .73 | .18 | .25 | .05 |
| SE3 | .03 | .05 | .11 | .22 | .18 | .36 | .13 | .76 | .11 | .20 | .12 |
| SE4 | .06 | .16 | .20 | .19 | .24 | .34 | .18 | .82 | .19 | .29 | .16 |
| SE5 | -.01 | .11 | .14 | .14 | .12 | .26 | .08 | .76 | .24 | .32 | .15 |
| SE6 | .03 | .03 | .09 | .10 | .02 | .03 | .03 | .32 | .16 | .29 | .10 |
| SE7 | .10 | .15 | .22 | .27 | .16 | .31 | .21 | .80 | .07 | .11 | .18 |
| SE8 | .13 | .15 | .13 | .14 | .17 | .26 | .12 | .70 | .26 | .33 | .06 |
| SE9 | .01 | -.01 | .07 | .20 | .04 | .19 | .12 | .63 | .17 | .22 | .15 |
| SE10 | -.01 | .11 | .11 | .22 | .08 | .25 | .14 | .70 | .18 | .25 | .16 |
| PU1 | .36 | .34 | .53 | .43 | .47 | .40 | .40 | .21 | .72 | .45 | .40 |
| PU2 | .34 | .31 | .54 | .48 | .50 | .38 | .38 | .19 | .93 | .53 | .60 |
| PU3 | .37 | .29 | .52 | .53 | .46 | .41 | .33 | .25 | .90 | .45 | .68 |
| PUR | .34 | .29 | .47 | .44 | .48 | .39 | .33 | .21 | .91 | .37 | .53 |
| PEOU1 | .22 | .28 | .41 | .56 | .29 | .47 | .26 | .34 | .39 | .86 | .48 |
| PEOU2 | .19 | .28 | .39 | .50 | .29 | .27 | .30 | .22 | .38 | .71 | .35 |
| PEOU3 | .30 | .37 | .49 | .62 | .41 | .49 | .34 | .30 | .50 | .86 | .51 |
| PEOU4 | .32 | .37 | .55 | .60 | .42 | .48 | .31 | .35 | .54 | .90 | .54 |
| BI1 | .46 | .30 | .51 | .48 | .40 | .31 | .27 | .17 | .59 | .54 | .94 |
| BI2 | .46 | .30 | .53 | .48 | .40 | .34 | .25 | .18 | .59 | .51 | .96 |
| BI3 | .46 | .31 | .57 | .53 | .42 | .36 | .29 | .15 | .65 | .56 | .96 |

TD = Temporal Dissociation; FI = Focused Immersion; HE = Heightened Enjoyment; CO = Control; CU = Curiosity; PIIT = Personal Innovativeness, CPS = Playfulness, PU = Perceived Usefulness; PEOU = Perceived Ease of Use; BI = Behavioral Intention

**Table 6. Inter-Construct Correlations**

| | Reliability[a] (# of items) | CA: TD | CA: FI | CA: HE | CA: CO | CA: CU | PIIT | CPS | SE | PU | PEOU | BI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CA: TD | 0.93 (5) | .85 | | | | | | | | | | |
| CA: FI | 0.88 (5) | .47 | .77 | | | | | | | | | |
| CA: HE | 0.93 (4) | .58 | .57 | .88 | | | | | | | | |
| CA: CO | 0.83 (3) | .22 | .35 | .42 | .78 | | | | | | | |
| CA: CU | 0.93 (3) | .55 | .54 | .66 | .37 | .90 | | | | | | |
| PIIT | 0.87 (4) | .28 | .42 | .50 | .37 | .50 | .79 | | | | | |
| CPS | 0.94 (7) | .32 | .37 | .49 | .25 | .56 | .42 | .82 | | | | |
| SE | 0.91 (10) | .06 | .13 | .18 | .26 | .19 | .38 | .17 | .71 | | | |
| PU | 0.93 (4) | .40 | .35 | .59 | .54 | .55 | .45 | .41 | .25 | .87 | | |
| PEOU | 0.90 (4) | .31 | .39 | .55 | .68 | .42 | .52 | .36 | .37 | .55 | .84 | |
| BI | 0.97 (3) | .48 | .31 | .56 | .52 | .43 | .36 | .28 | .17 | .65 | .57 | .95 |

[a]Composite Reliability = $\rho_c = (\Sigma\lambda_i)^2 / [(\Sigma\lambda_i)^2 + \Sigma_i var(\epsilon_i)]$, where $\lambda_i$ is the component loading to an indicator and $var(\epsilon_i) = 1 - \lambda_i^2$

The shaded numbers on the leading diagonal are the square root of the variance shared between the constructs and their measures. Off diagonal elements are the correlations among constructs. For discriminant validity, diagonal elements should be larger than off-diagonal elements.

CA = Cognitive Absorption; PIIT = Personal Innovativeness; CPS = Playfulness; PU = Perceived Usefulness; PEOU = Perceived Ease of Use; BI = Behavioral Intention

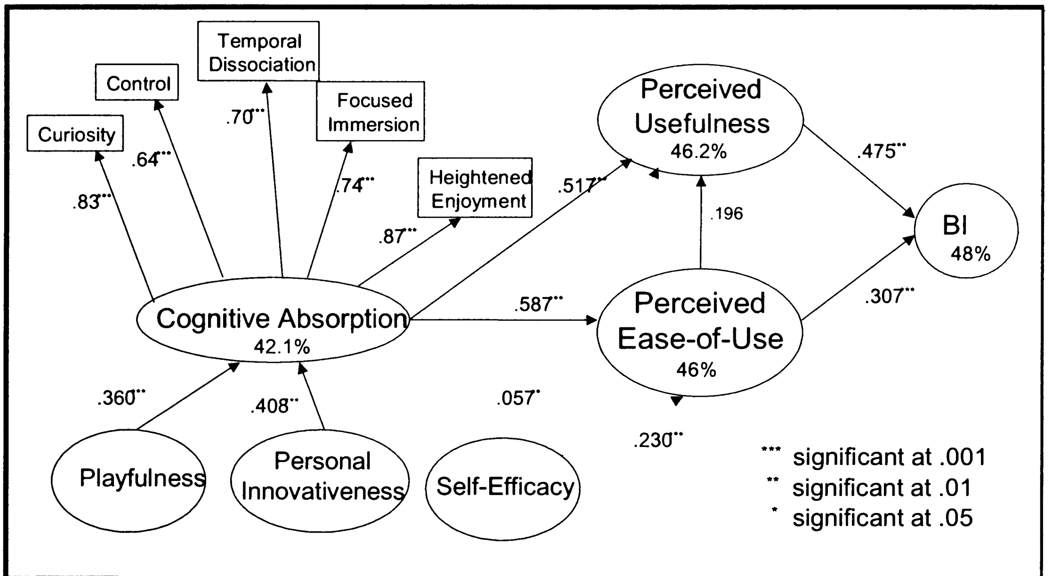


Figure 2. PLS Results

than with other constructs. Thus, these results point to the convergent and discriminant validity of our conceptualization of CA and reinforce its multidimensionality.

### *The Structural Model*

In a PLS structural model, loadings of measures of each construct can be interpreted as loadings in a principal components factor analysis. Paths are interpreted as standardized beta weights in a regression analysis. The path coefficients and explained variances for the model are shown in Figure 2. To eliminate the confounding of results based on specific individual characteristics, a respondent's web experience, PC experience, and gender were included in the analysis as controls. As none of the controls were significant, they were dropped from the model.

All of the constructs were modeled as reflective and most of the constructs in the model were measured using multiple indicators, rather than summated scales. The only exceptions are the cognitive absorption dimensions, which are represented by factor scores derived from the confirmatory factor analysis. This was necessary since PLS does not directly support second order factors. For ease of exposition, only loadings for the CA dimensions are shown in Figure 2. The outer model loadings of all other items on their respective constructs are shown in Table 7.

Cognitive absorption and self-efficacy together explain 46% of the variance in perceived ease of use, while cognitive absorption and self-efficacy explain 46.2% of the variance in perceived usefulness. Perceived usefulness and perceived ease of use account for 48% of the variance in behavioral intention. Self-efficacy alone explains 13.5% of the variance in perceived ease of use; the addition of CA increases the explained variance by 32.5%. With perceived usefulness, the addition of CA contributes to an increase in explained variance of 17% over and above that explained by self-efficacy and perceived ease of use. Finally, PIIT and CPS explain 42% of the variance in cognitive absorption.

As is evident from Figure 2, PLS results provide strong support for hypotheses 1 and 2, which were

**Table 7. PLS Outer Model Loadings**

| Construct | PLS Outer Model Loading |
|---|---|
| *Cognitive Absorption* | |
| Temporal Dissociation | .70 |
| Focused Immersion | .74 |
| Heightened Enjoyment | .87 |
| Control | .64 |
| Curiosity | .83 |
| *Self-Efficacy* | |
| SE1 | .74 |
| SE2 | .72 |
| SE3 | .75 |
| SE4 | .82 |
| SE5 | .75 |
| SE6 | .31 |
| SE7 | .80 |
| SE8 | .71 |
| SE9 | .64 |
| SE10 | .71 |
| *Perceived Ease of Use* | |
| PEOU1 | .85 |
| PEOU2 | .72 |
| PEOU3 | .87 |
| PEOU4 | .90 |
| *Perceived Usefulness* | |
| PU1 | .73 |
| PU2 | .93 |
| PU3 | .90 |
| PU4 | .81 |
| *Behavioral Intention* | |
| BI1 | .96 |
| BI2 | .94 |
| BI3 | .96 |

Note: All loadings are significant at .001 except for SE6, which is non-significant.

essentially drawn from the specification of the technology acceptance model (Davis 1989). Hypothesis 3, which posited that perceived ease of use would influence perceived usefulness, was not supported. This finding is consistent with that obtained by Davis et al. (1989). Hypotheses 4 and 5 were strongly supported: CA is a significant predictor of both perceived usefulness (H4) and perceived ease of use (H5). Furthermore, both playfulness and personal innovativeness have strong significant effects on CA (H6 and H7). Summarized results for the hypothesis tests are shown in Table 8. As a supplemental analysis, we examined a model containing an additional direct path from CA to behavioral intention to determine if the data supported the posited full mediation of the effects of CA on behavioral intention by beliefs of usefulness and ease of use. The results of this test are shown in Figure 3. Contrary to our predictions, there was a significant direct path from CA to behavioral intention.

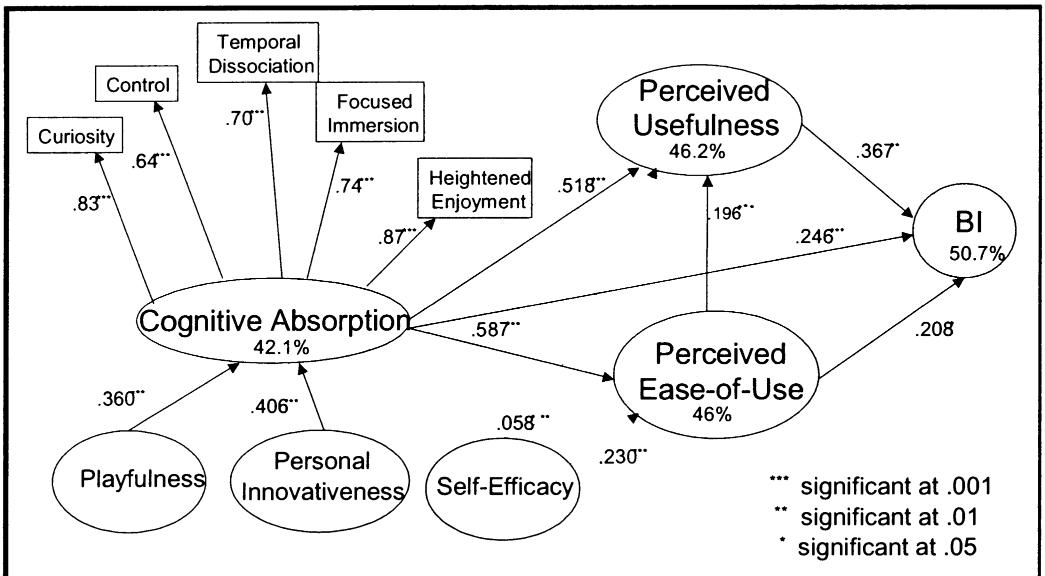


**Figure 3. Pls Results (With Direct Effects)**

**Table 8. Summary of Hypothesis Tests**

| Hypothesis | Support |
|---|---|
| H1: PU ➔BI | Yes |
| H2: EOU ➔ BI | Yes |
| H3: EOU ➔ PU | No |
| H4: CA ➔ EOU | Yes |
| H5: CA ➔ PU | Yes |
| H6: CPS ➔ CA | Yes |
| H7: PIIT ➔ CA | Yes |

Further tests focused on the predictive power of CA were performed as part of a *post hoc* analysis. Since both PIIT and CPS have been posited as important constructs in influencing user beliefs about information systems (e.g., Agarwal and Prasad 1998; Webster and Martocchio 1995), the question remains whether CA contributes to our understanding of perceived usefulness and perceived ease of use over and above what PIIT and CPS might contribute. An alternative model, which included PIIT and CPS as additional predictors of the two salient beliefs of perceived usefulness and perceived ease of use, was tested. Neither PIIT nor CPS were statistically significant predictors of perceived usefulness and perceived ease of use, further pointing to the relevance of CA as an important mediator of these traits with respect to beliefs about IT.

## *Limitations*

Prior to discussing the implications of our findings, limitations that circumscribe their interpretation must be acknowledged. To assess the external validity of the study, one needs to consider both the respondents and the setting in which the study took place (Cook and Campbell 1979). The setting for the study was an educational institution and respondents were students in a business school. Thus, the generalizability of the respondents' behaviors to a more general workforce may be somewhat limited. Typically, the criticism about using students as respondents or subjects for research revolves around whether students differ systematically from the target population in general about their perceptions of the phenomenon of interest. This may indeed be an issue in cases where students have uncrystallized attitudes (particularly as it pertains to social and political issues) or in cases where social norms may play an important role in the theoretical model of interest (Sears 1986). However, in this study there are a number of mitigating factors that suggest that the results may largely generalize to other individuals: this is an individual (versus organizational) level phenomenon that examines a state resulting from the interaction of an individual with a specific system and the subjects are asked about an object about which they have well-formed perceptions and attitudes.

Additionally, the phenomenon being examined here, viz., individual reactions to information technology, is expected to manifest itself in populations of many different varieties. Computing is not confined to the workplace and, indeed, recent evidence suggests that a majority of "new" computing is happening outside of the office environment (Kraut et al. 1999). Ultimately, however, the issue of generalizability is best addressed through replication in different contexts to identify the boundary conditions for the theoretical model. It could be argued that workplace environments place greater value on extrinsic rather than intrinsic motivators and that exploration is valued to a higher degree in an educational setting such as the context for this study. However, to the extent that there are work settings in which non-instrumental beliefs are relevant, we believe that the study provides useful theoretical insights into the role of such beliefs in technology adoption. Knowledge gained within this context will be invaluable in helping us extend this line of research further.

Another threat to the external validity of the study is the issue of respondent age. The average respondent in this sample was 23 years old. Webster and Martochhio (1993) found that younger employees who received training labeled as play exhibited amplified motivation to learn and improved performance as compared with older workers. Venkatesh's (1999) recent study, however, which examined game-based (more "playful") versus traditional training, did not find evidence of a moderating effect of age on the effects of the training method. Thus, while it is not obvious if our findings are sensitive to respondent age, the generalizability of the findings to other age groups would need to be established in future work.

We were unable to model the indicators for the five dimensions of CA in our analysis due to the limitations imposed by the analytic tool. However, reliability for the five dimensions was more than adequate and the confirmatory factor analysis supported discriminant validity with all the dimensions emerging as distinct factors. The loading of the control dimension on CA in the structural model was somewhat lower than the .70 guideline (.64). A possible reason for this may be the low loading of one of the items of the scale (CO2R). However, given the adequate reliability of the control scale (.83) and the fact that the item loaded on its own construct more strongly than on other constructs, we chose to retain it in the analysis. Further empirical testing of the model is required to determine whether the low loading of the control dimension on CA is an artifact of the study. One speculative explanation might be that the concept of control is not relevant in the context of a technology such as the Web.

Conclusions drawn in this study are based on a single technology and, to the extent that the Web is a distinctive technology, they may not generalize across a wide set of technologies. We believe, however, that the Web is not exceptional in that it embodies a trend toward more flexible and malleable information systems in contemporary IT environments.

Measures of cognitive absorption, self-efficacy, perceived usefulness, perceived ease of use, and behavioral intention to use were gathered at the same point in time. Consequently, the potential for common method variance exists. Due to the cross-sectional nature of the study, causality cannot be inferred from the results. Finally, self-efficacy in this study was assessed at the general rather than a task-specific level. As a consequence, this may have attenuated the relationship between self-efficacy and the two salient beliefs (Marakas et al. 1998), thus inflating the relative contribution of CA in explaining variance in perceived usefulness and perceived ease of use.

## Implications and Conclusions

This research was motivated by a broad interest in understanding user behavior toward information technologies. Acknowledging that the nature of information technologies has changed considerably, we argued for the need to focus attention on holistic experiences with IT. To this end, we described a conceptual construct labeled cognitive absorption that captures the totality of an individual's experience with new software and that is strongly grounded in prior research in cognitive and social psychology. Not only does this construct synthesize and integrate prior related research focused on intrinsic motivation variables in technology acceptance, it extends this body of work by incorporating the dimension of temporal dissociation which, while present in conceptual definitions of related constructs, has been absent from operational ones. The proposed nomological net for CA included behavioral beliefs about technology use as consequences and the individual traits of personal innovativeness and computer playfulness as antecedents. Results provide strong support for the posited relationships, as well as for a direct relationship between CA and behavioral intention to use. CA's highly significant relationships with crucial beliefs driving technology acceptance behavior affirm the value of this construct in extending our understanding of technology users.

Several implications follow for both theory development as well as practice. In regard to theoretical advancement, for researchers interested in extending this line of work, the first critical issue relates to the psychometric properties of the CA construct. Although our initial assessment of these properties in this empirical study is encouraging, the loading for one of the control items was not at the desired level. Interestingly this was the only item that was reverse scaled,[3] suggesting that perhaps the overall convergence of this dimension might be improved by utilizing a third positively as opposed to negatively worded item. Herche and Engelland (1996) observed a similar phenomenon in their examination of the behavior of reverse polarity items in several well-known marketing scales. They note that reverse coded items may have negative effects on the uni-dimensionality of the underlying scale. Therefore, we encourage others using the CA construct to consider replacing the reverse scaled item in the measurement of the control dimension in order to develop a scale that exhibits greater convergence.

Second, the nomological net for cognitive absorption is worthy of continued development and refinement. Our focus was on two individual traits that recur in discussions of human-computer interaction, notably CPS and PIIT. However, there are others that may be relevant. For instance, it has been noted (e.g., Roche and McConkey 1990; Wild et al. 1995) that the personality trait of absorption is likely to be a significant predictor of the state of CA. Absorption is the individual propensity to enter a psychological state that is characterized by "marked restructuring of the phenomenal self and world" (Tellegen 1992, as cited by Wild et al. 1995). Thus, individuals who are more disposed to absorption would more readily enter into a state reflective of temporal dissociation, focused immersion, and heightened enjoyment. The expectation of the trait of absorption predicting the state of CA, however, is in need of empirical evaluation.

Moreover, given that our conceptualization of CA draws upon prior related constructs of absorption, flow, enjoyment, and engagement, the antecedents to these constructs shown in Table 1 are candidates for study as potential predictors of CA. Additional antecedents of CA may include characteristics of technology that make it more or less prone to be absorptive. For instance, Turkle (1995) refers to the degree of access to virtual

[3]The item was recoded prior to entering it in the analysis.

worlds and the ability to adopt different online personas as two attributes contributing to the "holding power" or seductiveness of the internet. Webster et al. (1993) argue that perceived flexibility and modifiability of the technology are associated with flow. Based and expanding upon these, others may develop a set of dimensions that would classify a technology's "absorptive" potential. Technology absorptive potential may then be tested as an important antecedent of CA. Furthermore, future research may focus on identifying additional consequents of CA. We only examined the effect of cognitive absorption on perceived usefulness, perceived ease of use, and behavioral intention to use. Others might seek to explore effects of cognitive absorption on additional dependent variables such as infusion, reinvention, and intentions to explore (Agarwal 2000).

Finally, for researchers interested in examining CA further, many additional areas for future research remain. The research model could be tested using covariance-based techniques such as LISREL, which would permit a closer examination of the dimensions of CA as second order factors and allow us to isolate the effects of individual dimensions on technology acceptance beliefs and behavioral intention. In our study, we measured the state of cognitive absorption retrospectively. An ideal examination of this state would be during the activity that is its cause (i.e., the human-computer interaction), or immediately following the activity, as was done by Webster and Martocchio (1995). This suggests the need for longitudinal as opposed to cross-sectional studies, with the evaluation of PIIT and CPS, both relatively stable individual traits, preceding the computer interaction, the measurement of CA immediately following the interaction, and beliefs being gathered at a later point in time.

From the perspective of practice, three rich, important implications follow. First, our results point to the importance of eschewing a strictly utilitarian perspective on the usage of information technologies. As technology developments continue to focus on richer and more appealing interfaces, the importance of experiences that are intrinsically motivating, i.e., pleasurable and enjoyable in and of themselves, might dominate as predictors of usage intentions. For instance, as noted by Webster and Martocchio (1992), play represents an extremely important aspect of work. Managers desirous of successfully implementing new IT need to be cognizant of this relationship and strive to create an organizational environment that not only encourages experimentation and exploration with new technologies, but also offers opportunities for cognitive absorption. Prospective users need to believe that they can enjoy new technologies without fear of organizational censure; such enjoyment will then likely exhibit a positive influence on their intentions to use the information technology.

A second key implication for managers relates to prescriptions about the design of information systems and of training programs. Cognitive absorption is likely to be experienced with technologies that are visually rich and appealing. Moreover, the technology should provide users with a sense of being in command of the interaction through judicious use of help menus and hot keys that support easy and intuitive navigation (Shneiderman 1987). Paying close attention to such features of an information system would assist those responsible for the diffusion of new technologies via the direct effect of CA on behavioral intention. Training programs can also be designed to provide potential users with opportunities for cognitive absorption. Game-based training environments are more enjoyable (Venkatesh 1999) and more likely to result in cognitive absorption, thus amplifying both beliefs about the instrumentality of the technology and its ease of use, as well as enhancing its adoption and diffusion throughout the organization.

A final implication follows from the nature of the technology used to test the research model in this study. The explosion of e-commerce (Kalakota and Robinson 1999) has elevated the importance of user reactions to web site design. As observed by Hoffman and Novak (1996), the web offers marketers a new medium for advertising and selling that challenges the assumptions underlying most traditional media used for such purposes where the consumer is largely regarded as passive and captive. To the extent that marketers would find value in keeping consumers on their site for longer periods of time, the ability of the site to induce a state of CA provides some indication of how compelling it is for the user. Thus, usability testing of web sites in lab settings could include measures of CA as one dimension of the overall quality of the web site.

In conclusion, the overarching goal in this paper was to enrich our understanding of user reactions to information technology. We described a construct called cognitive absorption that was shown to play a significant role in the context of a nomological network, which included important constructs from prior research. Given the undeniable reality that IT is ubiquitous in business and personal settings, such research has value for theory development as well as for practice. Several avenues for future work remain and we hope this study will stimulate others to extend this line of research further.

## Acknowledgements

The authors express their gratitude for the assistance of the Senior Editor, an anonymous Associate Editor, and four anonymous reviewers whose comments have helped improve this paper considerably.

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# Appendix

## Scales and Items

### Cognitive Absorption

*Temporal Dissociation*
TD1. Time appears to go by very quickly when I am using the Web.
TD2. Sometimes I lose track of time when I am using the Web.
TD3. Time flies when I am using the Web.
TD4. Most times when I get on to the Web, I end up spending more time that I had planned.
TD5. I often spend more time on the Web than I had intended.

*Focused Immersion*
FI1. While using the Web I am able to block out most other distractions.
FI2. While using the Web, I am absorbed in what I am doing.
FI3. While on the Web, I am immersed in the task I am performing.
FI4. When on the Web, I get distracted by other attentions very easily.
FI5. While on the Web, my attention does not get diverted very easily.

*Heightened Enjoyment*
HE1. I have fun interacting with the Web.
HE2. Using the Web provides me with a lot of enjoyment.
HE3. I enjoy using the Web.
HE4. Using the Web bores me.

*Control*
CO1. When using the Web I feel in control.
CO2. I feel that I have no control over my interaction with the Web.
CO3. The Web allows me to control my computer interaction.

*Curiosity*
CU1. Using the Web excites my curiosity.
CU2. Interacting with the Web makes me curious.
CU3. Using the Web arouses my imagination.

## Perceived Ease of Use

PEOU1. Learning to operate the Web is easy for me.
PEOU2. I find it easy to get the Web to do what I want it to do.
PEOU3. It is easy for me to become skillful at using the Web.
PEOU4. I find the Web easy to use.

## Perceived Usefulness

PU1. Using the Web enhances my effectiveness in college.
PU2. Using the Web enhances my productivity.
PU3. I find the Web useful in my college activities.
PU4. Using the Web improves my performance in college.

## Personal Innovativeness

PIIT1. If I heard about a new information technology, I would look for ways to experiment with it.
PIIT2. In general, I am hesitant to try out new information technologies.
PIIT3. Among my peers, I am usually the first to try out new information technologies.
PIIT4. I like to experiment with new information technologies.

## Playfulness

CPS1. When using the Web I am Spontaneous.
CPS2. When using the Web I am Imaginative.
CPS3. When using the Web I am Flexible.
CPS4. When using the Web I am Creative.
CPS5. When using the Web I am Playful.
CPS6. When using the Web I am Original.
CPS7. When using the Web I am Inventive.

## Behavioral Intention to Use

BI1. I plan to use the Web in the future.
BI2. I intend to continue using the Web in the future.
BI3. I expect my use of the Web to continue in the future.

## Self Efficacy

Often we are told about software packages that are available to make work easier. For the following questions, imagine that you were given a new software package for some aspect of your work. It doesn't matter specifically what this software package does, only that it is intended to make your work easier and that you have never used it before.

The questions below ask you to indicate whether you could use this unfamiliar software package under a variety of conditions. For each of the conditions, please indicate whether you think you would be able to complete the work using the software package. Circle either "Yes" or "No." Then, for each condition that you answered "Yes," please rate your confidence about your first judgment, by writing in a number from 1 to 10, where 1 indicates "Not at all confident," and 10 indicates "Totally confident." You may enter any number in this range.

**I could complete the job using the software package...**

| | | Yes/No | Confidence (1-10) |
|---|---|---|---|
| SE1. | ..if there was no one around to tell me what to do as I go. | Yes No | ________ |
| SE2. | ..if I had never used a package like it before. | Yes No | ________ |
| SE3. | ..if I had only the software manuals for reference. | Yes No | ________ |
| SE4. | ..if I had seen someone else using it before trying it myself. | Yes No | ________ |
| SE5. | ..if I could call someone for help if I got stuck. | Yes No | ________ |
| SE6. | ..if someone else had helped me get started. | Yes No | ________ |
| SE7. | ..if I had a lot of time to complete the job for which the software was provided. | Yes No | ________ |
| SE8. | ..if I had just the built-in help facility for assistance. | Yes No | ________ |
| SE9. | ..if someone showed me how to do it first. | Yes No | ________ |
| SE10. | ...if I had used similar packages like this one before to do the job. | Yes No | ________ |