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ABSTRACT

Traditional TAM research primarily focuses on utilitarian systems where extrinsic motivations chiefly explain and predict acceptance. We propose a theoretical model, ISAM, which explains the role of intrinsic motivations in building the user attention that leads to hedonic system acceptance. ISAM combines several theories with TAM to explain how interactivity acts as a stimulus in hedonic contexts—fostering curiosity, enjoyment, and the full immersion of cognitive resources. Two experiments involving over 700 participants validated ISAM as a useful model for explaining and predicting hedonic system acceptance. Immersion and PE are shown to be the primary predictors of behavioral intention to use hedonic systems. Unlike traditional utilitarian adoption research, PEOU does not directly impact BIU, and extrinsic motivations are virtually non-existent. The implications of this study extend beyond hedonic contexts, as users of utilitarian systems continue to demand more hedonic features and enjoyment is often more important than PEOU.

Keywords

Technology acceptance model (TAM), immersion, enjoyment, interactivity, curiosity, hedonic, utilitarian, gaming, adoption, behavioral intention to use, perceived ease-of-use, control, interactivity-stimulus-attention model (ISAM), flow, attention, stimuli.

INTRODUCTION

Attention is the voluntary and alert process of a person selectively devoting limited cognitive capacity to a source of information or input (Posner and Boies, 1971). The purpose of attention is “to focus the human cognitive capacity on a certain sensory input so that the brain can concentrate on processing information of interest” (Biocca et al., 2007, p. 167). Attention is a scarce resource because of limited cognitive capacity, and to increase adoption, systems need to be designed to capture this scarce resource (Biocca et al., 2007).

TAM researchers have traditionally explained the motivation to give attention (and related behaviors) to systems in terms of intrinsic and extrinsic motivation (Koufaris, 2002). TAM was initially built on extrinsic motivation (Davis, 1989, Davis et al., 1989); however, intrinsic motivation often guides human behavior more powerfully than extrinsic motivation (Thomas and Velthouse, 1990), which is one reason why intrinsic motivation, in the form of perceived enjoyment (PE), was added to TAM (Davis et al., 1992). Still, this addition has been downplayed because most TAM research focuses only on utilitarian systems (van der Heijden, 2004, Hsu and Lu, 2007).

Recently, hedonic systems have become increasingly important both socially and economically, and cannot be ignored. The most explosive growth in the computing industry no longer belongs to the business sector. Home and personal computing represent billions of dollars of growth (Brown and Venkatesh, 2005), far outweighing growth in business systems. Home computing, social networking, online communities, blogs, gaming, and so on, have inspired profound changes in how people entertain themselves, how they socialize, and how they spend free time.

These factors have made explaining and predicting intrinsically motivated attention increasingly important in TAM research (e.g., Agarwal and Karahanna, 2000). Utilitarian applications in general are becoming so easy to use that they often require little to no training. Where there already exists a high level of ease-of-use, a focus on making a technology even easier to use may not increase acceptance as much as a focus on making a technology more fun or enjoyable (Huh et al., 2007). In addition, users are more likely to experience satisfaction, PE, and empowerment when they are intrinsically, rather than extrinsically, motivated to use a system. Therefore, the design implications of this social revolution do not just apply to hedonic systems. As people increasingly expect to enjoy system use, hedonic motivations will increasingly affect interactions with utilitarian systems.

Given these opportunities, we focus on intrinsic motivation in hedonic gaming systems. This is an untapped area of research that has vast social and economic importance to which information systems theories can greatly contribute. Increased knowledge of how intrinsically-motivated, gaming-related attention increases PE can potentially improve the design of both hedonic systems and utilitarian systems. Our specific research questions are as follows:

1. What aspects of gaming system interaction elicit and sustain attention?
2. What aspects of gaming system interaction promote PE?
3. How do interactivity, attention, and PE influence intention to use games?

BUILDING THE INTERACTIVITY-STIMULUS-ATTENTION MODEL (ISAM)

To sustain PE in hedonic systems, a user must be intrinsically motivated to invest a high level of attention. An effective, enjoyable game should capture attention to the point where players are so involved that they become completely immersed. Our theory focuses on the stimuli that initially create and then sustain attention in gaming, and ultimately develop into enjoyment, immersion, and intention to use—all in a chain of temporal precedence. We call our theory the *interactivity-stimulus-attention model* (ISAM). This chain of increasing attention is explained in four stages.

Stage 1: Interactivity as a Key Attention Stimulus

A key construct of interest that game designers wish to maximize is attention, with immersion being the highest form of attention (Brown and Cairns, 2004). An enjoyable game must give players reasons to give it their attention and concentration through interesting stimuli that are worth attending to.

The basis for attention theory is that various stimuli compete both to capture a person's attention and to be processed by his or her limited cognitive capacity (Posner et al., 1980). For attention to occur, a stimulus must be given that continues to capture a subject's notice and cognitive processing; this is enhanced by the alertness caused by novelty and diminished by boredom. When focused attention occurs, one focuses on an isolated field of attention somewhat like a spotlight, where the efficiency of detecting events and signals within the spotlight is enhanced and everything outside the spotlight becomes peripheral and harder to detect (Posner et al., 1980).

We posit that the design and implementation of *interactivity* between a user and a system is a critical stimulus of immersion that is especially pertinent to gaming. Moreover, every major description of gaming immersion cites high levels of interactivity as essential, because gaming is not a passive activity. Therefore, "interaction is considered one of the most important aspects related to optimal experience with computer games" (Choi and Kim, 2004, p. 13).

Although the gaming literature is clear in showing that interactivity is a critical stimulus for and a critical aspect of gaming, no gaming literature explains how interactivity helps to create immersion or fully explains what interactivity is. Thus, we start by providing a more complete conceptualization of interactivity, and explain how it drives ISAM in terms of attention and intrinsic motivation. An in-depth review of the interdisciplinary literature on interactivity shows that it is comprised of three subconstructs: control, two-way communication, and synchronicity. *Control* is the ability to manage the communication experience, including the ability to interrupt, to be spontaneous and unpredictable, to adapt the interaction to one's desires, to make choices, and to be generally in charge of an interaction. *Two-way communication* is a form of reciprocal communication where one or more senders and one or more receivers (human or system) communicate with each other. *Synchronicity* refers to "the degree to which users' input into a communication and the response they receive from the communication are simultaneous . . ." (Liu and Shrum, 2002, p. 55). Thus, we define *interactivity* as the degree to which an interaction involving people and a system exhibits control, two-way communication, and synchronicity.

As a defining and essential stimulus in gaming, interactivity is a baseline expectation for gamers, and sufficiently high levels of interactivity must be present within a game to act as a stimulus to capture and hold users' attention (Choi and Kim, 2004), as well as to provide intrinsic motivation. Otherwise, boredom, which breaks both attention and the stimulus stream, is likely to occur.

The most effective stimuli for fostering focused attention are typically sensory-oriented, such as visual and auditory stimuli (Bundesen et al., 2005). The use of graphics and sound are additional and often crucial supplemental stimuli.

Stage 2: Curiosity Arousal

If attention is captured from the stimulus of interactivity, we posit that sufficient conditions are met to create curiosity. Curiosity is an increase in interest or "a heightened arousal of sensory and cognitive curiosity" (Agarwal and Karahanna, 2000, p. 668), representing heightened attention or "increased perception of stimuli" (Berlyne, 1954, p. 180). If curiosity is never created or maintained, then a user does not progress to the deeper levels of attention and ceases involvement with the game.

H1. Interactivity increases curiosity.

Stage 3: Perceived Enjoyment

If a user gives heightened attention due to sustained interactivity and curiosity, then he or she is ready to experience PE, which requires higher levels of attention. *PE* is "the extent to which the activity of using a specific system is perceived to be enjoyable in its own right, aside from any performance consequences resulting from system use" (Venkatesh, 2000, Hsu and Lu, 2007). PE occurs when increased attention and involvement in the interaction provide the expected satisfaction (Choi and Kim, 2004, Huh et al., 2007). If PE is not created in gaming, a user will never enter the deepest level of attention—immersion.

Curiosity is especially important for sustaining PE in the context of interactive gaming, where novelty and interest are at a premium and must continue throughout a gaming experience to prevent player boredom, apathy, and disinterest. In sum,

H2. Curiosity increases PE.

Stage 4: Immersion

If a user continues to experience interactivity, curiosity, and PE, he or she can then experience the highest level of attention and intrinsic motivation, which is *immersion*. We consider immersion to be equivalent to the combination of focused immersion and temporal dissociation. In an intrinsically motivated task, such as gaming, PE needs to be present for immersion to occur (Brown and Cairns, 2004). In sum,

H3. PE increases immersion.

ISAM Assumptions and Limitations

A key assumption and limiting factor of our model is that, although there is a natural progression in attention (and intrinsic motivation) from interactivity to curiosity to PE to immersion, each characteristic of the lower stages must be sustained for immersion to be sustained. The chain cannot be broken. Likewise, it is likely that these constructs reinforce each other in a system of feedback loops. Though such feedback loops likely reflect reality, our basic model is linear to balance between explanatory power and parsimony.

ISAM Extensions to and Replications of TAM

To increase ISAM's nomological validity, we replicate and extend the key TAM predictions that complement ISAM. Namely,

H4a. PEOU increases BIU.
H4b. PE increases BIU.
H4c. PEOU increases PE.
H4d. Immersion increases BIU.
H4e. Interactivity increases PEOU.
H5a. Computer playfulness increases PEOU.
H5b. Computer anxiety decreases PEOU.
H5c. Computer self-efficacy increases PEOU.
H5d. Gaming experience increases computer self-efficacy.
H5e. Personal innovativeness increases computer self-efficacy.
H6a. Increased computer playfulness will increase the PE of games.
H6b. Increased computer anxiety will decrease the PE of games.
H6c. Increased computer self-efficacy will increase the PE of games.

Our research of hedonic systems involved two studies – a thought experiment and a controlled laboratory experiment.

STUDY 1 METHOD

Design

Study 1 was an online experiment with a two * two * four factorial design that manipulated interactivity (high vs. low), PE (high vs. low), and scenario type (four different types of hedonic programs). Scenario type was added to add more generalizability to the experiment by presenting four different scenarios that would induce different levels of interactivity and PE. The total number of conditions was 16. Each participant was randomly assigned to one of the 16 conditions.

Participants

A total of 491 participants from a large private university in the Western U.S. were involved in Study 1. Participants were primarily from eleven sections of a sophomore-level introductory information systems course.

Procedures

Unlike in Study 2, in Study 1 the participants did not actually play a game. Instead, each participated in a thought experiment, during which the participant was given a carefully written scenario and provided mock screen shots that carefully manipulated the level of PE and interactivity. Participants then completed a survey about their impressions based on the treatment they received.

STUDY 1 ANALYSIS

Since we created a complex path model, the major analysis was completed through structural equation modeling using PLS. We first determined which constructs were formative and which were reflective, and performed construct validity checks accordingly. The reflective constructs demonstrated adequate reliability, convergent validity, and discriminant validity. We used a modified multitrait-multimethod approach to validate our formative constructs (computer playfulness and computer self efficacy), as built on and demonstrated in (Loch et al., 2003). This analysis established the validity of the formative constructs. The following table summarizes the results of study 1:

Hypotheses and corresponding paths	β	*t*-value

		(*df* = 491)
H1. Interactivity → Curiosity	0.694	***24.40
H2. Curiosity → Enjoyment	0.794	***35.12
H4c. PEOU → Enjoyment	0.182	***6.55
H3. Enjoyment → Immersion	0.917	***101.30
H4a. PEOU → BIU	0.062	*2.35
H4b. Enjoyment → BIU	0.688	***12.62
H4d. Immersion → BIU	0.183	**3.23
H4e. Interactivity → PEOU	0.721	***26.87
H5a. Playfulness → PEOU	0.101	**2.86
H5b. Computer anxiety (-) → PEOU	-0.046	1.02 (ns)
H5c. CSE → PEOU	0.011	0.31 (ns)
H5d. Gaming experience → CSE	0.129	*2.16
H5e. Personal Innovativeness → CSE	0.380	***7.40
H6a. Playfulness → Enjoyment	0.027	1.10 (ns)
H6b. Computer anxiety (-) → Enjoyment	-0.010	0.45 (ns)
H6c. CSE → Enjoyment	-0.038	1.14 (ns)

STUDY 2 METHOD

Design

Study 2 was a controlled laboratory experiment where participants played commercial games that had different levels of interactivity and PE. This resulted in an online experiment with a two * two factorial design that manipulated interactivity (high vs. low) and PE (high vs. low). Each participant was randomly assigned to one of the four conditions.

Participants

A total of 212 students were involved in this experiment. Of these, 100 participants were students at a large private university in the Western U.S. and 112 participants were students at a large public university in the Southeastern U.S.

Procedures

Study 2 had more control, as it followed the pattern of a traditional laboratory experiment. Participants were randomly assigned to a laboratory session that included only one game condition. Participants were given rules to ensure that all results were individualized and all sessions followed the same facilitator script. Participants played their assigned game for exactly 15 minutes, and then filled out the post-experiment survey online.

STUDY 2 ANALYSIS

Because Study 2 analyzed the same theoretical model as Study 1, but with a different dataset, exactly the same procedures were used to establish construct validity. Given this analysis, we concluded that the constructs demonstrated adequate reliability, convergent validity, and discriminant validity. The following table summarizes the results of study 2:

Hypotheses and corresponding paths	**β**	***t*-value (*df* = 212)**
H1. Interactivity → Curiosity	0.470	***6.61
H2. Curiosity → Enjoyment	0.456	***8.98
H4c. PEOU → Enjoyment	0.494	***7.74
H3. Enjoyment → Immersion	0.641	***14.79
H4a. PEOU → BIU	-0.058	0.56 (ns)
H4b. Enjoyment → BIU	0.490	***4.07
H4d. Immersion → BIU	0.300	***3.87
H4e. Interactivity → PEOU	0.445	***6.64
H5a. Playfulness → PEOU	0.150	1.02 (ns)
H5b. Computer anxiety (-) → PEOU	-0.061	1.82 (ns)
H5c. CSE → PEOU	0.078	0.90 (ns)
H5d. Gaming experience → CSE	0.039	0.26 (ns)
H5e. Personal Innovativeness → CSE	0.398	***3.69
H6a. Playfulness → Enjoyment	-0.030	0.49 (ns)
H6b. Computer anxiety (-) → Enjoyment	-0.002	0.03 (ns)
H6c. CSE → Enjoyment	-0.051	0.81 (ns)

DISCUSSION

The most important finding of Study 1 fully supports ISAM; namely, we were able to demonstrate the relationship between interactivity, curiosity, PE, and immersion, extended to BIU and PEOU. We also confirmed our second-order conceptualizations of interactivity and immersion.

Importantly, the traditional TAM path between PEOU and BIU dropped out of the model. This indicates that the intrinsically motivated constructs of PE and immersion are much stronger determinants of BIU in a hedonic context. However, PEOU remains an important determinant of PE. Another key theoretical finding is that all of the personal disposition constructs dropped out of the model, with the exception of the path between computer playfulness and PEOU. This is particularly fascinating considering that these were constructs and relationships established in utilitarian contexts.

The key objective of Study 2 was to try to replicate the key theoretical findings of Study 1 in a controlled laboratory environment, using commercial games to enhance the verification of the generalizability of ISAM and the initial findings of Study 1. Impressively, despite being conducted in a very different context and environment, Study 2 virtually replicated the results of Study 1, showing the potential reliability of our theory. The only difference, other than differences in path strengths and t-statistics, is that in Study 2 the path between computer playfulness and PEOU dropped out of the model. By using real games in Study 2, we could not control the intended manipulations as precisely as we did in Study 1; however, this was clearly offset by the more controlled and realistic nature of Study 2. Importantly, the same dispositional constructs also dropped out of the Study 2 model as they did in Study 1. This provides strong support for ISAM in a gaming context and for the notion that intrinsic motivation dominates in gaming scenarios.

Contributions to Theory and Practice

The key contribution of our study was that we built an innovative theoretical model, ISAM, which provides a new explanation and prediction for highly hedonic systems. This is in contrast to traditional utilitarian systems, which were best explained by TAM. Specifically, ISAM explains how sustained interactive stimuli combine with strong intrinsic motivations to induce attention. This, in turn, leads to curiosity, enjoyment, and immersion (the ultimate state of attention that hedonic system designers wish to induce) in hedonic gaming systems.

PE and immersion are the most important determinants of BIU in a gaming context; interactivity is the major determinant of PEOU in our context, and PEOU is a factor that influences PE.

By providing the strongest explanation of hedonic system adoption to date, ISAM can lead designers to create immersive behavior that leads to prolonged system use, which is critical in online systems, and increased BIU, which drives hedonic systems sales. Our finding may portend the increased importance of intrinsic motivation in utilitarian systems. As this increasingly becomes the case, and as was previously called for (Litman, 2005), utilitarian software designers will need to shift design and development to focus more on intrinsic motivations and needs.

We also show that traditional, personal-disposition constructs—such as computer playfulness, computer anxiety, computer self-efficacy, and personal innovativeness—were not very important in establishing enjoyable and immersive gaming experiences in our studies. This is particularly notable because such constructs were previously shown to have a large impact in utilitarian TAM experiments (e.g., Venkatesh, 2000). Assuming this holds in other gaming contexts, this finding is highly salient to designers of games and other systems that are primarily hedonic (e.g., social networking, blogging, and text messaging), as well as those who want utilitarian software to benefit from gaming design concepts. Our findings suggest that designers need to concentrate on features that induce interactivity and PE, and not worry as much about designing to different kinds of users based on demographic differences. Thus, our model holds for all types of users.

Conclusion

Traditional technology acceptance research primarily focuses on utilitarian systems where extrinsic motivations, rather than intrinsic motivations, primarily explain and predict acceptance. Little research has been done in the way of hedonic system acceptance, where extrinsic motivations are virtually non-existent and intrinsic motivations dominate.

We conclude that hedonic systems are likely to be more enjoyable when they use principals of interactivity to attract and maintain attention via intrinsic motivation. Hedonic systems with a greater ability to envelop a user's attention are much more likely to be adopted. The model and results of this study provide useful guidance in practice to the design of hedonic systems. The implications of this study extend beyond hedonic contexts, as users of utilitarian systems continue to demand more hedonic features. Our results apply to systems use where intrinsic motivations, such as enjoyment, are often more important than PEOU.

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