5-2013

The changing nature of user attitudes toward virtual world technology: A longitudinal study

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Abstract

Virtual world technologies have been utilized in gaming for a number of years but only recently have they been applied as a serious tool for business. Many business applications have been identified, including the use of virtual worlds for team collaboration, training, and education, but a question remains about whether users will accept the premise that virtual worlds represent useful environments for engaging in business functions. We address this question by examining user reactions to virtual worlds. The first study looks at attitudes of users of the virtual world Second Life during three time periods (i.e., before exposure to the environment, after an information session and discussion of Second Life, and after use of the environment). Two variables, user acceptance of virtual world technologies and user self-efficacy, were examined as the primary dependent measures. Results show that while self-efficacy increases over time, user acceptance decreases in a highly correlated pattern. A second study investigates the underlying causes of the observed pattern of user acceptance using a content analysis of written reflections of user experiences. Both studies paint a detailed picture of user intentions and some of the reasons these intentions developed after use. The paper concludes with a discussion of the implications of these results for business managers and researchers.

Keywords

Virtual worlds, Technology acceptance, Longitudinal, Self-efficacy, Content analysis

Disciplines

Management Information Systems

Comments

This is the accepted manuscript of an article from *Computers in Human Behavior* 29 (2013): 1122–1132, doi:10.1016/j.chb.2012.10.004.

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A Longitudinal Study

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ABSTRACT

Virtual world technologies have been utilized in gaming for a number of years but only recently have they been applied as a serious tool for business. Many business applications have been identified, including the use of virtual worlds for team collaboration, training, and education, but a question remains about whether users will accept the premise that virtual worlds represent useful environments for engaging in business functions. We address this question by examining user reactions to virtual worlds. The first study described in this paper looks at attitudes of users of the virtual world Second Life during three time periods (i.e., before exposure to the environment, after an information session and discussion of Second Life, and after use of the environment). Two variables, user acceptance of virtual world technologies and user self-efficacy, were examined as the primary dependent measures. Results show that while self-efficacy increases over time, user acceptance decreases in a highly correlated pattern. A second study investigates the underlying causes of the observed pattern of user acceptance using a content analysis of written reflections of user experiences. Both studies paint a detailed picture of user intentions and some of the reasons these intentions developed after use. The paper concludes with a discussion of the implications of these results for business managers and researchers.

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1 INTRODUCTION

Video games are enjoyable and engaging, at least that is what many "technology enthusiasts" would say. Games allow the user to forget their worries and immerse themselves in a virtual world that is often quite different from the real world they physically inhabit. While not the real world, virtual worlds can offer a more stimulating and engaging environment compared to other online communication and collaboration tools such as email, chat, or instant messaging.

While virtual worlds may offer an engaging gaming and recreation experience for users, an important question facing individuals and corporations considering the adoption of virtual worlds is whether these environments have relevance to the business world? Various research directions for and application of virtual worlds for business have been suggested (Mennecke et al., 2008; Wasko, Teigland, Leidner, & Jarvenpaa, 2011), but one promising application is the use of virtual worlds for team collaboration activities in organizations (Brown, Fuller, & Vician, 2004). This is because virtual worlds enable those who are not in geographic proximity to more easily communicate, interact, and collaborate on projects in ways that mimic how we interact when physically proximate to one another. One benefit of this is that for many tasks virtual worlds can be used to enhance the perception of physical proximity, thereby creating a more fulfilling and enjoyable experience for users. An important question is whether and how exposure to these environments and the resultant perceptions will influence user intentions related to the adoption of these technologies for business applications?

The relationship between user attitudes and their exposure to technology as well as their subsequent intentions to adopt has been the focus of study in information systems for the last two decades. The technology acceptance model (TAM) and derivative theories (e.g., the Unified Theory of Acceptance and Use of Technology, UTAUT) have demonstrated that various factors influence the intention to adopt a new technology. These factors include the user's expected performance utilizing the technology, the effort expected to learn the technology, and the influence of others who believe in the technology (Venkatesh, Morris, Davis, & Davis, 2003). Additionally, attitudes are also influenced by how the user learns about a new technology. Specifically, the concept of self-efficacy has been shown to be an important factor influencing user attitudes and future use of technologies (Bandura, 1986; D. R. Compeau & Higgins, 1995; Marakas, Johnson, & Clay, 2007).

Research surrounding the effective utilization of virtual world technologies for business collaboration is important in the evaluation of whether and how this technology can be used in organizational contexts. Various studies have looked at both the user acceptance of virtual world technology as well as self-efficacy of users of the technology (Fetscherin & Lattemann, 2008; Holsapple & Wu, 2007; Hsu & Lu, 2004). One area that has been overlooked and which has both theoretical and practical import is the interplay between technology acceptance, self-efficacy, and the nature and time of exposure. In summary, when self efficacy is improved the likelihood that a user will use the technology in the future will be greater; thus, understanding the relationship between exposure to a technology, attitudes towards a technology, and the reasons why users develop these attitudes will be important to researchers and practitioners alike. Given this, our research aims to examine these relationships by utilizing a longitudinal study of users' initial vicarious and subsequent hands-on experiences with virtual world technology (Bandura, 1986). Furthermore, technology acceptance, task specific self-efficacy, and the relationship between these variables are examined in this model. As we explain below, technology acceptance is expected to be influenced not only by perceptions related to performance, effort, and the influence of others, but also by a user's perceptions of self-efficacy. This relationship is examined in the context of business applications, which represent an important application domain for study because of the high expectations that have built up concerning business applications of virtual worlds. Our research aims to address a fundamental question; do business professionals exposed to a virtual world expect that they would adopt virtual worlds for use as a business tool? The answer to this fundamental question is important because it may help to explain the somewhat anemic growth of virtual worlds for business applications.

The longitudinal component of our study will help to show how self-efficacy and technology acceptance vary over time with regard to the use of virtual world technology. Nevertheless, as is the case with many survey-based studies, questions remain as to *why* the observed relationships exist? To help answer the questions raised by the survey responses, a second study is used to explore in greater depth why individual attitudes change with regard to virtual world technology over time. A content analysis of user reflections of an activity performed in Second Life help to explain why user attitudes change.

The rest of this article is organized as follows. The background section provides context information regarding virtual worlds, technology acceptance, and self-efficacy. Data collection and results of the studies are detailed in the following two sections. A discussion follows detailing the implications of the findings. Finally, limitations and future avenues of research are discussed.

2 BACKGROUND

2.1 Virtual Worlds

Virtual world technologies have been utilized for many years by a number of different types of users for a wide variety of applications. The most common application has been for entertainment and competitive game play. Gaming platforms such as World of Warcraft™[1], The SIMS™[2], EverQuest™[3], and other similar technologies offer users the opportunity to engage in goal-oriented social gaming in three-dimensional, avatar-centric environments. It is only recently that scholars in the information systems community, a scholarly community focused on studying the intersection of technology and business, have begun to seriously investigate virtual world technologies and applications for business (Dev, Youngblood, Heinrichs, & Kusumoto, 2007; Mennecke, et al., 2008; Rickel & Johnson, 2003). Virtual worlds provide advantages compared to other collaboration and communication technologies because virtual environments resemble the three-dimensional physical world that humans are familiar with (Durlach et al., 2000; Turner & Turner, 2006). This suggests that these environments have the potential to support geographically dispersed team members in a variety of team functions that are benefited by proximity, serendipity, and propinquity. As a consequence, for many team activities the constraints imposed by a lack of physical proximity can be reduced or eliminated by members using virtual worlds to conduct meetings, hold seminars, or collaborate on a project. Given the increasing importance of virtual teams and telework, virtual worlds hold the promise of supporting many business-related functions and tasks.

Second Life™[4] is a virtual world technology that allows users to live out a virtual "life" online. Unlike other virtual world technologies, Second Life is targeted at adults and does not have one shared goal, theme, or objective embedded in the game infrastructure. In fact, the inspiration for Second Life is the book Snow Crash, where a *metaverse* was described in which users could explore in a physically unfettered manner alternative realities and representations (Stephenson, 1992). Second Life is a unique environment because it is an open economy, users are granted intellectual property rights to content they create, and the somewhat "open" economic features of the environment encourage entrepreneurial activities (Mennecke, et al., 2008). While the vast majority of "business" conducted in Second Life is represented by small, often sole proprietor businesses, larger corporate interests have explored applications of Second Life for collaboration, marketing, customer service, and training. For example, large corporations such as IBM, Best Buy, and Cisco were early adopters, built sophisticated Second

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1 http://www.worldofwarcraft.com/index.xml
2 http://www.thesims3.com/
3 http://everquest.com/
4 http://secondlife.com/

Life Islands, and, in some cases, engaged in serious efforts to engage in business applications such as marketing, team collaboration, personnel training, and product development (Ganis, Hall, & McNeill, 2008; Mennecke, et al., 2008). Nevertheless, while a number of medium and large sized businesses still have a presence in Second Life, many early adopters quickly departed after initial ventures failed to garner significant customer interest. An important question this raises is what factors influence business users to accept or reject future use of virtual worlds after they have used the environment. While many of these decisions were likely made based on ROI or site "hit" rates, it may also be the case that the attitudes of business users influence the longer-term decisions made by corporate decision makers. For example, if representatives of a firm like IBM were frequently rebuffed by business partners when they attempted to conduct business in a virtual world, this type of individual-level feedback might lead to decisions focused on curtailing future investments in virtual world ventures.

Figure 1. Second Life classroom utilized for study 1.

2.2 Technology Acceptance

Technology acceptance has become an established measure for technology use and, ultimately, has been used as a predictor of the likelihood of the adoption of technology. The technology acceptance model (TAM) was first offered by Davis in 1989, and postulated that the constructs of *Perceived Usefulness* and *Perceived Ease of Use* would be antecedents of the *Behavioral Intent* of an individual to use a technology (F. D. Davis, 1989). The theory was adapted from both the Theory of Reasoned Action (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975) and the Theory of Planned Behavior (TPB) (Ajzen, 1985).

TAM proved to be a useful predictor of behavior in a number of contexts and the theory garnered a considerable following; yet, while the original model was elegant, the relatively small number of variables limited its generalizability and usefulness in various contexts. As a result, numerous derivative versions of TAM have been proposed since its inception. For example, TAM2 added the construct of *Subjective Norms* as a predictor variable (Venkatesh & Davis, 2000). Subsequently, the Unified Theory of Acceptance and Use of Technology (UTAUT) was offered as a more encompassing theory of technology acceptance (Venkatesh, et al., 2003). This model combines models and theories of individual acceptance including TRA, TAM, TPB, the Motivational Model (F.D. Davis, 1992), the Model of PC Utilization (MPCU) (Thompson, Higgins, & Howell, 1991), Innovation and Diffusion Theory (IDT) (Rogers, 1995), and Social Cognitive Theory (Bandura, 1986; D. R. Compeau & Higgins, 1995). The UTAUT model proposes that Performance Expectancy, Effort Expectancy, and Social Influence together predict Behavioral Intention and Behavioral Intention along with Facilitating Conditions predict Use Behavior.

Researchers examining technology acceptance have focused on various outcome measures to examine the relationship between antecedents and adoption. Specifically, most of the literature in this domain has examined the intent of users to utilize the system, while a small subset of research has focused on actual measured system use. Given that we are interested in the intent of users to utilize virtual world technologies in the future, our research will focus on the more common outcome measure; that is, Behavioral Intention. Figure 2 shows the UTAUT model with each of the components of the model examined in this research.

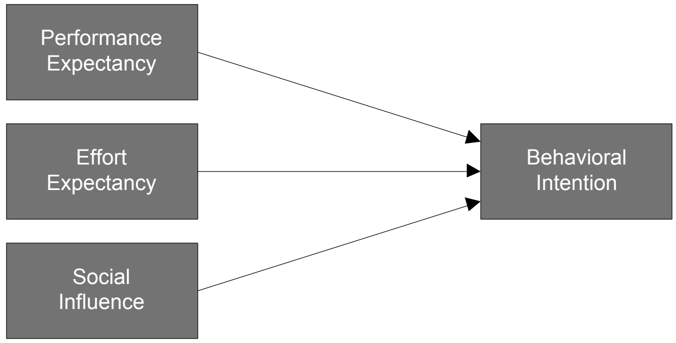

Figure 2. UTAUT model highlighting measures utilized in the current study.

A user's adoption intention for a technology such as Second Life is a key factor leading to the use of the technology in business applications such as virtual teams. In order for teams to function with maximum potential, the members must recognize and accept the potential usefulness of any given virtual world technology as the medium for participant interaction. Furthermore, a user must believe he or she has the capability to use the technology for its stated purpose. For example, factors I might consider when determining whether I would use a technology include whether the technology is something I will encounter difficulty with using, whether I possess the skills needed to utilize the technology, and whether my computer infrastructure adequately supports the use of this technology? Additionally, the hedonic tendencies of a potential user and contextual factors have also been shown to be important when investigating user acceptance of virtual world technology (Holsapple & Wu, 2007). For example, community factors have been shown to be an important construct that should be controlled for when measuring user acceptance of virtual worlds (Fetscherin & Lattemann, 2008). Additionally, social influence and flow experience have been shown to be significant in user acceptance of virtual worlds (Hsu & Lu, 2004).

A final, yet underappreciated, consideration in the evaluation of technology acceptance is the temporal nature of the factors influencing attitudes and, ultimately, behaviors. Most research examining TAM or UTAUT has focused on one-time snapshots of user attitudes or intentions rather than whether and how attitudes change over time. Yet, individuals' attitudes and beliefs about their likelihood of being a successful user are likely to change over time as they develop experiences with a technology or as their own skills change. For example, as users learn more about the benefits and costs associated with using a technology, they will weigh the net balance of these factors in their evaluation of whether they will use the technology. A potential user who, for example, knows little about virtual worlds (e.g., they know little or nothing about virtual worlds or have only heard about them from press reports) will presumably react to the Second Life environment quite differently compared to when the same user has been exposed to a more thorough description of the environment or after they have actually used the environment. Prior research that has examined attitudes toward technology acceptance has shown that these attitudes do shift as users learn more about the technology through training (Venkatesh & Speier, 1999) or as they experience the technology through use of the technology (Venkatesh & Davis, 2000; Venkatesh, Speier, & Morris, 2002). Also, as users become more familiar with a technology they begin to see its relevance or, alternatively, irrelevance to their job (Hu, Clark, & Ma, 2003). By studying technology acceptance over time, a greater understanding of the formation of attitudes can be garnered, which can help to better influence new product development and implementation. Given this, the following hypotheses are offered (a pictorial representation of all the following hypotheses can be seen in Figure 3)

H_1: Subjects who utilize a virtual world environment will show an increase in behavioral intention to use the system as their experience with the system increases over time.

H_2: There will be a significant causal relationship between performance expectancy and behavioral intention to utilize a virtual world environment for subjects as their experience with the system increases over time.

H_{2a}: The initial level of performance expectancy will influence the initial level of behavioral intention to utilize a virtual world environment.

H_{2b}: The change in the level of performance expectancy will influence the change in the level of behavioral intention to utilize a virtual world environment for subjects as their experience with the system increases over time.

H_3: There will be a significant causal relationship between effort expectancy and behavioral intention to utilize a virtual world environment for subjects as their experience with the system increases over time.

H_{3a}: The initial level of effort expectancy will influence the initial level of behavioral intention to utilize a virtual world environment.

H_{3b}: The change in the level of effort expectancy will influence the change in the level of behavioral intention to utilize a virtual world environment for subjects as their experience with the system increases over time.

H_4: There will be a significant causal relationship between social influence and behavioral intention to utilize a virtual world environment for subjects as their experience with the system increases over time.

H_{4a}: The initial level of social influence will influence the initial level of behavioral intention to utilize a virtual world environment.

H_{4b}: The change in the level of social influence will influence the change in the level of behavioral intention to utilize a virtual world environment for subjects as their experience with the system increases over time.

2.3 Self-Efficacy

Self-efficacy is a construct that describes how an individual evaluates his or her own ability to successfully complete a particular task (Bandura, 1986). Self-efficacy has been shown to be an important predictor of behavior because successful task completion depends not only on what you know, but on your personal beliefs about your ability to complete the task (Bandura, 1986). This implies that an individual can improve his or her performance and likelihood of task completion by increasing task-specific self-efficacy (Ramalingam, LaBelle, & Wiedenbeck, 2004).

Self-efficacy is a core construct in social cognitive theory, which argues that learning takes place as a result of observing others and undertaking actions that feed back into perceptions of one's ability and likelihood of completing tasks (Bandura, 1986). Bandura suggests that both vicarious experience and enactive mastery are experiential routes to learning and that each contributes to an individual's self-efficacy beliefs (Bandura, 1986). Vicarious experience increases self-efficacy in an observer by allowing the learner to view someone else completing the same task (Bandura, Adams, Hardy, & Howells, 1980). Through demonstration, the observer is persuaded that his or her ability to successfully complete a task has improved through observing an actor who models appropriate behaviors. Conversely, enactive mastery is thought to offer the most influential source of self-efficacy by allowing the individual to actively participate in activities germane to completing the task (Bandura, 1986). This method, if effectively utilized, can provide the individual with affirmation that he or she can complete the task in the future by engaging in the actions needed to complete the task. While typically looked at as two methods towards improving self-efficacy, many times both approaches are utilized when learning a new skill or technology. Given this, we hypothesize

H_5: Subjects who utilize a virtual world environment will show an increase in task specific self-efficacy towards the system as their experience with the system increases over time.

Research has shown that there is a positive relationship between the beliefs that one has about his or her task self-efficacy and the level of technology acceptance expressed by the individual (D. Compeau, Higgins, & Huff, 1999) and that this relationship changes over time as the product moves from its initial introduction to later stages of implementation. We are not aware of any research that has examined whether vicarious experience and enactive mastery have differing effects on technology acceptance; however, it is reasonable to expect that technology acceptance would be positively related to more effective modes of learning. Given that enactive mastery is usually considered to be a superior mode of learning, enactive mastery would be more strongly associated with acceptance when compared to vicarious modes of learning. Additionally, while researchers have looked at the acceptance of virtual reality technologies longitudinally (Venkatesh & Johnson, 2002), no longitudinal research has yet examined the adoption and use of virtual world technologies for business applications. Given this, we propose the following hypotheses

H_6: There will be a significant relationship between behavioral intention to utilize a virtual world environment and task specific self-efficacy towards the same environment for subjects as their experience with the system increases over time.

H_{6a}: The initial level of behavioral intention to utilize a virtual world environment and the initial level of task specific self-efficacy towards the same environment will be similar for subjects.

H_{6b}: The change in the level of behavioral intention to utilize a virtual world environment and the change in the level of task specific self-efficacy towards the same environment will be similar for subjects as their experience with the system increases over time.

Our expectations regarding the relationship between the variables we have thus far discussed are represented in the research model shown in Figure 3.

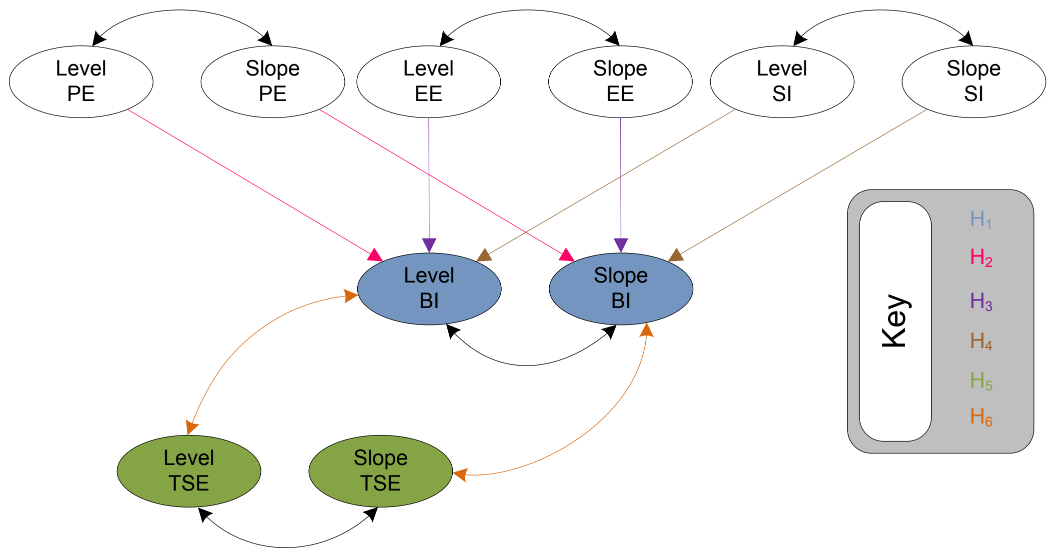

Figure 3. Research hypotheses

3 STUDY 1

3.1 Data Collection

This phase of the research utilized a survey methodology for gathering data related to subject attitudes towards the use of virtual world technology. MBA students in several sections of a graduate-level introductory management information systems (MIS) course at a large US university were exposed to Second Life as part of course activities and these students represent the population from which subjects were recruited. Surveys were administered and collected during the same semester by the same professor. The course included two sections, a full-time section and a part-time section. The full-time section included students who generally had 1-4 years of work experience; however, these students were not employed while they were enrolled in the course. On the other hand, students in the part-time program were generally working full time as business professionals and had an average of 10 years of work experience. All students were “business students,” which means the program exposed them to business concepts that informed them about business operations, strategies, and objectives. Data were collected from subjects in each section at the same time period in the course (i.e., weeks 2, 4, and 7).

The procedures used for all three sections were exactly the same in each section. The first survey was administered the week prior to introducing Second Life to the class. At this point the professor gave only a short description of virtual worlds in general and Second Life specifically. The description was designed to allow the students to have a general idea about virtual world technology so they could intelligently respond to the questions on the survey, but they were given few specifics about the use of Second Life. The survey included the UTAUT items adapted from Venkatesh et al. (Venkatesh, et al., 2003), TSE (task-specific self-efficacy) measures constructed based on research by Marakas pertaining to computer self-efficacy (Marakas, et al., 2007), as well as additional measures not used in this analysis.

The students’ second exposure to the environment was initiated during a subsequent week when students were given a more detailed introduction to the technology by the instructor who provided both a video demonstrating the technology in action as well as a live demonstration of the technology. The video was produced by Linden Lab, the developers of Second Life, and was meant to be an introduction to the technology for novice users by offering an overview of the technology and examples of what users could do and see in the Second Life environment. The instructor also provided a live demonstration in Second Life using a Second Life island sponsored by his university where he had erected a small outdoor virtual arena for conducting lectures. Additionally, the Second Life Island contained other structures that the professor had constructed and used for other classes as well as research within the virtual environment. The instructor gave a quick demonstration showing how to set up, control, and customize an avatar in the virtual environment so they would be prepared to use the environment in a subsequent class session. The students were also shown features of the island and offered a description of some of the activities that students in previous sections of the course had conducted on the island. The students were also assigned a reading describing Second Life, Linden Lab’s history, and possible business applications of virtual worlds. After this introduction, the students were asked to complete the second wave of the survey, which contained only the UTAUT and TSE measures. This second exposure corresponds with

Bandura's (1986) vicarious experience form of self-efficacy as the students watched the professor utilize the Second Life technology.

The students' third and final exposure to the environment was provided during the next week when a class session was held in the virtual classroom on the Second Life Island. All classes were held in the same area and covered the same content during the virtual lecture. Students could either utilize their own avatar or an avatar provided by the instructor. The class consisted of a "traditional" lecture, but this lecture was conducted in the Second Life classroom. After the lecture, students were given time to explore the island and they were invited to the island of another educational institution where the students were given a tour of various business and educational ventures. After this, students were given the third wave of the survey, which included only the UTAUT and TSE measures. This third exposure corresponds with Bandura's (1986) enactive mastery form of self-efficacy as the students interacted with the Second Life technology as a manner of learning to use it. The measures used for the three wabes can be viewed in Appendix A.

3.2 Results

In total, 59 students filled out the three questionnaires, which were administered during the time periods described above. Of the students surveyed, 84 percent had never used Second Life, and of the remaining students the highest reported use was "occasionally." Thirty-six percent had used some other type of virtual world technology (e.g., World of Warcraft, SIMs, etc.). The distribution of students in the classes was 68% males and 32% females. Because individuals who completed all three waves of surveys totaled 59 and the analysis was conducted over three time periods, the combined set of responses effectively became a "group level" variable in the model, which means that we had a total of 177 observations at the lower level (i.e., 59 x 3). Simulation research has shown that while 100 groups is a good number for multilevel analysis, 50 has been shown to be sufficient (Maas & Hox, 2005).

The analysis examined each of the six hypotheses separately and after including the two sub-hypotheses resulted in a total of six separate tests. The study examined three independent variables and two dependent variables. The independent measures of performance expectancy, effort expectancy, and social influence had high reliabilities (Cronbach's α = 0.921, 0.915, and 0.879 respectively). The dependent measures of behavioral intent and task self-efficacy also had high reliabilities (Cronbach's $\alpha = 0.926$ and 0.933 respectively). Table 1 summarizes the descriptive statistics for each of the measures.

Table 1. Descriptive statistics for independent and dependent variables

	PE (Performance Expectancy)	EE (Effort Expectancy)	SI (Social Influence)	BI (Behavioral Intention)	TSE (Task-specific self efficacy)
time 1					
n=59	2.43	4.20	2.51	2.49	3.94
	(1.32)	(1.32)	(1.49)	(1.50)	(1.35)
time 2					
n=59	2.29	4.31	2.20	2.15	4.75
	(1.14)	(1.47)	(1.31)	(1.51)	(1.27)
time 3					
n=59	2.41	4.55	2.25	2.20	5.82
	(1.23)	(1.37)	(1.53)	(1.54)	(1.08)
	4-items	4-items	2-items	3-items	7-items
(maximum preferred)	Min = 1, Max = 7	Min = 1, Max = 7	Min = 1, Max = 7	Min = 1, Max = 7	Min = 1, Max = 7
	$\alpha = 0.921$	$\alpha = 0.915$	$\alpha = 0.879$	$\alpha = 0.926$	$\alpha = 0.933$

For the analysis of the data, growth curve analysis was conducted utilizing a structural equation modeling framework. Growth curve analysis allows examination of both the combined as well as individual levels of change over time. These growth parameters can be represented in the first level by:

$$Y_{it} = \pi_{0i} + \pi_{1i}t + \varepsilon_{it} \qquad \text{(Level-1 equation)}$$

Where t and i are the tth occasion for the ith individual. The growth parameters are explained by second level predictors in

$$\pi_{0i} = \gamma_{00} + \gamma_{01}X_i + u_{0i} \qquad \text{(Level-2 equation)}$$

$$\pi_{1i} = \gamma_{10} + \gamma_{11}X_i + u_{1i} \qquad \text{(Level-2 equation)}$$

Where π_{0i} is the initial level of the ith individual, π_{1i} is the rate of change of the ith individual, γ_{00} and γ_{10} are the intercepts of the prediction equations, γ_{01} and γ_{11} are path coefficients linking change parameters and predictor variables, and u_{0i} and u_{1i} are disturbances.

Due to the sample size being less than 100, conservative tests for each of the proposed hypotheses were conducted using independent tests. Table 1 shows the fit statistics for each model. Each of these models was not significantly different from the saturated model ($p > 0.05$) and the CFI values were all very good indicating good fitting models. The RMSEA and SRMR values were also adequate to good. Figure 4 displays a visual depiction of the mean trajectories of each of the five variables measured over each of the three time periods, while Figure 5 shows a diagram depicting each of the models tested and the corresponding statistical values (red indicates significance).

The results (see Figure 5) for model 1 (M1) show that the initial level of behavioral intention to use virtual world technologies is significant (Mean = 6.747, $p = 0.000$), but there is a significant amount of difference between subjects (Variance = 9.183, $p = 0.000$). Also, the change in the level of behavioral intention to use the technology significantly decreases over time (Mean = -0.567, $p = 0.044$), and most people experience this decrease (Variance = -0.004, $p = 0.997$). The results for M5 show that the initial level of task self-efficacy with virtual world technologies is significant (Mean = 27.441, $p = 0.000$), but there is a significant difference between subjects (Variance = 101.506, $p = 0.000$). Also, the change in the level of task self-efficacy with the technology significantly increases over time (Mean = 6.461, $p = 0.000$), but again there is a significant difference between individuals (Variance = 26.602, $p = 0.003$). M6 tests for a relationship between TSE and BI over time utilizing an interlocking trajectories approach. The initial levels of TSE and BI are not highly correlated, but the correlation between the rates of change between the two is quite high, yet insignificant due to a high standard error ($\rho = 0.749$, $p = 0.291$). The high standard error is most likely due to the lack of variance in answers as all subjects were positioned almost exactly along the plotted regression lines. This holds huge promise for future research, which is discussed below.

Models M2, M3, and M4 each test the effect of the exogenous variables in the UTAUT model that are theorized to predict BI. M4 shows that there is a significant effect of the initial level of PE on BI ($\beta = 1.429$, $p = 0.000$) and a significant effect of the slope of PE on the slope of BI ($\beta = 1.605$, $p = 0.006$), but no accelerating effect of the level of PE on the slope of BI ($\beta = 0.035$, $p = 0.869$). M5 shows that there is no significant effect of the initial level of EE on BI ($\beta = 0.250$, $p = 0.353$), no significant effect of the slope of EE on the slope of BI ($\beta = -0.360$, $p = 0.959$), and no accelerating effect of the level of EE on the slope of BI ($\beta = 0.078$, $p = 0.886$). M6 shows that there is a significant effect of the initial level of SI on BI ($\beta = 1.105$, $p = 0.001$), a significant effect of the slope of SI on the slope of BI ($\beta = 1.120$, $p = 0.002$), and a moderately significant decelerating effect of the level of SI on the slope of BI ($\beta = -0.493$, $p = 0.073$).

Table 2. Fit statistics for models.

Model	χ2	RMSEA	CFI	SRMR
M1 (H1)	3.64 (3)	0.066	0.980	0.104
M2 (H2)	15.90 (12)	0.074	0.971	0.063
M3 (H3)	11.53 (12)	0.000	1.000	0.077
M4 (H4)	10.44 (9)	0.052	0.989	0.095
M5 (H5)	0.97 (1)	0.000	1.000	0.031
M6 (H6)	10.15 (7)	0.087	0.962	0.074

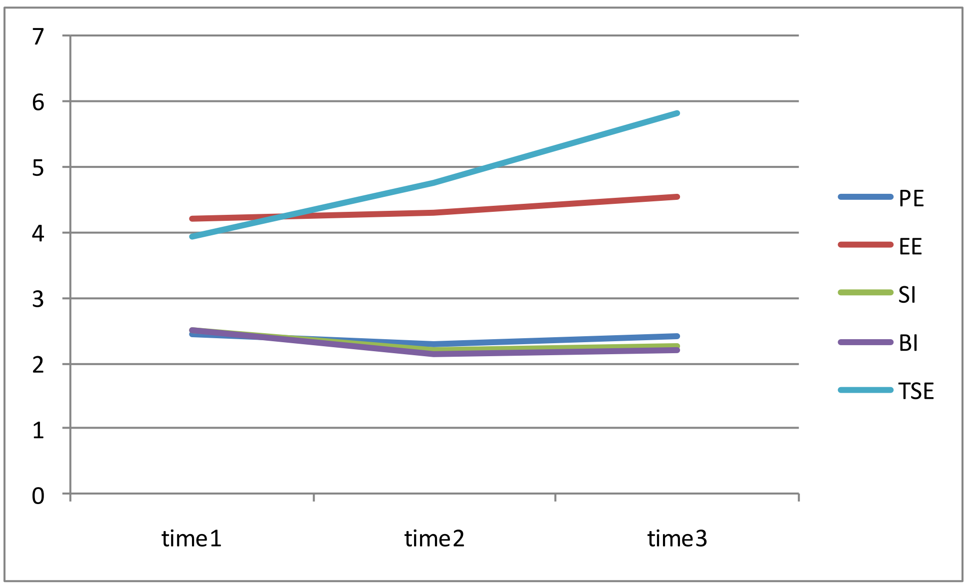

Figure 4. Trajectories of the five measured variables over each of the three time periods.

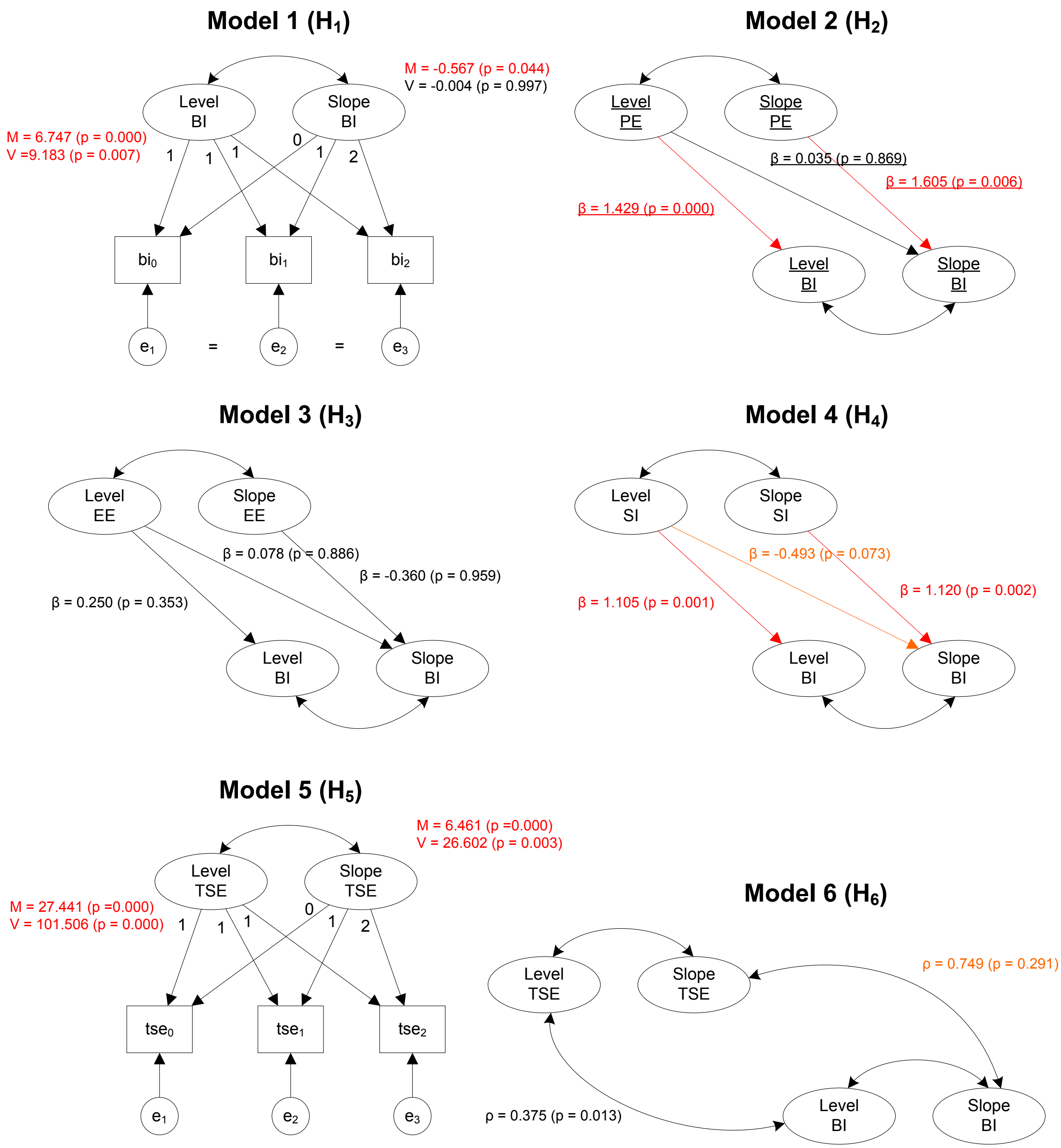

Figure 5. Models testing hypotheses with resulting values

4 STUDY 2

Study 1 provides an interesting yet provocative picture that indicates that users become less likely to use Second Life technology over time, even while they feel better able to use the technology. While interesting and provocative, these results leave us with the question as to why individuals are less likely to use virtual world technology as they gain more experience with the technology. To explore this relationship between experience and decreased acceptance, a second study was conducted that analyzed reflective narratives of individuals in two sections of a different set of graduate-level business courses.

4.1 Data Collection

Data for Study 2 was collected in an experimental e-commerce class that was developed to inform graduate students about topics related to the online consumer purchasing process as well as expose students to the realities of remote work and virtual teaming. The virtual environment of Second Life was used for several class lectures and students were encouraged to use Second Life for team meetings and to complete a team exercise. The course was taught during two different semesters and the two courses included a total of 57 students. This course differs from the course used for sampling in Study 1; however, the student population would be similar (i.e., MBA students), the focus on using the Second Life virtual world was the same, and the same instructor taught both courses and provided the introduction and descriptions of the Second Life environment. An important difference between the courses is that the exposure to Second Life in the e-commerce course was more extensive; nevertheless, this is useful because it provided students an opportunity to develop a more in depth understanding of the environment's features and business capabilities.

As a comparison exercise, the students were required to hold two online team meetings. They were instructed to conduct one meeting using a traditional, text-based chat application, and the second meeting using the Second Life environment. After the online team meetings, the students were asked to reflect on these two experiences by writing a reflection that compared and contrasted the team meetings. The text-based meeting provided a reference point that both the students and the researchers could use to better understand the Second Life virtual environment. Specifically, we asked the students to compare Second Life communication to a familiar and common business communication tool, text-based chat, which they had previously used in personal and professional business applications. As explained below, the comparisons made between these two modes of communication uncovered several of the reasons why business students expressed reservations about using virtual worlds in a professional setting.

4.2 Data Analysis

Gathered from this reflection narrative was a corpus of 44,227 words that compared and contrasted 2D and 3D chat. The researchers used content analysis to categorize the text (Berelson, 1952; Holsti, 1969; Krippendorff, 2004; Weber, 1990). The first phase of the analysis looked at word frequencies. The word ‘chat’ appeared 878 times within the text and was the second ranking word after ‘the’ and before common prepositions and articles such as to, and, I, a, in. The word ‘chat’ most often clustered with other words such as mode(s), session, is, and, with, tool(s), in, environment, sessions.

The second phase of the analysis examined the key word ‘chat’ in its context. The sampling unit consisted of a complete sentence describing ‘chat.’ Because the word ‘chat’ could occur more than once in a sentence the final number of observations describing the key word in context was 622.

The third phase of the content analysis categorized the 622 observations based on chat preferences. The reflection narrative provided a rich and detailed description as to why and in what circumstances the students liked one method of chat communication over the other. The final phase of the content analysis was to develop a coding scheme based on the sub-qualities that contributed and formed the larger chat preference categories.

4.3 Summary of Findings

From the 622 observations, five distinct chat preference categories emerged: 1) text-based chat not preferred for team meetings, 2) 3D virtual world environment not preferred, 3) text-based chat preferred for team meetings, 4) 3D virtual world environment preferred, and 5) both text-based and 3D virtual world environment were preferred depending on team needs and the communication context. Table 1 summarizes the preference Categories with the sub-qualities.

The data show several important patterns that can be understood by considering the contrast the subjects were asked to make; that is, compare and contrast those features preferred and not preferred about each environment. In this light, it should be recognized that the analysis includes information about what respondents thought worked well and didn’t work well in each environment. In the case of text-based chat, for example, they highlighted disruptions and the potential for misinterpretation as potential negative features but considered the familiarity and ease of use to be important features they preferred about this technology. In the case of 3D communication, disruptions and lack of file sharing capabilities were highlighted as potential negative features while the sense of presence and space along with the facilitation of group communication were features respondents preferred about the technology. Respondents recognized that both environments enabled instant and synchronous communication as well as recording of dialogs through saved chat logs.

Table 1: Preference Categories with their Sub-qualities

Preferences	Number of observations	Percentage
1) Text-based Chat not Preferred	35	6%
a) Contributed to a distracting work environment	14	40%
b) Required additional skills such as learning new online communication tools, improving typing and/or spelling	6	17%
c) Lacked security and/or privacy	2	06%
d) Contributed to misinterpretation of communication due to a lack of nonverbal cues	9	26%
e) Lacked features such as video/audio and/or file sharing	4	11%
2) 3D Virtual World Environment not Preferred	32	5%
a) Contributed to a distracting work environment	15	47%
b) Required additional skills such as learning new online communication tools, improving typing and/or spelling	6	19%
c) Lacked security and/or privacy	1	03%
d) Contributed to misinterpretation of communication due to a lack of nonverbal cues	3	09%
e) Lacked features such as video/audio and/or file sharing	7	22%
3) Text-based Chat Preferred	243	39%
a) Ease of use, simple, fast, stable platform	86	35%
b) Familiar, standard, accepted technology	61	25%
c) Communication tool that is not a distraction but one that fits into work processes by facilitating quick information gathering, multi-tasking	54	22%
d) Contained features that enabled document sharing and chat logging	42	17%
4) 3D Virtual World Environment Preferred	187	30%
a) Contributed to clarity of communication by providing expression of nonverbal cues	15	08%
b) Contained a feature rich toolbox (voice, video, visual, spatial)	59	32%
c) Facilitated group chat	38	20%
d) Provided a feeling of presence, co-presence, embodiment	51	27%
e) Created an entertaining, fun, customizable, and social environment	24	13%
5) Text-based and 3D Virtual World Environment Chat Preferred Depending on Needs and Context	125	20%
a) Both enabled a means of instant and synchronous communication	50	40%
b) 3D facilitated team building, group collaboration, strategy development	39	31%
c) Both allowed for saving chat logs	26	21%
d) 3D created opportunities to socialize with old and new contacts	10	08%
Total Observations	622	

When given a choice between two media respondents were contrasting and comparing the way each medium's features fit with common tasks and task characteristics they would encounter in typical professional communication activities. The pattern in the response frequencies show that the most frequently cited preferred features of text-based chat is that it is easy, simple, and efficient to use and that it is familiar and recognized tool that accommodates existing work practice (i.e., the three categories with these features, 3a-3c, include 201 mentions). On the other hand, the most commonly cited preferred features for the 3D environment include that it offers a richer set of communication features that create a sense of presence (i.e., the three categories with these feature, 3b-3d, include 148 mentions). In other words, when contrasting alternatives for communication, the most commonly cited preferred features relate to ease of use, convenience, and fit with existing business practices. While there were some mentions of ease of shared communication associated with both environments, this was not nearly as common as were the statements related to convenience and fit with current practices. As a consequence, when business professionals are asked to compare text-based chat with communication in a 3D environment, their thinking relates chiefly to fit and ease of use and secondarily to issues with "higher-level" benefits such as richness and facilitating feelings of closeness or presence. Of course, subjects did recognize and highlight some of the features that facilitate group interactions, but they subordinate these to the ease of use and fit criteria. These results have important implications in considering the results from Study1; we will highlight and summarize some of these implications in light of the results from Study 1 in the next section.

5 DISCUSSION

This study was designed to examine the change in user attitudes toward virtual world technology over time. Specifically, the study looked at the concepts of technology acceptance and user self-efficacy in relation to business uses of virtual worlds by utilizing a three-wave panel analysis where subjects were exposed to varying levels of knowledge about and immersion in the virtual world technology, Second Life. This study provides many important contributions. This is the first study to look at user's adoption of virtual world technologies for utilization in a business context over time. While some longitudinal studies have looked at adoption of virtual world technologies, these have utilized gaming systems. As virtual world technologies are utilized more and more for virtual teams in the workplace, the level of intention to use these technologies must be investigated as users' experiences with the technologies evolve over time.

The two primary outcome variables in this research were task self-efficacy and behavioral intention. The research showed that those who utilize a virtual world environment will show an increase in task specific self-efficacy towards the system as their experience with the system increases over time, supporting hypothesis H_5. While H_1 is not supported, the relationship that was observed is significant and contrary to our expectations. Specifically, as a subject's experience with virtual world technology increases, his behavioral intention to utilize the system significantly decreases; therefore, while H_1 is not supported the significant negative relationship suggests that over time users reduce their intention to utilize the technology again. This implies that the more a user learns and interacts with the technology, the more he or she thinks he would ***not*** use the technology for his daily job tasks. As highlighted in the analysis of This is a very important finding and one that needs to be addressed by further research. Many companies, such as IBM, Cisco, etc., are utilizing virtual world technologies in virtual team environments. If users are less likely to utilize the technology as they learn more about it, then they will resist the use of the technology.

This study also demonstrates that not only does a user's intention to utilize virtual world technologies in their future work decrease significantly over time, this decrease could be strongly correlated with the more they learn about the technology. While the correlation between the slopes of behavioral intention and task self-efficacy are not significant in M6, the high correlation offers a caveat. This elevated correlation suggests that the better a user believes they can use virtual world technologies, the less likely they are to use it for business applications. This is not consistent with our expectations given we would expect that experience with a technology would result in greater likelihood of future use. Our research utilized the vicarious experience and enactive mastery training methods proposed by Bandurra (Bandura, 1986) whereby students were exposed not only to concepts related to virtual world use (e.g., business applications, creation of virtual world content, social and organizational concepts) but also to practical, hands on use of the technology (e.g.,, moving and manipulating an avatar, engaging in communication and team activities, building and moving objects).

Additionally, several time-variant predictor variables of BI were also explored in study 1. Specifically, the variables that are generally expected to be antecedents in the UTAUT model were investigated in our study (Venkatesh, et al., 2003). Hypothesis H_2 was supported because a significant causal relationship between performance expectancy and behavioral intention to utilize a virtual world environment was seen both in initial levels and as the user's level of experience increases. The initial level of social influence is also significantly related to the initial level of behavioral intention to utilize a virtual world environment, and the slope of the relationship over time is significant, supporting H_4. No significant relationship was found between effort expectancy and behavioral intention to utilize a virtual world environment as subjects' experience with the system increased over time, failing to support H_3. These findings show that while performance expectancy does significantly impact both the initial level and change in behavioral intent over time, effort expectancy does not. The qualitative analysis confirms this with users preferring text-based chat because of its ease of use while not preferring 3D virtual world environments because of the required additional skills needed to use the technology. This indicates that greater resources need to be invested to lessen the effort required to learn and operate virtual world technologies. Social influence was also shown to be significant on both the initial level of behavioral intent to use virtual world technologies and on the change in behavioral intention. This implies that to motivate employees to utilize virtual world technologies, managers will need to instill this desire in the workers over time as they continue to learn and use the technology. The moderately significant decelerating effect of the initial level of social influence on the change in behavioral intention to utilize virtual world technologies implies that while managers need to instill their desire for employees to utilize the technology at the beginning, this level of influence should not be excessive as this will negatively affect the intention to use the technology over time.

While these results suggest that individual acceptance of virtual world technologies for business applications lessen over time, the longitudinal analysis from Study 1 leaves open the question of why this relationship exists? The qualitative analysis provides additional information about the underlying reasons for this dwindled acceptance. Individually, a greater number of comments showed preference for ease of use, simplicity, and similar features of text-based chat (201 mentions) as compared to the comments about the rich communication capabilities associated with 3D environments (148 mentions). An important and common comment cited by users for having lower preference for 3D environments is its distracting nature in the work environment. This is illustrated by a remark recorded by one respondent:

There are too many things to do in SL that the business may see a reduction in work since more employees would be "playing" in SL instead of chatting and working.

This quote suggests that students perceived that there is a disconnect between the work environment and Second Life because the 3D environment was perceived to create too many distractions that might divert attention and reduce productivity. Other reasons for not preferring 3D virtual environments included, its requirement to learn new skills, misinterpretation of nonverbal cues, and security and privacy concerns. One user described SL as useful, but given its security and privacy concerns, this usefulness was reduced:

The concept of Second Life can be very useful for an organization in that it builds group cohesiveness and allows for a relaxed and efficient form of communication, but the fact that Second Life is a third-party system not controlled by the business and for other privacy reasons, I can't see the use of Second Life for important business discussions and negotiations.

As highlighted in the analysis, while some respondents expressed a preference for 3D environments, the majority of respondents expressed a preference for traditional text-based chat mechanisms because they offered a better overall fit with business activities. Technology fit (Zigurs, Buckland, Connolly, & Wilson, 1999) may therefore be one reason why individuals concluded that 3D virtual world environments such as Second Life would be less useful in business environments.

6 LIMITATIONS AND FUTURE RESEARCH

The results of this research offer interesting findings exposing the relationship between technology acceptance and self-efficacy in relation to virtual world technologies. Nevertheless, there are several limitations that should be considered when interpreting the results of this study. First, while sufficient, the sample size is less than the ideal proposed in simulation research for multi-level modeling (Maas & Hox, 2005). To adequately explore the relationships, this study should be replicated with a larger sample size so that combined models could be examined. For example, a model that includes all three exogenous variables influencing behavioral intent should be considered. Additionally, another limitation is the use of Second Life. While Second Life is one of the most popular and widely used virtual world technologies, it has, so to speak, a reputation that might negatively influence users as they consider subsequent use of virtual world technology. It is possible that the negative reputation that Second Life has acquired outweigh the useful capabilities of the environment. Future research should explore whether and how the characteristics of the environment influence behavioral intentions.

7 CONCLUSIONS

We began this paper with a question about whether business professionals accept the premise that virtual worlds could be useful for business applications. To address this question, we conducted both a survey of MBA students who are business professionals and also examined detailed comments and reflections about virtual worlds made by a similar sample of business students. The results from the survey show that as self-efficacy increased, willingness to and expectations about use of virtual worlds in their future business activities decreased. This result was surprising; however, the results from our second qualitative analysis offer insights about the perceptions subjects have of virtual worlds; that is, they are useful for "high-level" functions like creating a sense of presence, but they are harder to use and would less easily be accommodated in regular business processes. These results, in retrospect, make sense in light of how business professionals typically communicate. For example, many people are more likely to send a text message or an email than to pick up a phone or initiate a video conference. Second Life and other virtual worlds carry with them overhead in their use that minimizes their usefulness for routine business activities. Our results are consistent with this ease-of-use perspective and suggest that future research should examine the fit of the technology with the task context. While businesses today include numerous virtual teams and dispersed organizational structures, it is likely that existing "simple" modes of communication will prevail for most business tasks.

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APPENDIX A

Please answer the following questions based on your feelings about your ***current*** skills/assessments of utilizing Second Life.

		Strongly Disagree			neutral			Strongly Agree
1.	I would find Second Life useful in my daily life.	1	2	3	4	5	6	7
2.	Using Second Life would enable me to accomplish an assigned task more quickly.	1	2	3	4	5	6	7
3.	Using Second Life would increase my productivity.	1	2	3	4	5	6	7
4.	If I were to use Second Life, I would increase my chances of completing an assigned task.	1	2	3	4	5	6	7

		Strongly Disagree			neutral			Strongly Agree
5.	My interaction with Second Life would be clear and understandable.	1	2	3	4	5	6	7
6.	It would be easy for me to become skillful at using Second Life.	1	2	3	4	5	6	7
7.	I would find Second Life easy to use.	1	2	3	4	5	6	7
8.	Learning to operate Second Life would be easy for me.	1	2	3	4	5	6	7

		Strongly Disagree			neutral			Strongly Agree
9.	People who influence my behavior think that I should use Second Life.	1	2	3	4	5	6	7
10.	People who are important to me think that I should use Second Life.	1	2	3	4	5	6	7
11.	The facilitator has been helpful in the use of Second Life.	1	2	3	4	5	6	7
12.	In general, the facilitator has supported the use of Second Life.	1	2	3	4	5	6	7

	Strongly Disagree			neutral			Strongly Agree
13. I have the resources necessary to use Second Life.	1	2	3	4	5	6	7
14. I have the knowledge necessary to use Second Life.	1	2	3	4	5	6	7
15. Second Life is not compatible with other systems I use.	1	2	3	4	5	6	7
16. A specific person (or group) is available for assistance with difficulties regarding Second Life.	1	2	3	4	5	6	7

	Strongly Disagree			neutral			Strongly Agree
17. Other than for my use in this class, I intend to use Second Life in the next 6 months.	1	2	3	4	5	6	7
18. Other than for my use in this class, I predict I would use Second Life in the next 6 months.	1	2	3	4	5	6	7
19. Other than for my use in this class, I plan to use Second Life in the next 6 months.	1	2	3	4	5	6	7

	Strongly Disagree			neutral			Strongly Agree
20. I can change what I am looking at in Second Life.	1	2	3	4	5	6	7
21. I can maneuver effectively in Second Life.	1	2	3	4	5	6	7
22. When using Second Life to see a presentation, I can control the audio effectively.	1	2	3	4	5	6	7
23. When using Second Life to see a presentation, I can read the messages that are sent to me.	1	2	3	4	5	6	7
24. When using Second Life to see a presentation, I can read the screen showing the presentation materials.	1	2	3	4	5	6	7
25. When using Second Life, I can make my avatar sit.	1	2	3	4	5	6	7
26. When using Second Life, I can make my avatar fly.	1	2	3	4	5	6	7