Influence of Interfaces on Novice Users' Performance in Social Virtual Worlds

사회적 가상세계에서 인터페이스가 초보사용자들의 성과에 미치는 영향

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ABSTRACT

This paper explores how interface environments have an influence on novice users' performance in social virtual worlds (SVWs), which are emerging user-centric three-dimensional cyberspaces. Despite their early popularity, SVWs have experienced that numerous new users leave the cyberspaces soon before they become long-term users. One possible reason is that unfamiliar interfaces of SVWs can be a barrier to novice users' adaptation of the technology. To understand a role of interfaces in the users' assimilation of SVWs, we examine an impact of three interface factors (presence, affordance, and feedback) on performance which is regarded as a yardstick for users' adaptation of SVWs. Forty participants were recruited and went through one-hour experimental sessions with seven tasks in Second Life; they were also asked to answer a questionnaire. Findings indicate that while affordance and feedback are significant factors influencing novice users' performance, presence has no impact on their performance.

초 록

본 연구는 사용자 중심의 3D 사이버공간인 사회적 가상세계에서 인터페이스 환경이 어떻게 초기사용자들의 성과에 영향을 미치는 지에 대해 탐색하였다. 초기의 인기에도 불구하고 사회적 가상세계는 많은 사용자들의 이탈을 경험하고 있다. 한 가지 가능한 원인은 초기사용자들에게 익숙하지 않은 사회적 가상세계의 인터페이스가 그들의 적응에 방해가 될 수 있다는 것이다. 사회적 가상세계에서 하고자 하는 작업에 대한 실패는 초기사용자들의 이탈을 가속화시킬 수 있다는 점에서, 본 연구는 인터페이스 요소들(현존감, 지원성, 피드백)의 초기사용자의 성과에 미치는 영향을 탐색하였다. 40명을 대상으로 하는 실험에서, 각 참여자는 사회적 가상세계인 세컨드라이프에서 7개의 작업을 수행한 후, 설문서에 답하였다. 실험결과, 사회적 가상세계의 지원성과 피드백은 초기사용자의 성과에 유의미한 영향을 끼치는 것으로 나타났으나 현존감은 영향이 없는 것으로 나타났다.

Keywords: social virtual world, 3-dimensional, user interface, performance, novice users
사회적 가상세계, 3D, 사용자인터페이스, 성과, 초기사용자

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1. Introduction

As users have shifted from the first generation of the World Wide Web to Web 2.0, their activities and interactions with the Internet and with other users have taken on new aspects. While the main activities in the first Web generation were searching and acquiring information that already existed on the Web, current users participate in the production of Web contents. They organize their own information on the Web using tags, set up their own sites to share information with like-minded people, upload video clips that they generated themselves, and construct or participate in social networks in cyberspace. In addition to this user-centric trend, the current Web environment has evolved from a flat world to a three-dimensional (3D) space (Argote & Ingram, 2000; MacMillan, 2006). Three dimensional techniques have already penetrated daily life; for example, 3D movies, 3D TV, 3D catalogs in online stores, 3D computer monitors; now these techniques are becoming ubiquitous on the Web environments such as social virtual worlds (SVWs) and gaming virtual worlds (GVWs), SVWs can be a typical Web space encompassing both user-centric features such as user-generated videos and a 3D interface environment. GVWs (e.g., World of Warcraft, Lineage) are characterized by a pre-defined structure and quest-driven behaviors, whereas SVWs have emergent structures created by users under minimum constraints (e.g., Second Life, Entropia Universe) (Juul, 2005).

The emerging Web environments, particularly social cyberspaces such as SVWs, require a new mind-set geared toward participation as well as new skills to facilitate social interactions. In the new user-empowered environment, the users themselves decide the meaning of the technology by personalizing their use experiences (e.g., weblog, social virtual worlds, smartphone) (Germonprez, Hovorka, & Collopy, 2007; Yoo, 2010). In particular, the impact of the unfamiliar environments is significant to novice users because they have little knowledge about what is going on in these environments and how to engage with them (Padovesi, 2008; Godvertiser, 2010). This is one of the reasons for the high drop-out rate in SVWs. For example, Second Life, which is a popular SVW, experienced a drop-out rate of eighty percent of registered users within the first two months after registering (Platoni, 2008); the unaccustomed environment including a 3D interface and avatar-mediated communication may be the cause of the early drop-outs in Second Life. In research on user adoption of IT, the ease of using technologies has been regarded as a crucial factor affecting novice users (Kim & Han, 2008; Venkatesh, 2000; Yu, Ha, Choi, & Rho, 2004). In addition, because the influence of interface settings on users' adaptation can be more salient in autonomous cyberspaces where users act on their own choice than in ready-made environments offered by service providers such as GVWs, we assume that interface factors are crucial for novice users to be assimilated into SVWs.

There are numerous studies dealing with user participation in or adoption of social cyberspaces; however, they have concentrated primarily on non-technological factors, such as sense of community (Koh & Kim,

2003), trust (Blanchard & Markus, 2004), social influence (Zhou, 2011), or network characteristics of online communities (Toral, Martínez-Torres, Barrero, & Cortés, 2009). There is still a gap in research on the role of user interfaces or technological factors in user adoption of social cyberspaces. For a better understanding in this area, we need to examine the influence of interfaces on user adoption of social cyberspaces. This study explores how novice users' assessment of interfaces is related to their performance in a SVW. More specifically, the study examines the influence of three factors (perception of presence, affordance, and feedback) reflecting interface environments on users' performance. In this study, actual performance, which is measured by completion or incompletion and completion time, is used as a dependent variable. According to expectation-confirmation theory (Oliver, 1980), which is widely used to investigate consumers' repurchase behavior, when consumers do not get expected outcomes from the product or service purchased, they are unlikely to purchase it again. In the same manner, if users fail to complete a task or feel that they spend more time in completing it than expected in a SVW, they are unlikely to log in again. Therefore, performance can be considered a gauge in predicting users' continuance to use a SVW.

In the following sections, the paper addresses the concept of SVWs and previous research on user adoption of social cyberspaces and then develops a research model in which three interface factors, including presence, affordance, and feedback, are assumed to affect users' satisfaction. The methodology, based on the design and measurement of the usability testing, is described in the third section, and the results of data analyses are presented in the fourth section. The paper concludes with a discussion of the findings, limitations, and areas for future research, and the implications of this study.

2. Theoretical background

2.1 Novice users' adaptation of social cyberspaces

Even though many individuals and organizations continue to be excited over Second Life, some have doubts about its future. The most critical challenge is the high user attrition rate. A significant number of Second Life users leave within a few months of registering; 80 percent of registered users leave within the first two months after registering (Platoni, 2008). Such high user attrition may threaten the survival of Second Life. In fact, user attrition and inactive participation is considered a chronic trouble in all social cyberspaces. According to prior research, only ten percent of the members of one popular peer-to-peer sharing virtual community provided 87 percent of all content (Adar & Huberman, 2000), and four percent of members of an open-source development virtual community produced 88 percent of new codes and 66 percent of code fixes (Mockus, Fielding, & Andersen, 2002). The results imply that high user participation is an essential factor in the ongoing viability of social cyberspaces. As a result, a number of researchers have concentrated on investigating which factors have an

influence on users' participation or adoption and lead to long-term usage in social cyberspaces.

One potential reason for the high user attrition in Second Life is a steep learning curve. Novice users' knowledge about how to engage is slowly accumulated and sharply increases at the critical-point time, suggesting that users may experience repeated failures of what they intend to do during their early use of Second Life because of lack of how-to-do knowledge. As a result, many novice users may leave Second Life after a short time because of their frustration. Therefore, novice users' performance (how efficiently they complete tasks) during their early activities in Second Life can be considered an important yardstick for predicting their continuing use.

The result variable, performance, proposed as a measure in the current study comes from the concept of usability. ISO 1941-11 (1998) states that the importance of usability is "concerned with the extent to which the users of the products are able to work effectively, efficiently, and with satisfaction." The standard also specifies measures for efficiency, effectiveness, and user satisfaction in the context of specific product or systems. It provides lists of operationalizable measures for each category, such as "percentage of goals achieved" for effectiveness measures, "time to complete a task" for efficiency measures, and "rating scales for satisfaction' for satisfaction measures. From these three factors (i.e., effectiveness, efficiency, and satisfaction), we operationalize performance as a factor consisting of two objective measures (effectiveness and efficiency); user satisfaction can be regarded as an outcome variable of the actual performance assessed by these objective measures.

Existing Second Life users can help novice users learn how to engage, and this assistance may improve novices' performance and reduce attrition. However, the user interface aspects of Second Life have a fundamental environment influencing their performance. Thus, it is important to investigate how these users' perceptions of the interfaces affect their performance. The question is rooted in the research domain of user adoption of social cyberspaces. Researchers have examined diverse users' perceptions relevant to the adoption of social cyberspaces. The sense of community, which is defined as the member's feeling about belonging, has been established as an important factor in users' participation in virtual communities, and other factors, such as leaders' enthusiasm, offline interaction, and community strategy, have been also examined for understanding users' participation (Koh & Kim, 2003; Yu & Chu, 2007). Trust is regarded as another decisive factor for participation in virtual communities (Blanchard & Markus, 2004). While some studies have examined how users' intrinsic motivations, such as needs (e.g., hedonic needs, social needs) or altruism (Kang, Lee, Lee, & Choi, 2007; Sun, Lin, & Ho, 2006), lead to their participation in social cyberspaces; others found a significant effect of social motivations, such as social identity or group norm, on participation (Zhou, 2011). Also, differently from perception-based research on virtual communities, some researchers have applied the social network perspective to understanding virtual communities (Toral et al., 2009). (see Table 1 for details of literature on user participation in social cyberspaces).

〈Table 1〉 Empirical Studies on User Adoption of Social Cyberspaces

Articles	Realm	Construct included	Outcome variable
Blanchard & Markus (2004)	Sports community	Trust, creating identification	Sense of virtual community
Chen (2007)	Knowledge sharing community	Social interaction ties, website use satisfaction (knowledge quality, system quality)	Continuance intention
Fetscherin & Lattemann (2008)	Social virtual world	Perceived usefulness, perceived ease of use, community, attitude toward technology, social norms, anxiety	Intention to use a virtual world
Kang et al. (2007)	Health community	Community commitment, loyalty, support for member, perceived community value, recognition for contribution, freedom of expression, interactive communication	Posting activity, viewing activity
Koh & Kim (2003)	Diverse	Leaders' enthusiasm, offline activities, enjoyability	Sense of virtual community
Koh et al. (2007)	Diverse	Leaders' involvement, offline interaction, usefulness, IT infrastructure	Posting activity, viewing activity
Ling et al. (2005)	Movie community	Uniqueness of contribution, specific goals	Logging-in behavior, rating-movie behavior
Shin (2008)	Social virtual world	Perceived usefulness, perceived ease of use, perceived risk, trust, subjective norm	Intention to use virtual currency
Ridings et al. (2002)	Diverse	Trust, perceived responsiveness, others' confiding personal information	Desire to give information
Sun et al. (2006)	Gaming virtual world	Altruism, reciprocity, reputation	Sharing of game tips
Yoo et al. (2002)	Diverse	Sense of community, managing strategy (purpose, rule, events, subgroups), information quality	Participation in community operation, subgroup or event, regular message boards, and chatting or e-mail with other members
Yu & Chu (2007)	Gaming virtual world	Cohesiveness , affection similarity, leader-member exchange	Organizational citizenship behavior
Toral et al. (2009)	Communities related to Linux	Network cohesion, network structure, network centrality, core of the community	Success of virtual community
Zhou (2011)	Diverse	Social identity, subjective norm, group norm	Participation intention, participation behavior
Keng et al. (2011)	Diverse	Interpersonal virtual product experience (social, information), machine virtual product experience (education, entertainment, aesthetics, escapism)	Sense of virtual community
Jung (2011)	Social virtual world	Telepresence, social presence, perceived autonomy	Satisfaction, continuance intention

Prior research on user adoption of social cyberspaces has focused primarily on non-technological factors. Although we basically agree with the essential role of those factors in users' activities in social cyberspaces, we also contend that technological environments significantly affect user adoption, particularly in an early adoption stage. Technological factors such as the quality of the user interface are

also assumed to have an influence on user activity in social cyberspaces (Godwin, 1994). In fact, the influence of technological factors on users' behavior has been often discussed in literature. Godwin (1994) states that in virtual communities discussions among users can be significantly promoted by supportive software, and Kim (2000) mentions that user-friendly interfaces and reliable systems can encourage users' participation by facilitating their access. More recently, a few studies have attempted to consider a technological influence on user adoption of cyberspaces, focusing on sense of presence (Jung, 2011; Keng, Ting, & Chen, 2011).

Nevertheless, as prior research has underestimated the impact of technological factors on user adoption, there is incomplete understanding of user adoption of social cyberspaces. In particular, the influence of technological factors may be even more prominent in user adoption of cyberspaces such as Second Life that support an advanced 3D interface. This study examines an impact of novice users' perception of interfaces or technological aspects (i.e., presence, affordance, and feedback) on their performance in Second Life.

2.2 Users' perception of interfaces

Presence, affordance, and feedback were chosen because we assume that they are key perceptions highly relevant to an interactive and dynamic 3D interface environment. The concept of "presence" has been operationalized as a variable in several previous studies (Bowman, Krujiff, Laviola, & Poupyrev, 2005; Yoon, Laffey, & Oh, 2008). Based on prior literature, we define perceived presence as users' feelings of being in virtual environments (Sheridan, 1992). Perceived presence can be enhanced mostly by 3D and avatar-based technological environments. Thus, we can think of perceived presence as a concept reflecting interfaces or technological aspects. A high-level perception of presence enhances users' concentration on their activities in virtual environments, and ultimately can lead to high performance in their activities. Prior literature suggests an influential role of perceived presence in web users' attitudes and performance (Hoffman & Novak, 1996), consumer learning in online shopping (Suh & Lee, 2005), and sense of virtual community (Keng, Ting, & Chen, 2011). Perceived presence has been also examined as a critical factor in understanding users' behavior in 3D virtual reality applications, avatar-based virtual gaming, and the web environment (Biocca, 1997; Jung, 2011; Venkatesh & Johnson, 2002). More directly, research on presence has assumed a positive relation between the sense of presence and task performance (Welch, 1999). We, therefore, believe that the more sense of presence the user has in the 3D and avatar-based virtual world, the better performance the user achieves.

H1. Perceived presence is positively related to performance.

Affordance is one of the critical design principles advocated by Norman (1990) and is defined as an attribute that provides a clue as to what to do with

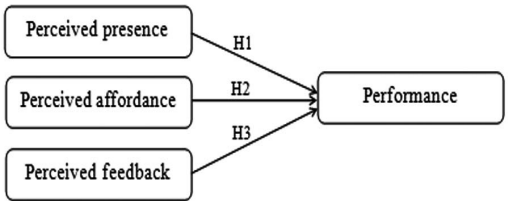
it. For example, buttons give users a clue to press and door handles to turn. Affordance allows users to create objects and environments that have meaningful properties and provides them with the way they should interact with those objects and environments (Herndon, van Dam, & Gleicher, 1994; Warren, 1995). Furthermore, Norman (1999) classified affordance into two distinct kinds; perceived and real. Real affordance is applied to physical objects such as push buttons or handles, which are familiar, so there is no need to learn how to interact with them. Perceived affordance is associated with designing a virtual interface and does not provide the same kind of clues that real affordance does. Preece and her colleagues (2002) pointed out that a mapping between graphical representations of interfaces and system responses as a consequence of doing something on those graphical representations are not always consistent. Virtual representation of any physical object is challenging due to this kind of arbitrariness, and applying affordance into 3D interfaces requires more careful consideration. As Norman (1999) suggested that perceived affordance can be conceptualized in the context of an interface, we determined to test the impact of perceived affordance on novice user performance.

H2. Perceived affordance is positively related to performance

Feedback was also identified as one of the major system design principles (Norman, 1990) along with perceived affordance. Feedback refers to the information given to users in response to the actions that have been done. Feedback has been adopted as a testing variable for the usability of various systems and environments (Faulkner, 2007). Several studies have attempted to categorize types of feedback (Kraus & Weinheimer, 1966; Duncan, 1973; Clarke & Brennan, 1991), while others have used feedback as a subcategory of the construct 'ease of use' (Venkatesh & Ramesh, 2006) to evaluate Web and wireless sites usability, immediacy of feedback to test media richness (Dennis & Kinney, 1998), the effect of tactile feedback for touch-screen feedback to increase input accuracy for the older adults (Chung, Kim, Na, & Lee, 2010), and the effectiveness of feedback to test whether it reduces the number of revisit to the websites, which improves web navigation performance on difficult search tasks (Toldy, 2010).

The Second Life interface environment embeds unique features and 3D presentation. Since it is also an experiential learning environment that does not come with user manual, immediate feedback seems to be critical for users' performance. Another aspect related to feedback and user performance can be users' mental state called "flow" which was introduced by Csíkszentmihályi (1988). Flow refers to an optimal state in which people feel fully immersed and absorbed in their activities. Csíkszentmihályi derived a set of six criteria to characterize experiences individuals consider optimal, and 'provide feedback' is one of the optimal experience people perceive, which leads to a full engagement of themselves into the activities (Heeter, 2000).

H3. Perceived feedback is positively related to performance



〈Fig. 1〉 Research Model

3. Research method

3.1 Participants

Participants (n=40) were recruited at a university in the southeastern USA through classroom visits and advertisements on campus bulletin boards. Participants had diverse majors including library and information science, business administration, and engineering. Twenty-seven out of 40 participants were female and thirteen were male students. All participants were volunteers and were provided with either extra credits or monetary compensation as an incentive. All participants had no experience of SVWs or little experience of virtual games. We regard our participants as novice users of SVWs.

3.2 Laboratory-based usability test and survey

Each participant was asked to sign consent forms, perform seven tasks on the Second Life interface (experimental sessions), and fill out questionnaire (questionnaire sessions). Each experimental session was held using two IBM compatible laptops that have the minimum hardware requirement for Second Life. Second Life Release 1.19.1(4) was used. Interaction with Second Life took place through interface software downloaded from Linden Lab, which is its service provider, not through any Web browsers. Render Software's CamStudio version 2.0 was used for capturing screens for time completion and users' mouse-clicking trends. In total, forty one-hour experimental sessions were conducted for data collection and two hundred eighty files were collected.

In order to decide tasks that participants completed in our experimental session, we not only got advice from several experienced users of Second Life, but also referred to guides for new comers in Second Life (Second Life User's Guide, 2011; Danton's Second Life User Guide, 2011). In result, we chose seven tasks, which were considered to be users' ordinary and basic activities in Second Life: Task1 (Avatar editing), Task2 (Avatar movement), Task3 (Travel through a virtual space), Task4 (Object editing), Task5 (Search an event), Task6 (Connect to a friend), and Task7 (Site visit by using a map). Also, the development of representative tasks for the participants of this study was undertaken according to Rubin and Chisnell's (2008) guidelines on how to prioritize tasks for usability testing. In the experimental session, participants completed seven tasks. Participants were instructed to click the start and stop buttons on the CamStudio software at the beginning and end of each task. Elapsed time (task completion time) was

measured in each task. If a participant did not complete a task within 5 minutes, he or she stopped the task and started the next task. Task completeness for each task was recorded as either success or failure.

3.3 Measurement development

Performance was measured based on both task completion and completion time, which ISO 1941-11 (1998) suggests as objective criteria for usability evaluation. To develop the overall performance variable combining both task completion and time, we followed the steps outlined below:

1) If a participant successfully completed a task and spent less or equal to time than the average of the other successful participants, then participant gets 2 points;
2) If a participant successfully completed a task but spent more time than the average of the other successful participants, then participant gets 1 point;
3) If a participant failed to complete task, then participant gets no points.
4) Because there is no pre-defined criterion of 'good performance' of tasks in a SVW, we employed a 'relative' performance criterion by using an average performance of participants. Each participant's points on seven tasks were summed up, and the average of all participants was calculated (8.4 points). Finally, if a participant's summed points were over the average (8.4 points), then the participant was classified as over-average performance; otherwise as under-average performance. This study therefore had a dichotomous dependent variable: over-average performance and under-average performance.

For the perceptual measures, participants were asked to fill out a questionnaire after completing the tasks. The questionnaire included questions assessing users' perceptions of presence, affordance, and feedback. Five-point Likert scales (Strongly disagree - Strongly agree) were used for all questions. Perceived presence was measured with the question. "Did you feel your presence (being there) while you were interacting with the site?", which has been commonly used in prior literature (e.g., Barfield & Weghorst, 1993; Kim & Biocca, 1997; Slater & Wilbur, 1997). Because we did not find previously used questions for measuring perceived affordance and perceived feedback, we developed the measurement questions based on their definitions. Perceived affordance was measured with the question, "Did the interface give you a cue intuitively (perceived affordance) when you needed to imitate a certain action/movement on the interface?"; perceived feedback was measured with the question, "Did you have appropriate feedback when you acted on or selected an object on the site?"

4. Analysis and results

Logistic regression analysis is widely applied to examine the influence of metric independent variables

on a dichotomous dependent variable (Hair, Black, Badin, Anderson, & Tatham, 2005). Because performance, our dependent variable, had dichotomous values (over-average and under-average), we used logistic regression analysis to test the research model.

To assess the overall fit of a logistic regression model, the difference of the -2 Log Likelihood (-2LL) value between the base model and the logistic regression model is examined. Smaller -2LL values indicate better model fit, and the chi-square test is used to access a significant decrease of -2LL values. As shown in Table 2, the -2LL value decreased in the logistic regression model (significance = .000), indicating that the set of independent variables significantly improves model estimation fit.

Results showed that perceived affordance and perceived feedback had significant impact on novice users' performance (Table 3). Thus, H2 and H3 are supported. However, perceived presence did not have a significant impact so novice users' performance, so H1is not supported. Coefficients of perceived affordance and perceived feedback had positive signs, indicating a positive relationship between both variables and performance. In terms of magnitude of relationships, perceived affordance (exponential coefficient = 31.7) has a stronger relationship with performance than perceived feedback (exponential coefficient = 8.7). The discriminating power was also accessed for validation of the logistic regression model. As seen in Table 4, the model accurately

〈Table 2〉 Overall Model Fit of the Logistic Regression Model

	Base model	Logistic model	Change	Significance
-2 Log Likelihood	55.051	25.003	30.048	.000

〈Table 3〉 Results of Logistic Regression Analysis

Factor	Coefficient	Wald statics	*df*	Significance	Exp(B)
Perceived presence	.210	.072	1	.788	1.234
Perceived affordance	3.456	6.673	1	.010	31.700
Perceived feedback	2.174	5.802	1	.004	8.798

〈Table 4〉 Classification Accuracy of the Logistic Regression Model

	Predicted		Accuracy (%)
Observed	Over-average performance	Under-average performance	
Over-average performance	19	3	86.4
Under-average performance	4	14	77.8
			82.5

classified 82.5 % of participants into two groups, suggesting a high classification accuracy.

5. Discussion

The goal of this study was to improve the understanding of novice users' adoption of new interface environments where users control their own avatars in 3D virtual spaces. The findings support the hypotheses that perceived affordance and perceived feedback are determinants of performance in a SVW. However, the results reject a significant influence of perceived presence on performance. This is not in agreement with findings in prior research. It is known that user interfaces providing a high-level presence environment make users concentrate on their activities and ultimately improve performance. Our inconsistent finding may suggest that novice users cannot enjoy the fruits of the sense of presence because their inexperience and confusion with the unfamiliar interface inhibit their reaching a state of high-level presence. This finding thus carries the important practical implication that SVW providers should be careful in providing technological features or functions for the high-level presence. If those technological features intensify the complexity of use, novice users' confusion may overwhelm the technological advantage. Hence, providers should consider whether their advanced interfaces for offering a high-quality presence may produce such complexity that the environment negatively affects novice users' performance.

Both perceived affordance and perceived feedback have significant influence on novice users' performance on the Second Life interface. With this new interface environment, our novice study participants expected to be able to explore and play with many features and functions of the interface without conventional learning and without referring to any documentation for help while they are interacting with it. Even if perceived affordance had not been operationalized as a factor influencing users' performance in the previous studies, a handful of authors in the field of interface/interaction design emphasized the importance of this concept (Norman, 1990, 1999; Preece, Rogers, & Sharp, 2002). Our results support this assertion by demonstrating a strong positive association between perceived affordance and user performance on the interface. For perceived feedback, our results showed that the more users got feedback from the interface the better their performance was; this is in line with previous research findings in Chung, et al. (2010), Dennis & Kinney (1998), Toldy (2010), and Venkatesh & Ramesh (2006).

Our study was not without limitations. First, the nature and the number of samples may weaken the generalizability of the findings. Because only university students participated in the experiment, the study may only reflect that particular population. The small number of participants dictated by the experimental design also limits the generalizability of interpretation. Thus, the results of the study should be re-examined with more and diverse types of samples. Another limitation is the examination of a limited number of tasks. In order to mitigate the bias from the selection of tasks, we referred to Second

Life user guides as well as opinions from experienced users of Second Life. Also, we followed Rubin and Chisnell's (2008) guidelines on how to decide tasks for usability testing. Future research may confirm our results as examining the research model in the context of different tasks. The use of a single item to measure each independent variable can be one of limitations of the study. For example, the insignificant effect of perceived presence on performance might be caused by the incomplete measurement using a single question. Because there are multiple questions to measure perceived presence (e.g., Lessiter Freeman, Keogh, & Davidoff (2001), Witmer & Singer (1998)), future research can select some of them. Because questions to measure perceived affordance and feedback of interfaces have been underdeveloped, future research needs to develop more question items related to the perception of affordance and feedback, which can be applied in the context of advanced cyberspaces. Also, we focused on only three factors for evaluating usability. In future research, more potential factors need to be included and examined to understand usability of SVWs: for example, affective factors (perceived enjoyment (van der Heijden, 2004)), personal characteristics (self-efficacy (Compeau & Higgins, 1995)).

6. Conclusion

With the increasing popularity of SVWs for Web 2.0 and beyond, users have more options of choosing where to play and meet people in cyberspaces. Attracting users to a specific SVW is challenging but retaining them is even more important for SVW providers. The current study attempts to shed light on the possible causes of user attrition rate of SVW, and examines it as a function of usability. Our results validate perceived affordance and perceived feedback as significant factors among others influencing novice user performance in SVW. Instead of merely evaluating Second Life, we tested the assumption that user attrition might be caused by factors of the interface on user performance. In brief, users' sense of presence, the perceived affordance, and the perceived feedback of the interface and their impact on user performance were tested in order to discover the magnitude and association among them. By considering the implications of this study, designers of SVWs may be able to modify the interfaces for novice users to avoid the frustration and confusion that occurs as a result of their inexperience and unfamiliarity with the interface. By keeping novice users engaged and lowering attrition among SVW sites, designers may achieve a more significant return on their investment.

References

Adar, E., & Huberman, B. A. (2000, October). Free riding on Gnutella. Retrieved from http://www.hpl.hp.com/research/idl/papers/gnutella/gnutella.pdf

Argote, L., & Ingram, P. (2000). Knowledge transfer: A basis for competitive advantage in firms. Organizational Behavior and Human Decision Processes, 82(1), 150-169.

Barfield, W., & Weghorst, S. (1993). The sense of presence within virtual environment: A conceptual framework. Proceedings of the International Conference on Human-Computer Interaction, 699-704.

Biocca, F. (1997). Cyborg's dilemma: Progressive embodiment in virtual environments. Journal of Computer-Mediated Communication, 3(2).

Blanchard, A. L., & Markus, M. L. (2004). The experienced sense of a virtual eommunity: Characteristics and processes. The Data Base for Advances in Information Systems, 35(1), 65-78.

Bowman, D., Krujiff, E., Laviola, J. Jr., & Poupyrev, I. (2005). 3D user interfaces: Theory and practice. Boston, MA: Addison-Wesley.

Chung, M., Kim, D., Na, S., & Lee, D. (2010). Usability evaluation of numeric entry tasks on keypad type and age. International Journal of Industrial Ergonomics, 40(1), 97-105.

Clark, H., & Brennan, S. (1991). Grounding in communication. In L. B. Resnick, J. M. Levine, & S. D. Teasley (Eds.), Perspectives on socially shared cognition (pp. 127-149). Washington. DC: American Psychological Association.

Compeau, D. R., & Higgins, C. A. (1995). Computer self-efficacy: Development of a measure and initial test. MIS Quarterly, 19(2), 189-211.

Csíkszentmihályi, M. (1998). Optimal experience: Psychological studies of flow in consciousness. Cambridge, NY: Cambridge University Press.

Danton's Second Life User Guide (2011). Retrieved from http://sluserguide.com/index.php?title=Main_Page

Dennis, A. R., & Kinney, S. T. (1998). Testing media richness theory in the new media: The effects of cues, feedback and task equivocality. Information Systems Research, 9(3), 256-274.

Duncan, S. (1973). Toward a grammar for dyadic conversation. Semiotica, 9, 29-47.

Faulkner, L. (2007). Structured software usability evaluation: An experiment in evaluation design. Unpublished doctoral dissertation, University of Texas, Austin, USA.

Fetscherin, M., & Lattemann, C. (2008). User acceptance of virtual worlds. Journal of Electronic Commerce Research, 9(3), 231-242.

Germonprez, M., Hovorka, D., & Collopy, F. (2007). A theory of tailorable technology design. Journal of the Association for Information Systems, 8(6), 351-367.

Godvertiser (2010). The reality of prayer in virtual reality. Retrieved from http://www.godvertiser.com/review/the-reality-of-prayer-in-virtual-reality

Godwin, M. (1994, June 2). Nine principals for making virtual communities work. Wired, 72-73.

Hair, F. J., Black, C. W., Badin, N. J., Anderson, E. R., & Tatham, R. L. (2005). Multivariate data analysis. New Jersey: Pearson Education Inc.

Herndon, K., van Dam, A., & Gleicher, M. (1994). The challenges of 3D interaction. SIGCHI Bulletin, 26(4), 36-43.

Hoffman, T. P., & Novak, D. L. (1996). Marketing in hypermedia computer-mediated environments: Conceptual foundations. Journal of Marketing, 60, 50-68.

ISO. (1998). Ergonomic requirements for office work with visual display terminals (VDTs) -- Part 11: Guidance on usability ISO 1941-11.

Jung, Y. (2011). User adoption of social virtual worlds from the perspective of the sense of presence and autonomy. Journal of Computer-Mediated Communication, 16(4), 492-510.

Juul, J. (2005). Half-real: Video games between real rules and factional worlds. Cambridge, MA: MIT Press.

Kang I., Lee, K. C., Lee, S., & Choi, J. (2007). Investigation of online community voluntary behavior using cognitive map. Computers in Human Behavior, 23, 111-126.

Keng, C-J, Ting, H-Y, & Chen, Y-T. (2011). Effects of virtual-experience combinations on consumer-related "sense of virtual community". Internet Research, 21(4), 408-434.

Kim, A. J. (2000). Community building on the Web: Secret strategies for successful online communities. London: Addison Wesley.

Kim, B., & Han, I. (2009). User behaviors toward mobile data service (MDS): The role of perceived free and prior experience. Expert Systems with Applications, 36(4), 8528-8536.

Kim, T., & Biocca, F. (1997). Telepresence via television: Two dimensions of telepresence may have different connections to memory and persuasion. Journal of Computer-Mediated Communication, 3(2). http://DOI: 10.1111/j.1083-6101.1997.tb00073.x

Koh, J., & Kim, Y. (2003). Sense of virtual community: A conceptual framework and empirical validation. International Journal of Electronic Commerce, 8(2), 75-93.

Kraus, R., & Weinheimer, S. (1996). Concurrent feedback, confirmation, and the encoding of referents in verbal communication. Journal of Personality and Social Psychology, 4, 343-346.

Lessiter, J., Freeman, J., Keogh, E., & Davidoff, J. D. (2001). A cross-media presence questionnaire: The ITC sense of presence inventory. Presence: Teleoperators and Virtual Environments, 10(3), 282-297.

MacMillan, D. (2006, November 20). Why savvy CEOs hang out in Second Life. Business Week.

Mockus, A., Fielding, R. T., & Andersen, H. (2002). Two case studies of open source software development:

Apache and Mozilla. ACM Transactions on Software Engineering and Methodology, 11, 309-346.

Norman, D. (1990). The design of everyday things. New York: Currency Doubleday.

Norman, D. (1999, May/June). Affordances, conventions and design. ACM Interactions Magazine, 38-42.

Oliver, R. L. (1980). A cognitive model for the antecedents and consequences of satisfaction. Journal of Marketing Research, 17, 460-469.

Padovesi, S. (2008). Is it possible to get a Second Life building guide? Retrieved from http://ezinearticles.com/?Is-it-Possible-to-Get-a-Second-Life-Building-Guide?&id=1602864

Parmentier, G., & Rolland, S. (2009). Identity building and consuming experience in Second Life. Recherche et Applications en Marketing, 24(3), 44-55.

Platoni, K. (2008, March/April). Will Second Life survive? California Magazine, 53.

Preece, J., Rogers, Y., & Sharp, H. (2002). Interaction design. London: John Wiley & Sons.

Rubin, J., & Chisnell, D. (2000). Handbook of usability testing: How to plan, design, and conduct effective tests (2nd ed.). Indianapolis, IN: Wiley Publishing Inc.

Second Life User's Guide (2011). Retrieved from http://community.secondlife.com/t5/English-Knowledge-Base/Second-Life-User-s-Guide/ta-p/1244857

Sheridan, T. B. (1992). Defining our terms. Presence, 1, 272-274.

Slater, M., & Wilbur, S. (1997). A framework for immersive virtual environments (FIVE): Speculations on the role of presence in virtual environments. Presence, 6(6), 603-616.

Suh, K-S, & Lee, Y. E. (2005). Effects of virtual reality on consumer learning: An empirical investigation in Web-based electronic commerce. MIS Quarterly, 29(4), 673-697.

Sun, C-T, Lin, H. L., & Ho, C. H. (2006). Sharing tips with strangers: Exploiting gift culture in computer gaming. CyberPsychology & Behavior, 9(5), 560-570.

Toldy, M. (2010). The impact of working memory limitations and distributed cognition on solving search problems on complex informational Websites. Unpublished doctoral dissertation, University of Colorado, Boulder, USA.

Toral, S. L., Martínez-Torres, M. R., Barrero, F., & Cortés, F. (2009). An empirical study of the driving forces behind online communities. Internet Research, 19(4), 378-392.

van der Heijden, H. (2004). User acceptance of hedonic information systems. MIS Quarterly, 28(4), 695-704.

Venkatesh, V. (2000). Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. Information Systems Research, 11(4), 342-365.

Venkatesh, V., & Johnson, P. (2002). Telecommuting technology implementations: A within- and between-subjects longitudinal field study. Personnel Psychology, 55(3), 661-687.

Venkatesh, V., & Ramesh, V. (2006). Web and wireless site usability: Understanding differences and modeling

use. MIS Quarterly, 30(1), 181-206.

Warren, W. (1995). Environmental design as the design of affordances. In J. M Flach, P. A. Hancock, J. Ciard, & K. J. Vincente (Eds.), The ecology of human-machine system. Hillsdale, NJ: Lawrence Erlbaum.

Welch, R. B. (1999). How can we determine if the sense of presence affects task performance. Presence, 8(5), 574-577.

Whitmer, B. G., & Singer, M. J. (1998). Measuring presence in virtual environments: A presence questionnaire. Presence: Teleoperators and Virtual Environments, 7, 225-240.

Yoo, Y. (2010). Computing in everyday life: A call for research on experiential computing. MIS Quarterly, 34(2), 213-231.

Yoon, S., Laffey, J., & Oh, H. (2008). Understanding usability and user experience of Web-based 3D graphics technology. International Journal of Human-Computer Interaction, 24(3), 288-306.

Yu, C. P., & Chu, T. H. (2007). Exploring knowledge contribution from an OCB perspective. Information & Management, 44(3), 321-331.

Yu, J., Ha, I, Choi, M., & Rho, J. (2004). Extending the TAM for a t-commerce. Information & Management, 42(7), 965-976.

Zhou, T. (2011). Understanding online community user participation: A social influence perspective. Internet Research, 21(1), 67-81.

[Appendix] Statistics of the data

Descriptive Statistics

	Mean	Std. Deviation	N
Presence	3.0750	1.45686	40
Feedback	2.8500	1.47718	40
Affordance	3.1000	1.41058	40

Correlations

		Presence	Feedback	Affordance
Presence	Pearson Correlation	1	.291	.321*
	Sig. (2-tailed)		.068	.044
	N	40	40	40
Feedback	Pearson Correlation	.291	1	.672**
	Sig. (2-tailed)	.068		.000
	N	40	40	40
Affordance	Pearson Correlation	.321*	.672**	1
	Sig. (2-tailed)	.044	.000	
	N	40	40	40

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).