Exploring the Use of Virtual World Technology for Idea-Generation Tasks

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ABSTRACT

While the potential value of Virtual World Technologies (VWTs) lies in their promise to facilitate communication through new and novel forms of collaboration, there is a lack of prior research that examines how VWTs compare to other types of information and communication technologies (ICT) commonly used to support collaborative work. This study investigates the effects of VWTs on group ideation outcomes; specifically, it compares the use of Second Life to a chat environment for idea generation tasks. As hypothesized, groups using VWTs for an idea generation task generated significantly more unique ideas and enjoyed using the environment more than the chat environment. Contrary to our predictions, no significant difference between the two environments was observed for satisfaction, group cohesion, and social presence.

Keywords: Communication, Cohesion, Satisfaction, Second Life, Virtual Groups

INTRODUCTION

Virtual worlds are three-dimensional, (3D) computer-based, simulated environments where individuals, represented by avatars, can interact and communicate synchronously in a shared space that mimics the real world. Virtual world technologies (VWTs), such as Second Life (by Linden Labs), have surfaced as a placeless space of immense opportunity. Virtual worlds have attracted the attention of businesses and researchers as a promising alternative environment in which to communicate, collaborate and organize economic activities (Davis, Murphy, Owens, Khazanchi & Zigurs, 2009; Kock, 2008; Wasko, Teigland, Leidner & Jarvenpaa, 2011). Researchers have even predicted that, by 2018, virtual worlds will be the principal platform for

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business applications and opportunities (Ives & Jungles, 2008). Many organizations such as Toyota, IBM, Reuters, and Wells Fargo have purchased land and other resources in virtual worlds with the hope of both exerting their presence (i.e., brand awareness) and providing their stakeholders with a virtual space to interact (Kock, 2008; Liu & Burn, 2009). Unfortunately, many organizations have grown impatient waiting to see a return on investment from their VWT projects and, in some cases, have even terminated such projects (e.g. Google's Lively and Oracle's Darkstar) due to insufficient evidence of the value of VWTs.

While the potential value of VWTs lies in their promise to help facilitate communication through new and novel forms of collaboration, little is known about the value of adopting and employing these emergent, virtual platforms as new work spaces and places for organizational groups and teams (Boughzala, Vreede & Limayem, 2012; Sivunen & Hakonen, 2011). One of the perceived advantages of VWTs over traditional communication technologies (e.g., e-mail, chat) is that they provide media capabilities that can enhance verbal, visual, and spatial cues (Davis et al., 2009) that may result in a richer, more immersive experience. Without specific metrics, however, the value that can be created by simply transferring existing business practices and processes from one medium to another remains unclear (Duranti & de Almeida, 2012; Ross, Recker & West, 2011; Sivunen & Hakonen, 2011).

In order to determine if VWTs provide more value than other mediums used for collaboration purposes, a direct comparison of mediums must be performed. Few studies, however, have empirically examined how virtual worlds compare to other types of information and communication technologies (ICT) commonly used by organizations to support group work processes, such as ideation (e.g., Hoyt & Blascovich, 2003; Siau, et al., 2010).

To date, virtual world studies have primarily centered on a medium's effectiveness for enhancing learning outcomes, commerce activities, work-flow outcomes, general collaboration, and, more recently, enriching creativity (Davis et al., 2009; Siau, Nah, Mennecke, & Schiller, 2010). A recent study by Venkatesh & Windeler (2012) compared two collaborative technology systems, one of which was a virtual world system, and found that the relationship between team technology use and team cohesion was stronger over time for teams using a VW system, which positively influenced team performance. In the Venkatesh & Windeler (2012) study, team performance was a self-reported measure of how the team felt about the quality of their work and the effectiveness of their team.

The current study examines whether VWTs can enhance outcomes for groups working on an idea generation task. An empirical study comparing two different types of computer-mediated settings (i.e., a chat room and a VWT) was conducted to see if VWTs facilitate relative, measurable value as compared to other techniques that have been examined in the extant ideation, group decision support, and computer-mediated collaboration literature. Consistent with prior ideation research (e.g., Dennis & Reinicke, 2004; Valacich, Dennis, & Connolly, 1994), this study does not operate under the assumption that every single idea formulated is contributory to better group performance, or that idea quantity and quality are the only important dependent variables in ideation research. Rather, we recognize many additional dependent variables in the broader context of collaboration activities that holistically embody the study of socio-technical phenomena in the context of group-supported work in organizations. Hence, we also measure satisfaction, enjoyment, social presence, and cohesiveness.

LITERATURE REVIEW

Many organizations have adopted some form of computer-mediated communication (CMC), particularly chat-type programs, to support communication and collaboration tasks performed by teams whose members reside in geographi-

cally dispersed locations. Prior research comparing groups using CMC to nominal groups (i.e., a condition where group members work individually to generate ideas and their ideas are later pooled together) for idea generation tasks has led to mixed results, with nominal groups appearing at least as productive as some CMC groups (e.g., Dennis & Valacich, 1994; Gallupe, Bastianutti & Cooper, 1991; Pinsonneault, Barki, Gallupe, & Hoppen., 1999a, 1999b). In contrast, research comparing groups using a CMC environment versus a face-to-face environment for idea generation tasks has overwhelmingly found that using a CMC environment provides groups with the opportunity to increase their productivity and potency by reducing and overcoming various physical constraints as well as social and psychological phenomena (e.g., Nunamaker, Dennis, Valacich, Vogel, & George, 1991; Connolly, Jessup & Valacich, 1990; Gallupe et al., 1991; Gallupe et al., 1992; Valacich, et al., 1994; Valacich & Dennis, 1994). Moreover, it has been reported that participants using CMC are more satisfied than participants using other forms of idea generation (e.g., face-to-face, or nominal) (Dennis & Valacich, 1993; Gallupe et al., 1990 & 1991; Valacich et al., 1994).

To date, most research comparing different types of CMC technologies has focused on 2D, or "flat" text, systems despite the existence of richer, 3D, computer-simulated environments (Fjermestad, 2005; Fjermestad & Hiltz, 1998; Wasko et al., 2011). The goal of the current study is to help fill this gap in knowledge by investigating the effects on group outcomes between leaner and richer CMC environments for an idea generation task. In an effort to add to the existing body of knowledge on group ideation, the study also provides results comparing a nominal treatment condition to the virtual world treatment condition.

Media Capabilities

Researchers (Jiang and Benbasat, 2005; Lim and Benbasat, 2000) suggest that many newer computer-mediated platforms provide various multimedia features and formats that yield two primary advantages over traditional computer-mediated environments, namely: (1) multimedia bring together "the symbolic and processing capabilities of various media," and (2) by doing so create a "richer symbolic system of communication" (p. 118). Lim and Benbasat (2000) suggest that multimedia environments augment perceptual experiences by providing users with different information cues (verbal and nonverbal) without competing for, or overloading, their limited cognitive resources. According to theories of media richness, providing individuals with multi-sense, rich environments can directly influence their levels of involvement and engagement, which may lead to improved performance on an array of tasks. As a result, the more immersive, personalized experience provided by VWTs may offer many advantages relative to traditional mediums without such features, which should lead to improved outcomes (Hambley, O'Neill & Kline, 2007).

While a number of media characteristics have been examined in the information systems literature, there are two that seem especially relevant to the current study – vividness (e.g., Lim & Benbasat, 2000; Lim, Benbasat, & Ward, 2000) and interactivity (e.g., Haseman, Nuipolatoglu, & Ramamurthy, 2002; Kettanurak, Ramamurthy, & Haseman, 2001). These two, unique media characteristics differentiate virtual world environments from traditional, computer-mediated environments (Davis et al., 2009). A collaboration environment that is more vivid and interactive, and therefore more immersive, interesting, and engaging, should lead to improved outcomes when performing a task such as idea generation.

Vividness

Vividness is defined as "the representational richness of a mediated environment as defined by its formal features; that is, the way in which an environment presents information to the senses" (Steuer, 1992, pp. 81). There are two components of vividness – sensory breadth and depth. Sensory breadth refers to

the number of sensory dimensions and cues that are presented simultaneously, while depth refers to the resolution within each perceptual channel. A presentation media with a high level of sensory stimulation and appeal is associated with increased sustained attention (Agius & Angelides, 1999; Burns & Anderson, 1993). Nisbett and Ross (1980, p.45) suggest that as information cues increase in vividness, they are more "likely to attract and hold our attention and to excite the imagination to the extent that [they are] (a) emotionally interesting; (b) concrete and imagery-provoking; and (c) proximate in a sensory, temporal, or spatial way." Similarly, it has been argued that human senses are the conduit to the mind, and since multimedia appeals to a variety of senses, it is posited that multimedia technologies generate greater perceptions of immersion as well as foster greater involvement and engagement with computer systems (Biocca, 1997) and associated objects (e.g., avatars). Burns and Anderson (1993) note that increased sustained attention is also associated with greater sensory stimulation and appeal.

Interactivity

Liu and Shrum (2002) suggest that the array of conceptualizations and operationalizations of interactivity yield, at best, inconclusive findings; however, the body of mixed results begins to crystallize under the taxonomy of *user-machine interactivity*, *user-user interactivity*, and *user-message interaction* (Szuprowicz, 1996). *User-machine* or *user-document* interactivity emphasizes human interaction with computers (both assume navigation with no manipulation of content), whereas in the *user-user* interactivity perspective, the focus is on interpersonal two-way communication. Within the *user-user* component of the interactivity taxonomy, users perceive the technology (e.g., computer-mediated communication tools) to be more interactive as the environment increasingly resembles interpersonal communication (Ha & James, 1998). In the *user-message* interactivity perspective, interactivity refers to the ability of the user to control and modify the content of virtual worlds where continuous change in graphics resembles world-one (real world) action-reaction sequences (Schneiderman, 2005; Steuer, 1992).

As a result of the increased vividness and interactivity inherent in VWTs, it is proposed that small groups using VWTs for an idea generation task will experience increased levels of satisfaction, enjoyment, social presence and group cohesion, as well as produce more ideas. Specific hypotheses are developed in the next section.

HYPOTHESIS DEVELOPMENT

Idea Generation

Given the aforementioned literature review and subsequent findings on the roles of interactivity and vividness, it would be reasonable to expect a difference in productivity between chat and virtual world environments. Specifically, virtual worlds, relative to chat, are infused with higher levels of both interactivity and vividness, which increases engagement, involvement, and ultimately productivity.

H1: Groups using a virtual world technology for an idea generation task will produce significantly more ideas than groups using chat technology.

Satisfaction and Enjoyment

System usage is a necessary condition when it comes to reaping the productivity benefits from IS investments (e.g., Davis, Bagozzi, & Warshaw, 1989; Thompson, Higgins & Howell, 1991). Two factors that play an important role in system usage are satisfaction and enjoyment. Satisfaction has been used in prior IS research as a proxy for system effectiveness or success (e.g., Mahmood & Sniezek; 1989; Negash, Ryan, & Magid, 2003). In other words, the more satisfied a user is with the system, the more likely it is that they will use it and consider it to be

more effective. Likewise, if using the system is perceived to be personally enjoyable, users will be intrinsically motivated to use it (Lu, Zhau, & Wang, 2009).

Multimedia that are highly vivid and interactive are believed to foster greater levels of involvement, as well as focus and engage an individual's attention (Agius & Angelides, 1999; Biocca, 1997). Attention has been shown to be related to interest, motivation, and satisfaction (Alessi & Trollip, 1991). Moreover, involvement, which essentially speaks to an individual's level of interest in an activity, product or context (Decloe, Kaczynski, & Havitz 2009), is often conceptualized as a positive emotional construct consisting of elements of enjoyment, fun or excitement. Prior research shows that information systems that offer higher levels of interactivity and vividness are more interesting, fun, and stimulating, as well as lead to more positive user attitudes (Kettanurak et al., 2001). It is therefore posited that individuals will be more satisfied using a virtual world environment than a chat environment for an idea generation task, and will find it more enjoyable to use, due to the richer, more immersive qualities.

H2: Individuals using a virtual world technology for an idea generation task will experience greater levels of satisfaction than individuals using chat technology.

H3: Individuals using a virtual world technology for an idea generation task will experience greater levels of enjoyment than individuals using chat technology.

Social Presence

Social presence is defined as the feeling one has of being with another (Biocca, Harms, & Burgoon, 2003) and, along with satisfaction and enjoyment, is an important factor in determining system usage intentions as well as enhancing a user's experience (Karahanna & Straub, 1999), especially in a virtual world setting (Lingyun & Dong, 2008). According to Social Presence theory (Short, Williams, & Christie, 1976), social presence is a way to characterize an individual's subjective experience with a communication medium; the more cues conveyed by the medium, the higher social presence will be. It is posited that face-to-face communication provides the highest level of social presence while leaner computer-mediated communication, such as email and chat, are associated with lower levels of social presence due to the inability to convey social cues and tendency to "depersonalize" the communication interaction (Straub & Karahanna, 1998). Therefore, the variety of social cues provided by the interactive and vivid nature of VWTs can improve human communication by more closely mimicking face-to-face communication (Steinbruck, Schaumburg, Duda, & Kruger, 2002), which should lead to higher levels of social presence.

H4: Individuals using a virtual world technology for an idea generation task will experience greater levels of social presence than individuals using chat technology.

Group Cohesion

Prior research on workgroups suggests that group cohesion is an important factor in group processes and outcomes (Knight, Pearson, & Hunsinger, 2008; Summers, Coffelt, & Horton., 1988). Group cohesion is described as a members' feeling of belongingness or attraction to the group (Hogg, 1992). According to media richness theories (i.e. Daft & Lengel, 1986; Short, et al., 1976), the ability of a medium to facilitate social relationships is related to its capacity for conveying a variety of cues. As such, it is believed that a richer media allows for more relational interactions than a leaner media and therefore leads to higher levels of group cohesion (Knight, et al., 2008). It could therefore be argued that VWTs, with their richer environment, may be more conducive to building social relationships and therefore should lead to higher levels of group cohesion.

H5: Individuals using a virtual world technology for an idea generation task are likely to experience greater levels of group cohesion than individuals using chat technology.

It should be noted, that while this study does not formulate hypotheses comparing either CMC treatment condition to the nominal treatment, it does report on and discuss such findings in order to provide a baseline for comparison between the current research and the extant literature as well as to present relative comparisons of chat and virtual world environments to a standard methodology of ideation.

METHOD

Participants

The subjects for this study were drawn from the population of business students at a northeastern university in the United States. Specifically, subjects were enrolled in an introduction to management information systems course taken by all business majors and received course credit for their participation. In total, 115 subjects enrolled in the study (57% (n= 66) male, 43% (n = 49) female) and were randomly placed into 23 different groups – each group consisting of 5 to 7 members. Each group was then systematically placed into one of six treatment series.

The study's selection of group size was based on two premises. First, the purpose of the study is not to enter the debate of group size effects on ideation; rather, it is to explore the technology effects on ideation between electronic brain storming (EBS) formats – chat room vs. virtual world environment. Second, the extant literature and summative meta-analyses on EBS (e.g., Dennis &Williams, 2005) reveal a positive and significant effect of group size (i.e., as group size increases so does ideation, especially on unbounded tasks). Specifically, whenever group membership reaches four or more, EBS groups significantly outperform verbal ideation groups of similar size, and when group membership reached 10 or more, EBS groups significantly outperformed nominal groups of similar size. As such, the current study sought to avoid group size main effects on ideation modality by keeping membership between the aforementioned minimum and maximum thresholds of 4 and 10. In doing so, it is believed that groups of at least 5 and no more than 7 could serve to isolate any plausible effects of technology on ideation (i.e., group size would no longer be a key determinant).

Experimental Design

The experiment was a 3 x 3 factorial design with both order and control. Factor one – ideation environment - consisted of three levels (nominal, chat and virtual world). Factor two – task - consisted of three levels (parking, registration and technology). The control was within subject, or repeated measure, i.e., each subject provided data on the same dependent variables after each treatment. The design included full randomization for factor one and two such that all potential order effects were minimized (i.e., randomizing both the order of exposure to the vignettes as well as the order of the technology paired with a given vignette) (see Table 1).

In every treatment, subjects used the same computers with the same resolution and processing power. All subjects were exposed to the same lab conditions. All activities required subjects to type in their ideas. One unique feature of this study is that we did not artificially form nominal groups after the experiment by randomly pooling together ideas generated by individuals (Dennis & Valacich, 1993; Valacich et al., 1994). Rather, in order to measure the unique number of ideas generated by a nominal group, we pooled together ideas from individuals that had also worked together as a group in both CMC environments.

Task

The nominal treatment required subjects to collectively work together by producing ideas on their own (i.e., by typing them into a simple text editor). Subsequently, subjects emailed their solution to one of the researchers who then combined all answers for later analysis. The chat

Table 1. Sequence of treatments and vignettes

Treatment	1	2	3	4	5	6
Vignette						
Parking	VW	VW	C	C	N	N
Tech	C	N	VW	N	VW	C
Registration	N	C	N	VW	C	VW
Note. VW – Virtual World; C – Chat; N – Nominal.						

treatment required subjects to collectively work together by producing ideas in a synchronous chat tool available in Blackboard 9. The chat tool afforded subjects to see, at all times, every plausible solution submitted by themselves and all other members in real time. Upon completion of their task, each group submitted the entire thread of ideas to one of the researchers who saved the document for subsequent analysis. The virtual world treatment required subjects to collectively work together by producing ideas in a synchronous, virtual conference room that the researchers built in Second Life. This environment also allowed subjects to see their own solutions, as well as those generated by their team members.

As recommended by prior research, the current study utilized tasks that are relevant to the subjects, and that subjects are personally knowledgeable about (e.g., Nunamaker, et al., 1991; Fjermestad & Hiltz, 1998). As such, the vignettes used arose from an initial pilot study where subjects were asked to identify the top five problems they face at the university. The following three scenarios were identified as being most salient to the population: (1) issues with registration, (2) issues with parking, and (3) issues with technology. For all treatments, subjects were exposed to a series of three vignettes – one per treatment. To remove potential order effects, the sequence of treatments and vignettes were counterbalanced (see Table 1 above).

Training

For the nominal treatment conditions, subjects were required to show proficiency in opening Notepad, creating content, saving the file, and sending it to one of the primary investigators as an email attachment. For the computer-mediated conditions, subjects participated in a two-part familiarization session approximately one week prior to the experiment. The first part of the session required students to open Blackboard, enter into the chat function, and chat with a preset initial thread posted by one of the primary investigators. In the second part of the session, all subjects were required to create a Second Life account, create and customize their avatar, and take a tour of the virtual conference room. The purpose of the tour was to familiarize subjects with the functionality of the chat tool in the virtual world environment.

Procedure

All subjects filled out an initial questionnaire with demographic information. Subsequently, students were randomly assigned to one of six treatment groups to complete three consecutive, independent tasks. Each task instructed participants to produce as many high-quality, plausible solutions to the aforementioned campus-based issues (registration, parking, and technology). The vignettes have been provided in the appendix. Immediately following each treatment,

subjects filled out a questionnaire ascertaining their perceptions of cohesion, social presence, satisfaction, enjoyment, ease of use, and usefulness relative to the ideation environment they had just participated in.

Measures

The extant literature presents two competing views when it comes to declaring the critical dependent variable – or desired outcome – in ideation research. While some argue that it is the number, or quantity, of ideas produced, others argue that it is the quality of the ideas produced (e.g., Barki & Pinsonneault, 2001; Diehl & Stroeb; 1987; Diehl & Stroeb, 1991; Fjermestad & Hiltz, 1999; Valacich & Dennis, 1994). More recently, Reining and Briggs (2008) suggest that the difference can be explained by cognitive inertia and limits within the solution space. Regardless of what side of the argument one favors, the correlation between idea quantity and idea quality remains quite high (e.g, > 0.90) suggesting that either can be used for the purpose of comparing ideation techniques (e.g., Reining & Briggs, 2008). Hence, the current study measures productivity in terms of the number of unique ideas generated.

The procedure used to determine the number of unique ideas generated was similar to that used by Dennis & Valacich (1994). After collecting the thread of ideas generated by all teams for each treatment, three of the primary investigators then went through each thread and individually identified what they believed were unique ideas. The same investigators then met as a group and discussed any discrepancies relative to any differences that emerged for each and every thread. For every discrepancy, the same three investigators openly debated the uniqueness of the thread (e.g., Nicholson, Sarker, Sarker, & Valacich, 2008) until complete agreement was reached.

In addition to measuring idea quantity, the study also collected data on salient beliefs and affective states. Specific information regarding the scales used to measure each of these constructs can be found in Table 2. Construct validity for the measures was established using Structural Equation Modeling (SEM). Although other methods exist in the literature for determining construct validity (e.g., MTMM, PCA, etc.), testing the measurement model (CFA) via SEM is an extremely powerful and accepted technique. As such, structural equation modeling (SEM) was employed to test for convergent and divergent validity. Group cohesion, social presence, satisfaction, enjoyment, ease-of-use and usefulness were evaluated in a single measurement model with AMOS 21. All factor loadings (squared multiple correlations) exceeded the threshold of 0.60 and were significant at $p < 0.001$ (See Table 3). Moreover, although the measurement model was significant at $p < 0.001$, the fit statistics indicate a good fit: chi-square/df = 1.996, GFI = 0.883, AGFI = 0.855, CFI = 0.974, NFI = 0.949 and RMSEA (CI) = 0.054 (0.048-0.061).

Discriminant validity was also verified using a chi-squared differences test. Specifi-

Table 2. Measurement variables used in study

Name	Items	Scale	Treatment Assessed	Adapted From
Group Cohesion	6	7 point	Nominal, Blackboard, Virtual	Chin, Salisbury & Gopal, 1999
Social Presence	6	7 point	Nominal, Blackboard, Virtual	Short, Williams & Christie, 1976
Satisfaction	5	7 point	Nominal, Blackboard, Virtual	Doll & Torkzadeh, 1988 Kim, Hiltz & Turoff, 2002
Enjoyment	3	7 point	Nominal, Blackboard, Virtual	Venkatesh, 2000
Ease of Use	4	7 point	Blackboard, Virtual	Venkatesh, 2000
Usefulness	4	7 point	Blackboard, Virtual	Venkatesh, 2000

Table 3. Factor loadings for measurement variables

Item		Construct	Factor Loadings
gc1	←	Group Cohesion	.942
gc2	←	Group Cohesion	.923
gc3	←	Group Cohesion	.950
gc4	←	Group Cohesion	.823
gc5	←	Group Cohesion	.942
gc6	←	Group Cohesion	.895
sp1	←	Social Presence	.853
sp2	←	Social Presence	.907
sp3	←	Social Presence	.938
sp4	←	Social Presence	.778
sp5	←	Social Presence	.891
sp6	←	Social Presence	.859
sat5	←	Satisfaction	.868
sat4	←	Satisfaction	.746
sat3	←	Satisfaction	.744
sat2	←	Satisfaction	.975
sat1	←	Satisfaction	.975
eou1	←	Ease-of-Use	.699
eou3	←	Ease-of-Use	.884
eou4	←	Ease-of-Use	.842
usf4	←	Usefulness	.950
usl3	←	Usefulness	.961
usf2	←	Usefulness	.967
usf1	←	Usefulness	.934
enj3	←	Enjoyment	.923
enj2	←	Enjoyment	.911
enj1	←	Enjoyment	.946

Note. eou2 was removed from the measurement model as its factor loading (i.e., squared multiple correlation) did not exceed the prescribed threshold of 0.60.

cally, we examined the change in chi-squared (ΔX^2) between models where one model was set to unity (i.e., the correlation between latent constructs was set to 1.0) and the other was free to vary. Discriminant validity is established when the ΔX^2 exceeds the critical value (CV) of 3.841. All ΔX^2 exceeded the CV. As such, discriminant validity was established.

RESULTS

All variables of interest were analyzed by conducting a series of one-way repeated-measures ANOVAs. Specifically, the within factor in the current study is treatment condition – nominal, chat, and VWT – and the dependent variables are group cohesion, satisfaction, social presence,

enjoyment, and total number of unique ideas generated. The means and standard deviations for all dependent variables are presented in Table 4 (the nominal condition was included to serve as a baseline).

Without exception, all one-way repeated-measures ANOVA tests indicated a significant treatment effect. Moreover, all tests supported the assumption of equal variances (i.e., the Levene's test for homogeneity of variance were non-significant) and sphericity assumptions (i.e., Greenhouse-Geisser and Huynh-Feldt yielded the same F value as Sphericity Assumed). Results of hypothesis testing are presented in Table 5.

Follow-up pairwise comparison tests of within subject effects were conducted on all dependent variables. The acceptable α levels were systematically adjusted by way of Holm's (1979) sequential Bonferroni procedure to control for family wise error rates (i.e., the largest p value was tested for significance with a threshold of α/3 and the second largest p value was tested for significance with a threshold of α/2) (Holm, 1979; Rosenthal & Rosnow, 1991). Pairwise comparison results are presented in Table 6.

DISCUSSION

Summary of Findings

As hypothesized, groups using VWTs produced significantly more unique ideas, and enjoyed the environment more, than a chat environment. However, no significant difference was found between CMC environments on social presence, satisfaction, or group cohesion. Possible explanations for these unexpected results follow.

Our results found that subjects were slightly more satisfied with the chat environment than the VWT environment. One possible explanation for this result may be found in the extant literature on end user satisfaction, which suggests that satisfaction is determined by factors such as ease-of-use, frequency of use, and memories based on prior usage (e.g., Doll

Table 4. Means and standard deviations for variables used in study

Variable	Mean			SD		
	VWT	Chat	N	VWT	Chat	N
Group Cohesion	5.38	5.50	3.63	.984	1.05	1.64
Social Presence	5.04	4.90	2.51	1.35	1.29	1.39
Satisfaction	5.56	5.60	3.62	1.04	.950	1.54
Enjoyment	5.60	5.32	3.34	1.15	1.22	1.56
Unique Ideas	9.53	7.12	12.12	2.40	2.50	3.31

Table 5. Results of ANOVA procedures testing hypotheses

Hypothesis	t statistic	p value	Results
H1 (Ideas: SL vs BB)	6.13	.001	Supported
H2 (Sat: SL vs BB)	- .371	.355	Not Supported
H3 (Enj: SL vs BB)	2.42	.008	Supported
H4 (SP: SL vs BB)	.821	.206	Not Supported
H5 (GC: SL vs BB)	- 1.09	.138	Not Supported

Note. Results column indicates whether or not hypothesis was supported.

Table 6. Pairwise comparison tests of within subject effects

Variable	Wilks' Λ	F (2,106)	Significance	Multivariate η^2
Group Cohesion	.480	57.34	$p < .001$	.520
Social Presence	.315	115.30	$p < .001$	.685
Satisfaction	.455	63.61	$p < .001$	.545
Enjoyment	.393	82.03	$p < .001$	.607
Unique Ideas	.169	36.85	$p < .001$	.831

Note. Wilks' Λ = Wilks' Lamda, F = F-ratio

& Torkzadeh, 1988). As such, it is plausible that users may have formed a more positive attitude – in this case satisfaction – toward the chat environment because they found it easier to use, more useful, or had prior experience using the system. The current research collected data from subjects regarding their prior experience with chat and VWT environments on the initial questionnaire, as well as their post-treatment perceptions of ease of use with each ideation environment. As illustrated in Table 7, there was a significant difference between the VWT and chat environments on both prior experience ($t(115)=31.53$, $p < 0.001$) and ease of use ($t(115)=3.527$, $p=0.001$), which, in lieu of prior research, may have led to higher levels of satisfaction with the chat environment.

While there was no significant difference between the VWT environment and the chat environment for group cohesion and social presence, these results do not come as a complete surprise. First, group cohesion is an outcome of the group development process (Forsyth, 1990; Tuckman, 1965). Since these groups had no prior history of working together, there may have been a ceiling effect on the impact of a particular media's richness such that it had a limited effect on feelings of belonging or attractiveness to the group. Secondly, prior research (Yoo & Alavi, 2001) shows that media condition has less of an influence on social presence than other psychological constructs, such as group cohesion.

While the study did not hypothesize any relationships between virtual world and nominal contexts per se, it should be noted that additional analysis revealed significant differences between the VWT condition and the nominal condition (see Table 8). Specifically, individuals experienced greater levels of satisfaction, social presence, group cohesion, and enjoyment using the VWT for idea generation over the nominal condition. These findings are similar to results from prior research that find that individuals who work on a particular task as part of a group have a greater positive affect toward the experience than individuals who work in isolation on the same task (Heath & Jourden, 1997).

There was also a difference in the number of unique ideas generated, with the nominal condition producing significantly more unique ideas than the VWT condition. This finding lends support to prior studies where nominal groups have been shown to outperform CMC

Table 7. Mean difference testing of prior knowledge and ease of use

Variable	Mean		SD		Significance
	VWT	Chat	VWT	Chat	
Prior Knowledge	2.02	5.43	.874	.984	$p < .001$
Ease of Use	5.51	5.84	.973	.824	$p = .001$

Table 8. Mean difference testing of VWT and nominal condition

Hypothesis	t statistic	p value
Group Cohesion	10.38	< .001
Social Presence	14.54	< .001
Satisfaction	10.60	< .001
Enjoyment	12.86	< .001
Unique Ideas	2.56	.015

Note. ANOVA procedures were used for these tests

groups, especially in smaller groups (e.g., Dennis & Valacich, 1994).

Based on the aforementioned findings, this study provides evidence that if organizations employ a VWT, rather than a chat environment, for idea generation, it can result in significant increases in both relative productivity and enjoyment for group members. While there was no significant difference between the VWT and chat environment for other meaningful indicators of group wellbeing, specifically group cohesion and social presence, it would be expected that as groups work together for an extended period of time, these social factors would naturally increase and be even more enhanced by the rich environment offered by VWT. Nevertheless, only after longitudinal studies have been conducted will the actual nature of the medium's social and technological affordances on group-level activities and overall wellbeing be better understood.

As such, we suggest organizations take advantage of the combinatorial benefits of both face-to-face and VWT environments. That is, as groups go through the group development process, both face-to-face and VWT interactions should be encouraged and supported. In doing so, it is believed that other salient indicators of group wellbeing will be positively affected thereby having additive social effects in addition to the technology-enhanced benefits of increased productivity and enjoyment. Furthermore, organizations that plan on employing VWT environments should provide ample training to familiarize users with these highly interactive and vivid environments. By doing so, users may perceive these richer environments to be just as easy to use as chat environments, which may lead to increased satisfaction and system success.

Limitations and Future Research

The use of student subjects could be considered a limitation, as relying on student subjects has been criticized for lacking both generalizability and realism (e.g., Gordon, Slade, & Schmitt, 1986, 1987). This limitation has, however, been challenged. For example, it has been argued that all research, to some extent, draws from a set of homogeneous subjects. That is, there are unique factors common to all groups (e.g., students, employees in an organization, citizens of a community, etc.) that, to some extent, limit a study's external validity. Despite the fact that we drew from a set of homogenous subjects, we believe we have come as close as possible to mimicking a "real-world" idea generation task by choosing problems/issues that are relevant to the subjects and that subjects are personally knowledgeable about (e.g., Nunamaker, et al., 1991, Fjermestad & Hiltz, 1998). Another limitation is that we used groups with no history of working together. Prior research (e.g., Burke & Chidambaram, 2001; Yoo & Alavi, 2001) has shown that as groups spend more time working together, they can perceive lean media to be richer than it is. Future research should therefore investigate the use of different CMC environments for idea generation tasks using both established and zero-history groups.

Future research on the longitudinal effects of using VWTs as a platform for ideation is necessary based on the notion that an individual's perceptions of the technology, such as its ease of use, would be expected to change with prolonged use of the technology and in turn affect their attitude toward the technology. For example, had we conducted a longitudinal study on the effects of using a VWT versus a chat environment for idea generation, we may have found that individuals were more satisfied with the VWT. In other words, we might have

found that the influence of media richness on satisfaction is additive, rather than substitutive, to that of ease of use.

CONCLUSION

This research presents a broad-brush investigation of whether using a virtual world technology for idea generation creates additional value for a firm and its group-related processes. Findings from the study suggest that organizations should exercise caution in adopting and deploying VWTs for purposes of collaboration. Our findings reveal mixed support for the use of a VWT over a chat environment for purposes of idea generation; however, additional analysis beyond the hypotheses provides some plausible explanations for our results. Given the results of this study, firms can employ VWTs for an idea generation task with the confidence of knowing that they may enhance productivity and that employees will enjoy using the environment. Furthermore, while the results of this study did not find support for increased levels in other group process outcomes, such as satisfaction, social presence, and group cohesion, there was no evidence that the use of VWTs has a significant negative impact on these outcomes. Hence, while the potential value of VWTs lies in their promise to help facilitate innovation by opening up new and novel forms of interaction, the initial findings may still cause researchers to question the assumption that more is better.

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APPENDIX

VIGNETTES

Problem A – Parking at XXXX University

As many of you may know, for both residential and commuter students, parking has been a serious issue at XXXX University. Parking spaces are frequently unavailable in both lots, especially during the afternoon hours, and the number of parking lots for use is limited. Furthermore, many lots are located far away from many academic buildings and many available parking spaces are difficult to find or get to, leaving closer and more convenient parking to be desired. Within the confines of your specific method of communication, please work together to present as many thorough ideas for solutions to this problem as you can within the respective time frame provided.

Problem B – Registration and Course Selection XXXX University

One problem that students of all levels frequently encounter is the registration process. Advisors can be hard to schedule meetings with, course structuring can be very confusing, and information about the registration process and specific dates is not always convened in the most effective manner. Course selection is also a problem that many students have issues with, as well as the size of each class. Many students have trouble making sure they are officially registered for specific courses with prerequisites that may or may not have been covered and must work around these issues. Within the confines of your specific method of communication, please work together to present as many thorough ideas for solutions to this problem as you can within the respective time frame provided.

Problem C – Technology Operation and Availability at XXXX University

Recently, many students have experienced various problems with the availability and functionality of technology at XXXX University. XXXX University now charges for printing in computer labs, and wireless/cellular/internet coverage at Rowan is limited or does not always work properly. Computers in these respective labs are becoming increasingly full during peak study hours, leaving a lack of available machines. Also, many of these machines are consistently not functioning properly. Within the confines of your specific method of communication, please work together to present as many thorough ideas for solutions to this problem as you can within the respective time frame provided.

Jennifer A. Nicholson is an Associate Professor of MIS at Rowan University. She received her Ph.D. Business Administration with a specialization in Information Systems from Washington State University. Dr. Nicholson's research interests include computer-mediated learning and collaboration, human-computer interaction, and mobile computing. Her work has been published in the Journal of Organizational and End User Computing, the Journal of Information Technology Education, Informing Science, as well as in many national and international conference proceedings. Dr. Nicholson also serves on the Editorial Review Boards of the Journal for Computer Information Systems and the Journal of Information Technology Education. She also serves as an ad-hoc reviewer for many peer-reviewed journals and international conferences.

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Andrew Hardin is the director of the Center for Entrepreneurship and an associate professor in the Lee Business School at the University of Nevada, Las Vegas. Dr. Hardin's research is focused on organizational collaboration and virtual work, financial decision support systems, and research methodologies. His work has been published in journals such as Management Science, MIS Quarterly, Organizational Behavior and Human Decision Processes, Journal of Management Information Systems, European Journal of Information Systems, Journal of the Association for Information Systems, The DATA BASE for Advances in Information Systems, Group Decision and Negotiations, Small Group Research, and Educational and Psychological Measurement. He currently serves as a senior editor for Information Systems Journal and The DATA BASE for Advances in Information Systems, as a senior associate editor for the European Journal of Information Systems, and as a guest associate editor for MIS Quarterly.

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