Telepresence in Virtual Conferences: An Empirical Comparison of Distance Collaboration Technologies

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ABSTRACT
We evaluate two virtual conferences held using Second Life™ (an avatar-mediated 3D virtual world), desktop video, and text-mediated asynchronous conferencing. Both events spanned several days, used several formats (e.g., keynotes, poster sessions, social events), and had attendance in the hundreds. We examine meeting success, technical issues, and how virtual experiences compare to face to face conferencing. A majority felt the conferences were a success despite technical and other issues. In both conferences, Second Life™ was more successful than other technologies in creating a sense of co-presence.

Author Keywords
Virtual meetings/conferences, distance collaboration.

ACM Classification Keywords
H.5 [**Information Interfaces and Presentation**]: H.5.1. Multimedia Information Systems – *artificial, augmented, and virtual realities;* H.5.3 Group and Organizational Interfaces – *collaborative computing, computer-supported cooperative work, synchronous interaction.*

INTRODUCTION
Over the last year, economic conditions led IBM to curtail internal travel. One consequence was the replacement of some face to face meetings – meetings that would have required travel by participants across the globe – with virtual meetings. The virtual meetings were held using a variety of technologies, but the centerpiece, and most ambitious use of technology was IBM's behind-the-firewall version of Second Life™.

Given arguments that distance (still) matters [2] and documented challenges for virtual world technologies in business contexts [1], this effort raises questions from how well the technology works to how effective virtual conferences are at providing the benefits – information exchange, opportunistic interactions, social network building – commonly found in face to face conferences.

Rather remarkably, there is almost no research in this area. We have been unable to find any scientific studies of meetings or conferences held in Second Life™ or other virtual environments. The closest the literature comes is a small body of reports on the use of digital backchannels like IRC, chat or Twitter as adjuncts to face to face conferences. Beyond the scientific literature, there are anecdotal accounts of virtual meetings and conferences online. Much of the material we found was produced on internal blogs in response to the 2008 virtual meeting of IBM's Academy of Technology. In short, it appears that the study of *virtual conferences* breaks new ground.

Even more surprising is the absence of a literature on face to face conferences. While meetings – in the sense of single session, short duration, purpose-oriented gatherings of up to a few dozen people – have received considerable attention, conferences – multi-session, long duration gatherings of hundreds of people – have received little. The practical import of this is that there is no baseline against to which compare virtual conferences. Nor is there agreement on what social and professional qualities face to face conferences offer, or how their study should be approached. So, this study very much starts from scratch.

We examine two virtual meetings held in 2009: a software technology conference and the IBM Academy of Technology General Meeting (AGM). Both meetings consisted of multiple sessions over multiple days with various types of gatherings such as keynote talks and poster sessions, and with hundreds of attendees.

We note that it was not our purpose to assess the extent to which face to face interactions are replaceable with virtual technologies. Nor was the study designed to assess how closely "virtual conferences" come to being "just like" face to face conferences. (Indeed, we found some advantages unique to virtual conferences.) We are interested in what qualities of social and professional interaction can be supported with various technologies, which technologies should be used for what purposes, and in users' perceptions. Our view, based on the results, is that virtual world technology has great potential to engender a high-quality social experience, and that experiments in remote conferencing are worth continuing.

SOFTWARE TECHNOLOGY CONFERENCE
This was an annual meeting of a globally distributed technical organization, with about 300 attendees. We

carried out a pilot study focused on Second Life™, which was used to support the meeting.

Because of the absence of previous research, we developed a broad questionnaire. It covered topics such as how users prepared, how they felt about their avatars, how comfortable they were interacting with the virtual world, how satisfactory they found the meeting, and so on. The questionnaire made frequent use of open ended questions – useful when little is known about a domain.

The questionnaire was constructed as an online web form, and a link to it was distributed by email a few days after the conference. 123 people responded (41% response rate); however, halfway through significant proportions of people were failing to answer questions, a sign that the questionnaire was too long.

Findings

In response to questions about the success of the meeting, 73.3% agreed that the meeting was "very" or "somewhat" successful in achieving its purpose, 64.1% agreed that new ideas or productive outcomes occurred, and 58.2% agreed they would like to participate in future meetings held in the virtual world venue. In terms of how well the technology worked, respondents reported a variety of problems. The most frequent issues involved audio (25%), disruption due to non-muted microphones (20%), and assisting new users (21%).

Figure 1 compares respondents' views of how well various technologies perform *vis à vis* their ability to (i) enable information sharing, (ii) support social activity, and (iii) enable results-oriented work. It also asks them to rate face to face interaction. Each technology's most frequent response is highlighted, and the highest combined "high" and "medium" technology is yellow.

It is clear – and unsurprising – that face to face interaction is the gold standard. Looking just at the "high" ratings, there are sizeable gaps between face to face and all technologies, with technology solutions faring best in terms of information sharing.

Giving technologies a benefit of the doubt by combining

Please rate each meeting technology on each attribute as "high," "medium," or "low"				
Information: Ability to Share Content				
	High	Medium	Low	"Satisfactory"
Face to Face Meeting	94.7% (54)	3.5% (2)	1.8% (1)	98.2%
Teleconference (audio only)	11.1% (6)	42.6% (23)	46.3% (25)	53.7%
Web Conference (telecon plus shared presentation)	55.6% (30)	40.7% (22)	3.7% (2)	96.3%
Desktop Video	40.0% (16)	52.5% (21)	7.5% (3)	92.5%
Virtual 3D Space Meeting	36.8% (21)	47.4% (27)	15.8% (9)	84.2%
Social: Sense of Co-presence, Engaging				
	High	Medium	Low	"Satisfactory"
Face to Face Meeting	96.4% (54)	1.8% (1)	1.8% (1)	98.2%
Teleconference (audio only)	3.7% (2)	42.6% (23)	53.7% (29)	46.3%
Web Conference (telecon plus shared presentation)	1.9% (1)	61.1% (33)	37.0% (23)	63.0%
Desktop Video	12.5% (5)	45.0% (18)	42.5% (17)	57.5%
Virtual 3D Space Meeting	28.1% (16)	57.9% (33)	14.0% (8)	86.0%
Work: Ability to Produce Results				
	High	Medium	Low	"Satisfactory"
Face to Face Meeting	96.3% (52)	1.9% (1)	1.9% (1)	98.2%
Teleconference (audio only)	5.8% (3)	69.2% (36)	25.0% (13)	75.0%
Web Conference (telecon plus shared presentation)	19.2% (10)	75.0% (39)	5.8% (3)	94.2%
Desktop Video	2.6% (1)	79.5% (31)	17.9% (7)	82.1%
Virtual 3D Space Meeting	10.9% (6)	67.3% (37)	21.8% (12)	78.2%

Figure 1. Software technology conference attendees' ratings of ability to share information, provide an engaging social experience, and to produce work results. Note that only Desktop Video and Second Life™ were used in the virtual conference. Highest responses are shown in gray. "Satisfactory" is "high" + "medium" responses; highest-rated technology is highlighted.

"high" + "medium" ratings into a new rating of "Satisfactory," a more optimistic picture emerges. In terms of information sharing, web conferencing and desktop video come quite close to face to face (96.3% and 92.5%, compared to 98.2%). Virtual 3D comes in at a respectable 84.2%, while teleconferencing trails at 53.7%.

In terms of the social dimension, where respondents were asked to rate the degree of social engagement and co-presence engendered by the medium, the clear technology leader is 3D virtual spaces at 86% (compared to 98.2% for face to face). The other technologies lagged at 63% (web conferencing), 57.5% (desktop video), and 46.3% (teleconferencing).

In terms of enabling results-oriented work, web conferencing is the runner up to face to face at 94.2% (compared to 98.2%), followed closely by the other three technologies: desktop video (82.1%), 3D virtual spaces (78.2%), and teleconferences (75%).

Two things stand out to us in these preliminary results. First, in this population of IBMers who have extensive experience in teleconferencing (often including slides shared by email), this medium does not do very well overall. It is outshone by web conferencing and desktop video for information sharing, and by all the other technologies in terms of social experience and ability to get work done. Second, as the newest technology on the block, and the one with which participants had the least experience, virtual 3D does surprisingly well. It comes closest to face to face in terms of social experience, and is comparable to other technologies on sharing content and getting work done.

ACADEMY GENERAL MEETING (AGM)
The IBM Academy of Technology is a merit-based organization of top technical employees that holds an annual meeting called the Academy General Meeting (AGM). In 2008, the AGM was held virtually for the first time. In preparing to evaluate the 2009 meeting, we took into account the results of the pilot study as well as comments on internal blogs and fora from participants in the 2008 AGM. The 2009 meeting used desktop video for keynote talks, Second Life for poster sessions and planned 'socials,' and a text-based conferencing system to share ideas (the "MiniJam").

The study consisted of (i) participant/observation of the meeting, (ii) a post-meeting questionnaire, and (iii) post-meeting interviews with 30 participants.

The AGM questionnaire was launched the day after the conference closed. It was sent to 1095 people who were invited to attend the conference, most of whom were existing or new members of the Academy. It accumulated approximately 100 responses in the first 24 hours, and a total of 444 by the time the questionnaire was closed a week later giving a response rate of 40%.

Findings
Overall, the findings from the AGM were similar to the software technology conference. In terms of the success of the meeting, 66.2% agreed it was a good experience overall, 73.1% agreed that the time spent installing and using the various technologies was worth it, and 56.5% said they would use the technologies in the future to enhance communication in their job.

Second Life™ was the technology most used by our respondents: about 70% used it, versus around 50% for desktop video and the MiniJam. When asked how well the technology worked for the portion of the event it was used for, about 53% felt Second Life™ worked well (vs. much higher proportions for the MiniJam and video). Additional comments for this part of the survey showed quite a few complaints about system crashes and lags. Respondents also reported significant issues with audio.

On the other hand, when it worked, Second Life™ was fairly successful at supporting the social interactions that make going to conferences valuable. In response to comments made by participants in the previous year's AGM, we probed for social behaviors such as "bumping into" people and "having conversations with strangers." In general, as evident in Figure 2, more people had such social encounters than not.

Figure 3 shows the comparison across technologies. The pattern of responses here is similar to that seen in the software technology study. As before, nothing else comes close to face to face. As before, web conferencing (teleconference plus slide sharing) and desktop video are runners up in supporting content sharing. And finally, as before, virtual 3D space meetings are the runner up in supporting a sense of social engagement – but they are still a pretty distant runner up (76.4% across "high"+ "medium" compared to 99.5% for face to face and 37.7%, 72.1%, and 67.3% for teleconference, web conference, and desktop video, respectively).

Question	Agree	Disagree
I unexpectedly encountered at least one acquaintance at the event	59.4% (167)	40.6% (114)
I got into at least one informal conversation with a small group	64.7% (189)	35.3% (103)
I got into conversations with strangers	52.4% (155)	47.6% (141)
I met at least one new person that I expect to maintain connections with afterwards	40.0% (118)	60.0% (177)

Figure 2. AGM attendees' responses to questions relating to their social experience in Second Life™.

Please rate each meeting technology on each attribute as "high," "medium," or "low"			
Information: Ability to Share Content			
	High	Medium	Low	"Satisfactory"
Face to Face Meeting	94.6% (331)	4.0% (14)	1.4% (5)	98.6%
Teleconference (audio only)	15.7% (54)	46.2% (159)	38.1% (131)	61.9%
Web Conference (telecon plus shared presentation)	50.9% (177)	47.1% (164)	2.0% (7)	98.0%
Desktop Video	58.0% (163)	35.2% (99)	6.8% (19)	93.2%
Virtual 3D Space Meeting	21.4% (70)	45.3% (148)	33.3% (109)	66.7%
Social: Sense of Co-presence, Engaging			
	High	Medium	Low	"Satisfactory"
Face to Face Meeting	97.2% (341)	2.3% (8)	0.6% (2)	99.5%
Teleconference (audio only)	4.7% (16)	33.0% (113)	62.3% (213)	37.7%
Web Conference (telecon plus shared presentation)	10.8% (37)	61.3% (211)	27.9% (96)	72.1%
Desktop Video	13.6% (39)	53.7% (154)	32.8% (94)	67.3%
Virtual 3D Space Meeting	28.4% (93)	48.0% (157)	23.5% (77)	76.4%
Work: Ability to Produce Results			
	High	Medium	Low	"Satisfactory"
Face to Face Meeting	90.5% (316)	8.6% (30)	0.9% (3)	99.1%
Teleconference (audio only)	13.3% (45)	60.4% (204)	26.3% (89)	73.7%
Web Conference (telecon plus shared presentation)	24.9% (86)	67.1% (232)	8.1% (28)	92.0%
Desktop Video	21.6% (61)	62.8% (177)	15.6% (44)	84.4%
Virtual 3D Space Meeting	9.5% (30)	41.6% (132)	48.9% (155)	51.1%

Figure 3. AGM attendees' ratings of various technologies on ability to share information, provide an engaging social experience, and to produce work results. Note that only Desktop Video and Second Life™ were used in the virtual conference. Highest responses are shown in gray. "Satisfactory" is "high" + "medium" responses; highest-rated technology is highlighted.

Interviews

Thirty people were interviewed in the week following the end of the conference; all were drawn from questionnaire respondents who had indicated that they would be willing to answer further questions.

Everyone we spoke with understood and accepted the reasons that the AGM was held virtually. Barring those who had such trouble with the technology that they could not participate, most felt that it provided an acceptable conference experience, although not as good as face to face. In the course of the interviews, it was evident that most participants had at least two things they wanted from the conference: one was to gather information and engage in technical conversations, and another was to make contact and build relationships with people. We focus our findings on three themes related to these concerns.

Social Interactions in Second Life™

As noted previously, participants did engage in social interactions: they 'bumped into' old friends, encountered colleagues with whom they'd previously worked, and got into conversations with strangers. These encounters often occurred during the poster sessions, but also just before or after talks, and in scheduled "socials."

Some aspects of the virtual meeting technology made social encounters easier. Foremost among these was the use of participants' real names (in contrast to the 2008 meeting in which Second Life™ handles were used), and the display of those names over participants' avatars. As one person remarked, this is an aspect of virtual meetings that is better than face to face; not only does one not have to recall names from faces, but, as several participants reported doing, if one vaguely recognizes a name, it is possible to look it up in the corporate directory. Participants also mentioned the ability to see and engage in textual chat with others during talks as something that furthered social interaction.

Many informants commented that the poster sessions worked well in Second Life™, albeit not perfectly.

Several reported getting into productive technical conversations with colleagues, whether they were presenting or happened upon a poster in which they were interested. One at first reluctant participant commented:

In terms of the poster session I was very skeptical, but I felt obliged to give it a try. I installed the client, attended the practice sessions; I was very surprised that it seemed to work. Some of my friends came by, and I engaged in technical conversations... and we talked. All in all it was a positive experience and it worked much better than I expected.

An experienced real-life poster presenter said:

When I went to present my poster, I actually felt like I was there – it was amazing. [...] I'm a little shy in real life, so it carries over. But what's great about these poster sessions is that you're presenting your poster, and you have people coming to you if they're interested in the topic. So mine was on the topic of [X], and someone I knew in [dept] who was an [X] expert who I've never got to meet before, but I knew his name, stopped by and I was able to get into a discussion with him through the poster. And that was great; I feel like I got to know him and wouldn't hesitate to contact him via email.

Other aspects of the virtual meeting technology made social interactions more difficult, such as the lack of clues about an avatar's real-life identity outside of the name. Several presenters mentioned that they were uncertain to whom they were talking in the virtual world. As one described the experience:

I found my mind was going back and forth between the name and what the avatar looked like. Because of this one instance with the General Manager, and another one where I thought it was a high-level executive by the name, but when I was looking at the avatar, I thought this was some 20-year-old. So I found that a little confusing and maybe a bit upsetting, because I wanted to talk professionally. And I present my poster differently depending on who I am talking to – an engineer I might use more technical information; if I know they're a top executive in sales I'll talk very differently to them about how this technique might affect their sales.

Presentation of Self and Building Relationships

Another interesting and not unrelated set of findings revolves around how well participants felt they were able to present themselves in the virtual environment. Informants commented on many aspects of this including their avatar appearance, how effectively they were able to come across the way they wanted to in a professional setting and communicate their work or ideas, and how well or easily they felt they were able to initiate personal relationships that could be important in their careers or work.

Most participants wanted their avatars and those of others to reflect their real life appearance, even though many did not spend a lot of time trying to customize their appearance. One informant said he just wanted a "one-click" way to put his avatar in a business suit; he did not want to be "creative" in his appearance in a business context:

I just prefer to be in formal dress [...] I think it's [about] just making the person more approachable. [...] If [...] someone has blue hair, I don't think someone will go up to them as easily as if they are just standing around in a suit. [...] The other thing was that it was my first SL experience, and I don't know who's going to [be there]. If I don't know the name of the person – I might be getting my General Manager visiting me – and I want to be presentable.

Another commented:

I definitely needed to spend time on my avatar, because that pink polka-dot outfit was just horrendous. [...] I did spend a little time. I didn't spend any $ or anything like that, but I did go so far to get a business suit, etc. I tried to look like I would in a real business environment. And that was funny because a lot of people were in shorts & stuff; and that was kind of fun, but for me as a first-time attendee, it was important to look more professional.

Finally, the concerns informants expressed about the value of face to face conferences for relationship building shaded over into intangible benefits. For example:

I was invited as a guest to [a previous] Academy meeting; I gave a poster. And it really motivated me to go beyond where I was at. I knew I could succeed. But after going to the Academy meeting and spending time with the executives and the other Academy members, I didn't feel that my contributions were adequate. And for the first time I thought my work could have worldwide impact.

The Tension between First Life and Second Life

Another form of social interaction was more problematic: interruptions from colleagues who were in the same physical space, but not attending the AGM, or (for example) from clients with whom participants were involved. A number of informants commented that it was difficult to stay engaged with Second Life™ because colleagues (or clients or family members) would see them at their computers or online and assume that they could be interrupted. Even when colleagues understood that the informant was 'at' a conference, they would often still interrupt. One informant noted:

I'm in this situation where we have responsibilities to clients and sales, and I wouldn't want to turn my instant messaging off, for instance, and sacrifice someone being able to get in touch with me. I think that would be similar to leaving your cell phone number if you were traveling to a meeting.

While many appreciated not having to travel to attend the conference, at the same time they noted that travel serves to protect the conference interactions. When at a conference, your work colleagues cannot see you, and thus they need to make more of an effort to interrupt. Furthermore, conferences also cause attendees to control their accessibility more explicitly: cell phones are switched off during a talk, and many attendees check email and IMs only during the breaks. A further benefit for those who travel some distance to attend conferences is time-shifting. Being several time zones removed from colleagues one works with serves as an extra buffer from interruptions.

DISCUSSION

Both the software technology and AGM conferences can be labeled as successes. Majorities liked the conferences and got value from them. At the same time, there were frequent problems with the technology.

When the technology worked, it supported both information exchange and social interaction, although neither was on a par with what face to face meetings provide. Still, it is notable that majorities of respondents got into conversations with strangers, bumped into friends unexpectedly, and ended up in small group conversations, just the sorts of things that happen in face to face conferences. This is one of the *raisons d'être* of conferences, and it is difficult to see how this could be replicated through other technologies.

There seem to be considerable opportunities for improvement. On the technology end, it is clear that lags and crashes are still an issue, as is audio. Comments from informants suggest that this year's AGM was technically more stable than last year's; continued improvement will certainly make a difference to many people.

In terms of event design, the poster sessions appeared especially valuable in terms of supporting interaction. Further work – perhaps providing more structure to social events, or perhaps ensuring that social events are actively moderated – could enhance sociality.

One of the most common themes in the interviews had to do with the tensions between 'first lives' and 'second lives.' It would be worth considering ways to provide spatial segregation for attendees – either setting up satellite conference venues, or allowing participants to book hotel or other rooms that spatially separate them from the demands and interruptions of their day to day jobs and personal commitments.

CONCLUSION

We are optimistic about the use of virtual meeting tools. Virtual space technologies clearly excel in offering a sense of co-presence and engagement beyond traditional distance collaboration tools with affordances that seem different from video conferencing. Every aspect of virtual space tools and their use is currently a moving target, yet three quarters of our respondents said they see potential in virtual conferences despite their current shortcomings. Technical problems must be improved quickly to keep participants from giving up on the technology too soon. Continued evolution of the design and structure of virtual events will create better experiences and more value. Systematic participant feedback will help organizers optimize matches between event types and technologies.

There is no doubt that a small number of people are naturally inclined either toward enthusiasm or skepticism about virtual world technology. In between are the vast majority of users who will participate because they feel obligated or find it kind of interesting or fun, but mostly because it's what's on offer and better than not having a meeting at all. Making the most of virtual world interactions will take time as participants' skills, attitudes, and capability to interact well in virtual spaces improve. How far virtual technologies will ultimately go is an open question, and one that can only be answered over time with continued study.

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