Is there a Trade-off between Presence and Copresence?

Maria Spante, Ilona Heldal, Ann-Sofie Axelsson, and Ralph Schroeder
Department of Technology and Society
Chalmers University
412 96 Gothenburg
Sweden
Corresponding author: marspa@mot.chalmers.se

Abstract
Presence and copresence have been key goals of researchers and developers of shared virtual environments. Much research has assumed that the two reinforce each other; that is, an enhanced sense of presence enhances copresence and vice versa. In this essay we question this assumption, and provide some examples in which users experience high presence and low copresence - and the opposite. Although the results are qualitative, we argue that it is worth pursuing the situations in which there seems to be a trade-off between the two, since this will have implications for design and for the future uses of shared virtual environments generally.

1. Introduction

The study of presence and copresence has been an important part of the research and development of virtual reality (VR) systems and shared virtual environments (SVEs). Indeed, presence, the sense of 'being in an environment other than the one you are physically in', and copresence, the sense of 'being there together', have been commonly accepted definitions among VR and SVE researchers (Schroeder 2002a). Intuitively, it seems that there should be a correlation between presence and copresence, especially such that more immersive VEs should provide an enhanced sense of copresence. However, we need only to think of equivalent face-to-face situations, where we are highly aware of the other person but not of the surroundings – and the other way around – to recognize that this may not necessarily be the case. For SVEs, the relationship between the two has not been systematically examined.

2. Background and Previous Studies

In research on presence and copresence, even though there are now a number of studies, there is still considerable debate. For presence, there are studies which have used subjective measures such as questionnaires, as well as objective behavioural and physiological measures (Scheumie et al. 2001). It will suffice here to say that there is a growing body of findings about presence, but some fundamental issues, especially the applicability of findings across different contexts and tasks, are still open. For copresence, there are far fewer studies (the survey in Scheumie et al. 2001 mentions three), but this should be a growing area of interest since SVEs are becoming ever more popular.

As for the relation between presence and copresence, previous studies have examined this relationship in various ways (the full paper will contain a more comprehensive review). In a study of small groups of three participants collaborating in a networked VE with one person using an immersive HMD system and two using desktop systems, Slater et al. (2000: 37) 'found a positive relation between presence of being in a place and copresence – the sense of being with the other people'. Schroeder et al. (2001: 788) found in a trial of pairs of participants collaborating on a Rubik's cube type puzzle in various types of systems - networked immersive projection technology systems, desktop systems, and combinations of the two - that the 'partner's "co-presence" is related to their sense of presence'. In an acting trial in which pairs of actors rehearsed over the course of four sessions of half an hour each, Slater and Steed (2002: 159) reported that presence and copresence both increased over the course of the sessions. There are further studies which do not investigate presence and copresence directly, but which raise broader issues about the sense of place and its relation to interaction with others in SVEs (see the essays in Churchill, Snowdon and Munro, 2001; Schroeder 2002b).

The discussion could also be broadened at this point since there are other, related concepts: for presence, there is involvement, engagement with the environment, awareness of the environment, etc. For copresence, related ideas are social presence, social influence (Blascovich 2002), and, again, awareness of the other. Whatever concepts are used, however, it is clear that presence and copresence are critical to how people interact with each other and collaborate in SVEs.

3.Research Process and Scenarios

In this paper, as will be explained below, we present only qualitative data, though we aim to follow this up with quantitative experimental studies. We will use the terminology 'high' and 'low' presence and copresence for occasions when we infer, based on our observations and questionnaires or interviews demonstate, that participants experienced either a high or low sense of these states if these could be arrayed on a high-low continuum. This provides us with a two-by-two grid of variation (the numbers refer to the examples that will be described below):

	High Copresence	Low copresence
Low presence	Immersive 2 Desktop 3, 5	
High presence		Immersive 1 Desktop 4

All the examples here are taken from two trials - with the exception of the fifth example, which will be described below. The trials are described in more detail elsewhere (Steed et al. 2003, Nilsson et al. 2002) and will also be presented more thoroughly in the full version of the paper. The first two examples are taken from a trial with two networked immersive Projection Technology (IPT) systems in which five pairs carried out different tasks together for a period of more than three hours (with short breaks). The tasks, all highly collaborative, included building together, solving spatial and verbal puzzles, and exploring a landscape. The third and fourth are from a trial with four participants (though often only two engaged with each other) using networked desktop VEs, carrying out a similar range of activities as in the first trial over the course of ten one hour sessions. In other words, both trials involved a variety of spatial tasks and interpersonal encounters for extended periods of time. By presenting examples from both highly immersive (IPT) and non-immersive but commonly used desktop systems and covering a variety of tasks, these trials are representative of a wide range of SVE settings and collaborative activities.

For the first trial (examples 1 and 2) and example 5, we have video- and audio-recordings of the session, questionnaires and debriefing interviews. For the second trial (examples 3 and 4), participants kept written logs and took part in debriefing sessions (the participants were the researchers themselves). For the full version of the paper, we will carry out a further trial so that we have the same type of data for second trial as for the first.

4. Examples

Example 1. Immersive VE: high presence – low copresence

The pair had been working for over two hours together on several tasks, and had been collaborating for 20 minutes on a word puzzle with different pieces of paper stuck on a wall in a small room. The puzzle required putting together words from different pieces of paper to make a sentence. They had walked through each other several times, not taking notice of each other and looking intently at their own pieces of paper – but still talking all the while. On one occasion one person had accidentally walked through the wall and outside the room. When he returned, he said 'wow, here I come', and his partner asked 'did you spot it?'[the word in the puzzle], he responded laughingly 'I've just been somewhere else', which his partner ignored. After a while of working together, when he left again, he said 'I was just taking a walk, I'll be right back', with the partner again not paying attention. When he returned after half a minute, he said cheerfully 'Aaah here I come again', and asked: 'Have you finished the exercise?...You did…uuhhh…six [sentences] when I was out moving? Seven?'. To which his partner responded 'yeah, let's move on to seven then' in a tone of being dissatisfied with how it was coming along.

In the debriefing interview, the person who had been in and out of the room said: ‘It would have been just as interesting from my point of view if I had solved this puzzle myself. It was totally irrelevant that he was there.’ Our interpretation of this sequence is that even though both were highly aware of the place, and the person who left the room obviously so, neither of them was aware of the other – even though this was a highly collaborative task.

Example 2. Immersive VE: low presence – high copresence
The partners were in a world with an extensive landscape and their task was to familiarize themselves with the landscape and the buildings. They maintained a continuous dialogue throughout the task, but at a certain point one person fell through the bottom of the landscape and was surrounded by empty white space instead of the green grassy landscape. At this point she said: ‘Now I went down into…’, at which point she reentered the landscape and said: ‘Well now I came up again’, stood on the green grass but almost immediately fell under it, and commented ‘Oh, now I went under again. How did you get out earlier, did you reverse?’. This example shows that a dialogue is kept going fluidly (high awareness of each other) even while the two are not sharing the same space.

Example 3. Desktop VE: low presence – high copresence
During the ninth out of ten sessions, the four participants went exploring in worlds that were new to three of them. The fourth had been to these worlds before and she thought that it would show some interesting features to the others. To do this, however, a constant effort on the others’ part was required – keeping up with her, trying to adopt her point of view, and maintaining the conversation, and this proved difficult in the course of the exploration. After the session, one participant wrote: ‘keeping up with her [the fourth participant] and the others reduced my understanding and focus of the place’. The point of this session – to allow the participants to get a sense of this new space – was evidently lost on this participant who struggled just to keep up with the ‘guide’ on the ‘guided tour’. At the same time, the others clearly needed to maintain a strong awareness of their ‘guide’.

Example 4. Desktop VE: high presence - low copresence
During the fourth of the ten sessions, participants were looking for objects to build with, planning what to build, and receiving some instruction in building. Afterwards, one participant commented: ‘I felt very present, as always, but had problems feeling co-present, since I think the audio reduces the feeling of communicating with the avatar. It feels like I am looking at avatars and talking to people over the phone. When using text communication it feels more like the whole person is in there…’. It needs to be added that this participant was quite used to using this environment in text-only mode. In this example, the participant would have been able to engage with the others more in the building task if she had used text-communication, whereas audio communication detracted from this interpersonal engagement for her.

Example 5. Desktop VE: low presence – high copresence
The following example is taken not from the two trials described so far, but from a trial with a desktop VE system in which two partners solve a Rubik’s cube-type puzzle for a brief period (though this puzzle was also undertaken as part of the other two trials). In this case two people had been working together for approximately twelve minutes (they were close to solving the puzzle) and they had maintained a constant conversation about their puzzle-solving activity – which indicates copresence. Yet they had been talking about what was going on in the space as if they were not at all engaged in it, and also referred to things going on in the physical environment around them:

A: Can you take the one which is a little bit free in the space, most free in the space…
B: yeah I’ll fix it
A:…and see if you fit it in such that
B: yes I’ll take care of that
A: and I’ll read the instructions here [which are not onscreen]
B: let’s see I rotate around a little bit here
A: mark click [function to mark a cube]

One indication of the obliviousness to the space here is that they did not use spatial expressions in relation to their bodies, like ’next to me’ or ’close to you’, but instead used expressions about functionality (’rotate’,

'mark click'). It may seem obvious that a collaboration on distributed desktop VEs might not produce a strong sense of presence, but it is worth pointing out that this is a highly spatial task and the two were evidently collaborating intently in relation to the space.

5. Discussion and Conclusion

Presence and copresence have so far mainly been studied in experimental situations. The findings reported to date are about the psychological state of the user - either for their experience at a particular point in time, or how they report their state for the session as a whole. This may not, however, adequately reflect the way in which the experience can vary over the course of the session, and therefore how the relationship between presence and copresence can vary. We have shown that there may be conflicts or trade-offs between presence and copresence in certain situations, and this may apply not only to the segments of tasks or of communication situations in our examples, but to longer periods during a session.

While we think that the investigations of presence and copresence have been useful, and the two constructs should be maintained in the study of VEs, it may be important in future research:

- to investigate when the two go together and when they do not (it has been an implicit and unquestioned assumption in research that they do go together). This could be done by designing comparable scenarios in which there are trade-offs and when there are not, and systematically comparing the two
- to examine whether other concepts - such as involvement, awareness, common ground, and focus of attention – should be used in combination with presence and copresence to modify or complement them
- to widen research to focus not only on user's psychological states of mind or their self-reports about these two states, but identify ways of examining how their experience changes over the course of time and with different activities

Since we did not directly test whether there was a trade-off between presence and copresence, we cannot offer an explanation for the examples we have presented, but only some informed guesses: one possibility is that there are conditions when our sensory apparatus is unable to focus on the virtual space and on the other person simultaneously. If we reconstruct the examples in our minds, one feature that they have in common is that attention is dominated or the focus of attention is intently on one or the other - the space and the objects in the task, or the other person. Another potential explanation of the trade-off is that it may be difficult to sustain a sense of presence *and* of copresence *over time*. In either case, it seems that the situations of trade-offs between presence and copresence can be explained by focus of attention: it is not possible to focus on both the space and the other at the same time. This does not imply a zero-sum trade-off, but a trade-off whereby one is at the expense of the other. Note that focus of attention is not the same as 'awareness' in the sense that this has been typically been discussed in relation to VEs, which is to do with whether one has enough information to be able accomplish something. We should also note that the absence of a trade-off, or the idea that presence and copresence are not zero-sum, entails either that that there is no conflict between the two, or that it is possible to have an equal focus on both at the same time.

It is useful to tackle some potential objections here: one is that some of our examples seem to be based on technical or task failures, and another is that improvements in technology could overcome the trade-offs that have been described here. These objections can be rejected: even in technically stable systems, users in complex and unfamiliar systems will make mistakes which cannot be overcome by technology improvements alone, and even in systems which could provide a 'perfect' sense of presence and copresence, there will still be situations where it will be impossible to focus on the surrounding space and on the other person *simultaneously*.

To conclude: our examples show that presence and copresence do not necessarily go together. Does this mean that there is a trade-off? We cannot be sure since we did not investigate the relationship experimentally and with systematic variation, but it seems that in our examples it is possible to experience high presence *or* high copresence, but not both. The implications are that:

- in the design of environments or tasks, it may be important to consider whether one or other of the two states is dominant or exclusive

- from the user's point of view, it may be possible to increase awareness about when the space or the presence of other persons can be taken for granted (so that attention to the other state can be 'freed up'), or when the need for awareness of the others (often an issue in SVEs) or for manipulating and being aware of the space or the objects in the space detract from each other
- for research, it may be possible to design experiments which could show when the presence-copresence relationship is zero-sum and when they reinforce each other.

References

Blascovich, J. (2002). Social Influence within Immersive Virtual Environments. R. Schroeder (Ed.), *The Social Life of Avatars: Presence and Interaction in Shared Virtual Environments*. London: Springer, 127-145.

Churchill, E., Snowdon, D. and Munro, A. (Eds.) (2001). *Collaborative Virtual Environments: Digital Places and Spaces for Interaction.* London: Springer.

Nilsson, A. et al. (2002), The Long-Term Uses of Shared Virtual Environments: An Exploratory Study, in R. Schroeder (ed.), *The Social Life of Avatars: Presence and Interaction in Shared Virtual Environments*. London: Springer, 112-126.

Scheumie, M.J., van der Straaten, P. Krijn, M & van der Mast, C. (2001). Research on Presence in Virtual Reality: A Survey. *Cyberpsychology and Behaviour*, 4**(**2): 183-201.

Schroeder, R. et al. (2001), Collaborating in networked immersive spaces: as good as being there together? *Computers & Graphics*, 25 (5): 781-88.

Schroeder, R. (2002a). Copresence and Interaction in Virtual Environments: An Overview of the Range of Issues. *Presence 2002: Fifth International Workshop.* Porto, Portugal, Oct.9-11, 274-295.

Schroeder, R. Ed. (2002b). *The Social Life of Avatars: Presence and Interaction in Shared Virtual Environments*. London: Springer

Slater, M., Sadagic, A., Usoh, M. & Schroeder, R. (2000). Small Group Behaviour in a Virtual and Real Environment: A Comparative Study. *Presence: Journal of Teleoperators and Virtual Environments*. *9*(1): 37-51.

Slater, M. & Steed, A. (2002), Meeting People Virtually: Experiments in Shared Virtual Environments. R. Schroeder (Ed.), *The Social Life of Avatars: Presence and Interaction in Shared Virtual Environments*. London: Springer, 146-171.

Steed, A. et. al. (2003). Strangers and Friends in Caves: An Exploratory Study of Collaboration in Networked IPT Systems. *ACM SIGGRAPH 2003 Proceedings on Interactive 3D Graphics.* New York: ACM Press, 51-54.