Social Presence as a Multi-Dimensional Group Construct in 3D Virtual Environments

Anu Sivunen
Department of Industrial Engineering and Management, Aalto University School of Science, P.O.Box 15500, FIN-00076 Aalto, Finland

Emma Nordbäck
Department of Industrial Engineering and Management, Aalto University School of Science, P.O.Box 15500, FIN-00076 Aalto, Finland

One of the key challenges of distributed teams is the lack of social presence resulting from multiple work locations. Virtual environments (VEs) have been viewed as a collaboration tool for distributed teams that can enhance social presence via shared collaboration space and avatars. We observed, recorded, and analyzed the VE meetings of a globally distributed team. Data were analyzed through quantitative and qualitative content analysis. Our findings show that in the meetings, social presence was a situational phenomenon that constantly varied in strength. Social presence occurred as either a subgroup or group phenomenon, which at times coexisted at both levels. In particular, 2 of the 3 subdimensions of social presence, psychological involvement and behavioral engagement, were observable in team interaction.

Keywords: Avatars, Distributed Team, Social Presence, Virtual Environment, Virtual Team, Virtual World.

doi:10.1111/jcc4.12090

Introduction

Distributed teams that work toward a common goal, are dispersed among many locations, and communicate through technology face several challenges. One of the key challenges is the lack of presence resulting from different work locations and the use of communication technology. As the physical distance hinders visual awareness of one another, it is difficult to know what the distanced team members are working on and how they are doing (Kraut, Fussell, Brennan, & Siegel, 2002; Cramton, 2001). Moreover, it may be particularly challenging to perceive presence in terms of daily involvement, engagement, and the attention of one’s distributed team members, when opportunities for face-to-face communication are limited (Kiesler & Cummings, 2002).

Communication technology has been viewed as a solution to the problems created by the lack of physical presence inherent in distributed teams. However, text-based tools in particular are traditionally deemed to have limited capacity to transmit social cues (Daft & Lengel, 1984). Phone calls and call
conferencing tools do not enable visual feedback, which is crucial when interpreting cues regarding one another’s involvement (see review on gaze effects on involvement, e.g., Ellsworth & Ludvig, 2008). Three-dimensional virtual environments (VEs) could be viewed as a collaboration tool that resolves some of the challenges of physical distance, as they provide a unique sense of being together in a virtual space (e.g., Durlach & Slater, 2000). VEs can be defined as collaborative spaces that allow geographically separated individuals to interact with one another via avatars, which are easily transformed digital self-representations in a graphical 3D form (Yee & Bailenson, 2007). VEs have different communication possibilities, such as text and voice chat, one-to-one messaging and avatars’ nonverbal communication (pointing, moving objects, etc.). Navigating in the environment is done via keyboard or mouse.

Social presence has been one of the interests of scholars studying VEs over the last decade (Slater, Sadagic, Usoh & Schroeder, 2000; Hoyt, Blascovich, & Swinth, 2003; Axelsson, Abelin, Heldal, Schroeder, & Wideström 2001). Social presence can be defined as the psychological sense of being with others in the mediated environment (see, e.g., Biocca et al., 2001; Shen & Khalifa, 2008). However, research has predominantly examined social presence as a one-dimensional phenomenon measured only one time after an experiment (e.g., Axelsson et al., 2001; Hoyt et al., 2003; Sallnäs, 2005; Bente, Rüggenberg, Krämer, & Eschenburg, 2008). Although this strategy may be an adequate method for some purposes, we argue that the nature of social presence as a fluctuating and ongoing phenomenon is not captured by post hoc surveys. Thus, observable ways of studying the phenomena as a process in natural settings are needed.

This article focuses on the examination of social presence as an ongoing process during distributed team meetings in a VE and contributes to our knowledge of the study of social presence as a group process that varies over time by performing quantitative and qualitative content analysis on recorded team meetings. Hence, we extend earlier cross-sectional assessments of social presence and previous technology-centric focus to cover the dynamic nature of social presence during team interaction.

Social Presence in Mediated Settings

Social presence has interested scholars for decades (Short, Williams, & Christie, 1976; Lombard & Ditton, 1997; Biocca, Harms, & Craigg, 2001; Shen & Khalifa 2008). It can be viewed as a subcomponent of a broader discussion of presence. In a widely used classification, Lombard and Ditton (1997) divide presence into six dimensions, of which one is called presence as social richness. According to this dimension, people evaluate the capabilities of a medium to convey social presence. This dimension defines social presence as the extent to which a medium is perceived as warm, sociable, personal, or intimate when used to communicate with someone else (Lombard & Ditton, 1997). Theories that have paved the way for this approach include the theory of social presence (Short et al., 1976) and media richness theory (Daft & Lengel, 1984). Both perspectives examine the presence that a medium can convey on the basis of traits of the technology. In social presence theory, technologies are sorted in accordance with their capacity to transmit information on expressions, gestures, and vocal cues, and these characteristics enable technologies to convey socially richer information, and ultimately, the perception of social presence. The media richness theory categorizes different technologies in accordance with the availability of immediate feedback, nonverbal back-channeling cues, personalization, and language variety. This theory suggests that a lean medium, such as e-mail, is not as socially rich as, for example, a VE and therefore cannot transmit social presence as well as a richer medium. From this theoretical perspective, social presence is tightly entwined with the features of the technology (see, e.g., Bulu, 2012). Therefore, some researchers have separated copresence from social presence on the basis that the latter relates to the quality of the medium and users’ perceptions of it, whereas copresence, a concept originated by Goffman (1963), addresses the psychological interaction of the individuals – their “psychological connection of minds” (Nowak, 2001).
Other researchers have defined the concept of copresence as a mutual awareness of the other within the larger construct of social presence (see Shen & Khalifa, 2008 for a review). Work performed by Biocca and his coauthors (Biocca et al., 2001, 2003) has contributed to theory development by conceptualizing social presence as a multidimensional, social aspect of presence that is focused on the properties of communication interaction and psychological aspects rather than the direct attributions of the medium. According to these authors, social presence is composed of three dimensions: 1) copresence, which includes feelings of isolation or inclusion and mutual awareness; 2) psychological involvement, which refers to mutual attention, empathy, and mutual understanding; and 3) behavioral engagement, which refers to behavioral interaction, mutual assistance and dependent action (Biocca et al., 2001). Drawing from this theoretical perspective, we define social presence as a multidimensional construct, which refers to the sense of being with another in a mediated setting and can be manifested via copresence, psychological involvement, and behavioral engagement (Biocca et al., 2001, 2003; Shen & Khalifa, 2008).

Methodological Means of Studying Social Presence

Much of the research on social presence has used post hoc questionnaires to measure the subjective experiences of respondents in experimental settings after they have collaborated on a common task (see, e.g., Axelsson et al., 2001; Hoyt et al., 2003; Nowak & Biocca, 2003; Sallnäs, 2005; Bente et al., 2008). As a literature review by Schroeder (2010) shows, there are only a few VE long-term studies (e.g. Nilsson, Heldal, Schroeder, & Axelsson, 2002). Some experiments with several trials (e.g. Tromp et al., 1998) have looked at social presence among other things but they have not focused on analyzing the process of social presence per se. Although there is still debate on the construct of social presence (Bulu, 2012; Biocca et al., 2003), various measures have been tested and validated. However, real-time assessment of social presence during user interaction has been limited compared with postexperimental research (von der Pütten et al. 2012). One exception is a method developed for real-time self-measurement of presence (Freeman, Avons, Pearson, IJsselsteijn, 1999), but such procedures can interfere with the presence experience itself (von der Pütten et al., 2012).

In addition to self-ratings, scholars have proposed that social presence could be studied via objective, corroborative means, such as physiological or behavioral measures (IJsselsteijn, de Ridder, Freeman, & Avons, 2000; von der Pütten et al., 2012). Physiological measures include, for example, cardiac interbeat intervals (Ravaja et al., 2006), facial electromyography, and respiration (Chanel, Kivikangas, & Ravaja, 2012), which are assessed during interaction. Behavioral measures include subjects’ behavioral responses, such as pointing or body posture, and have rarely been used in studies thus far (von der Pütten et al., 2012). These studies have usually combined the physiological or behavioral responses to self-rated, postexperimental social presence measures.

Social presence has typically been studied as a subjective, personal experience, whereas efforts to aggregate results to the group level are more or less nonexistent. Although social presence is composed of components that are primarily personal (such as feelings of isolation and inclusion), the concept also includes several interpersonal components that are focused on the mutual feelings and reciprocity of the participants (such as dependent action) (Biocca et al., 2001). Therefore, we argue that social presence could also be viewed as a group-level construct and observed during several distinct occasions of interaction between different people within a group. There is a need for observation schemes and guidelines to enhance this type of observational study of social presence (one exception presenting an observational method is a study of text-based computer-mediated communication by Rourke, Anderson, Garrison, & Archer, 1999).

Finally, originating from the earliest studies of social presence (Short et al., 1976), past research has mainly considered social presence in terms of the features of media (e.g., Lombard & Ditton, 1997),
whereas the quality of interaction as a prerequisite for social presence has not been systematically explored. Much of the academic literature on VEs tends to take an optimistic tone that emphasizes the technological features of these environments to promote social presence between users. Shen & Khalifa (2008) state that particularly in VEs, showing one’s online status and using avatars could evoke social presence. Bulu (2012) concurs that the use of avatars and nonverbal and verbal communication channels make it possible for users to connect both socially and psychologically. However, we suggest that media high in information richness, such as a VE, does not always guarantee high social presence between participants. Intensive and engaging discussions may occur via media that is low in information richness, and attention and other levels of social presence can be lost (at least for a while) in communication mediated by a richer medium.

Therefore, it is important to study social presence as an observable, on-going process instead of a subjective, stable state and to consider the role of interaction in this process. Accordingly, we propose the following research questions:

1) Which observable dimensions compose social presence?
2) How does social presence vary within a team during distributed team meetings held in a VE?

Methodology

Participants
The participants of this study included 11 graduate students from four universities in the USA, Finland, and India. The participants represented five national cultures (American, Finnish, German, Indian/Indian-American, and Asian/Asian-American) and seven educational backgrounds (computer science, development studies, industrial design, industrial management, information science, mechanical engineering, and new media). The distributed student team participated in a 9-month long university course for which the goal was to design and implement complete prototypes of a product or service for a global company. Students received credits based on their coursework from their home universities.

The group held weekly meetings on a Second Life island, which was designed specifically for their use. The island contained a meeting place with two screens for slideshows where the team usually gathered for the meetings. The team leader had always prepared an agenda for the meeting that was discussed during the meeting. Team members contributed to it with slides related to their responsible topic areas. Some members worked in subgroups (e.g. the industrial designers), and during the meetings the responsible persons of the subgroups presented their progress to others and asked for other members’ opinions.

Each meeting began with a quick round of questions regarding how everyone was doing and ended with tasks to complete for the next week. In between, different topics related to the execution of the project were discussed. The meetings were dominated by the team leader in number of speak turns and words spoken. Some members were more active in the discussions than others, and this varied somewhat depending on the group composition in each meeting and communication channels used (see more detailed description of the division of speak turns and amount of spoken words in Nordbäck & Sivunen, 2013.) The team leader used dominantly voice chat as a communication channel. Some members used mostly text chat for communication whereas others used both voice and text interchangeably.

During the meetings, the students’ avatars typically stood in a circle or in a semicircle in front of the two screens and changed their position rarely (see Figure 1). If two subgroups wanted to discuss different topics simultaneously, they still stayed in one place and one subgroup used the voice channel whereas the other used the text chat.
Figure 1 Coding video in Atlas.ti.

For daily interaction, the group used e-mail as well as an online project management tool. In addition, the company sponsor of the team provided extra money for the members to travel to two face-to-face team meetings during the course.

Data Collection
We used qualitative methods of data collection. The first author and a second field researcher participated in ten of the team meetings in the VE and video-recorded them. We were able to analyze 5 of these meetings. Five other meetings were not included in the analysis due to technical problems with the recordings. The meetings lasted 235 (meeting 1), 188 (meeting 3), 133 (meeting 5), 104 (meeting 7), and 60 (meeting 15) minutes, and were on average 144 minutes long. The team leader chaired all team meetings except for the seventh meeting, during which a team member chaired the meeting because the team leader was absent. Most of the members were present in all of the analyzed meetings.

Analysis
Data gathered from the team meetings were analyzed using quantitative and qualitative content analysis. Quantitative content analysis has been referred to as “a research technique for the objective, systematic, quantitative description of the manifest content of communication” (Berelson, 1952, p. 519). This technique allowed us to tune into the dynamics and sequential flow of social presence, i.e., how it unfolds over time, to observe the overall picture of the distributed team’s social presence throughout the five meetings. Qualitative content analysis (see, e.g., Strauss, 1987; Boyatzis, 1998) was used for a more in-depth examination of the social presence processes and communication dynamics surrounding them. Using qualitative content analysis, we thus aimed to explore the underlying dimensions of social presence and to map the communicational components increasing or diminishing social presence in the group.

The five video files were uploaded to the Atlas.ti qualitative data analysis program. The analysis was begun with careful observation of the group discussions using the video files. During the observation, the second author began to unitize the meetings according to a coding scheme we developed iteratively. First, behavioral indices were derived from Biocca and his coauthors’ (2001, 2003) social presence
measure. Second, additional indices were deduced from detailed observations of the video files. This process produced an initial coding scheme that the authors discussed and re-evaluated.

The second author continued to unitize the meetings based on the social presence cues found in the message content or on the rhythm of discussion (e.g., a question without an answer resulting in a clear pause in the group’s interaction was one distinct unit). Both audio-based communication and text chat communication were marked simultaneously using the same video screen (see Figure 1).

The final coding scheme was developed iteratively in discussions between the authors, and disagreements were resolved through negotiation. The coding scheme is presented in Table 1. The scheme consists of three positive and three negative categories that contribute to social presence: High copresence, low copresence, high psychological involvement, low psychological involvement, high behavioral engagement, and low behavioral engagement. These categories are equivalent to Biocca and his coauthors’ (2001) original categories. They were further divided into subcategories and individual codes. Each unit was thus coded at all three levels to enable both detailed analysis and abstraction of results.

After the development of the final coding scheme, the first author and an independent, trained judge coded one of the meetings independently by identifying and labeling all units consisting of social presence cues and assigned each unit to one or more social presence cue categories that best represented the participants’ meaning when considered in context. Some units were given several codes referring to different subdimensions of social presence, whereas others clearly belonged to only one subdimension and were coded only with one code. If a unit did not include social presence cues or was difficult to track using the video, it was not coded. The coders compared the results, and Cohen’s Kappa was calculated to assess interrater agreement and ensure the reliability of the results. The Cohen’s Kappa score was 0.81 (Cohen 1960), indicating a sufficient degree of agreement. Thereafter, the trained judge coded the rest of the meetings independently. Table 2 provides sample codes and quotes.

Finally, the strength of social presence, i.e., the group’s level of social presence, was coded. The independent judge identified and coded the number of participants in the thematic units to determine whether the positive or negative social presence cues in each occurrence could be traced from the majority or part of the group. In cases when positive or negative social presence cues could be identified in more than half of the group members’ communication behaviors, the entire group’s social presence was identified as high or low at that particular time. In cases when only a few of the members discussed or replied to a question targeted to the entire group, subgroup social presence was identified and coded. Some occurrences were characterized by more than one group-level social presence code and were accordingly coded with two group-level codes.

The way we have operationalized group social presence has an impact on the combinations of social presence levels we were able to find in the meetings. For example, high subgroup social presence is always mutually exclusive with high group social presence occurrences. According to our analysis scheme, two parallel discussions were always coded as subgroup social presence (high or low) as one person can be socially present only in one situation at a time. We present the dimensions and the levels of social presence we found from the distributed team meetings in detail in the next section.

**Findings**

**Quantitative Results**

Figure 2 illustrates the social presence dimensions and their occurrence rate measured in frequencies per hour during the VE team meetings. Figure 2 shows that generally the dimensions related to positive social presence increase over time, so that their frequency rate is higher in later meetings. Correspondingly, the
**Table 1 Coding Scheme**

<table>
<thead>
<tr>
<th>Category</th>
<th>Subcategory</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. High copresence</td>
<td>1.a) High inclusion</td>
<td>Subject shows / notices that s/he is not alone and secluded.</td>
</tr>
<tr>
<td></td>
<td>1.b) High mutual awareness</td>
<td>Subject shows high awareness of the other, and the subject notices that the other is highly aware of him/her.</td>
</tr>
<tr>
<td>2. Low copresence</td>
<td>2.a) Low inclusion</td>
<td>Subject shows / notices that s/he is alone and secluded.</td>
</tr>
<tr>
<td></td>
<td>2.b) Low mutual awareness</td>
<td>Subject shows low awareness of the other and/or notices that the other is not aware of him/her.</td>
</tr>
<tr>
<td>3. High psychological involvement</td>
<td>3.a) High empathy</td>
<td>Subject responds empathically to the emotional states of the other.</td>
</tr>
<tr>
<td></td>
<td>3.b) High mutual attention</td>
<td>Subject shows high attention to the other.</td>
</tr>
<tr>
<td></td>
<td>3.c) High mutual understanding (not observable)</td>
<td>Subject shows that s/he has insight into the intentions, motivation, and thoughts of the other.</td>
</tr>
<tr>
<td>4. Low psychological involvement</td>
<td>4.a) Low empathy</td>
<td>Subject does not respond empathically to the emotional states of the other.</td>
</tr>
<tr>
<td></td>
<td>4.b) Low mutual attention</td>
<td>Subject shows low attention to the other.</td>
</tr>
<tr>
<td></td>
<td>4.c) Low mutual understanding</td>
<td>Subject shows that s/he has no insight into the intentions, motivation, and thoughts of the other.</td>
</tr>
<tr>
<td>5. High behavioral engagement</td>
<td>5.a) High mutual assistance</td>
<td>Subject offers assistance to another person.</td>
</tr>
<tr>
<td></td>
<td>5.b) High dependence on others’ actions</td>
<td>Subject shows that his/her actions are interdependent to the other and notices the interdependence of the other to his/her actions.</td>
</tr>
<tr>
<td></td>
<td>5.c) High behavioral interaction</td>
<td>Subject shows that his/her actions are responsive to the other and notices the responsiveness of the other to his/her actions</td>
</tr>
<tr>
<td>6. Low behavioral engagement</td>
<td>6.a) Low mutual assistance</td>
<td>Subject does not offer assistance to another person.</td>
</tr>
<tr>
<td></td>
<td>6.b) Low dependence on others’ actions</td>
<td>Subject does not show interdependence to the other and does not notice the interdependence of the other on his/her actions.</td>
</tr>
<tr>
<td></td>
<td>6.c) Low behavioral interaction</td>
<td>Subject shows that his/her actions are not responsive to the other and/or notices that the others are not responsive to his/her actions.</td>
</tr>
<tr>
<td></td>
<td>6.d) Lag in response</td>
<td>Subject replies after a notably longer time than what would be typical in face-to-face discussion</td>
</tr>
<tr>
<td>Sample codes</td>
<td>Example</td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>1.a) Indication of togetherness</td>
<td>“Great that we are all together here in SL.”</td>
<td></td>
</tr>
<tr>
<td>1.b) Appearance with feedback</td>
<td>Greetings at the beginning of the meeting / on person’s arrival.</td>
<td></td>
</tr>
<tr>
<td>2.a) Technical problems lead to hearing problems</td>
<td>A person says s/he has problems hearing anyone.</td>
<td></td>
</tr>
<tr>
<td>2.b) Information / person left unnoticed because of a lack of awareness</td>
<td>“I’m so confused … What? I’m a bit lost because I was typing on what we were saying and I didn’t catch up.”</td>
<td></td>
</tr>
<tr>
<td>3.a) Indication of positive emotion / feedback</td>
<td>“Kim, would you like to say a couple of words about this, cause they are very cool and good ideas.”</td>
<td></td>
</tr>
<tr>
<td>3.b) Mutual spatial direction</td>
<td>A person asks the group to turn to the right screen and everyone obeys.</td>
<td></td>
</tr>
<tr>
<td>4.a) Indication of no emotion/feedback</td>
<td>A person asks for feedback but does not get any responses.</td>
<td></td>
</tr>
<tr>
<td>4.b) Parallel discussions in chat and audio channel</td>
<td>Parallel discussions in chat and audio channel on different topics take place simultaneously.</td>
<td></td>
</tr>
<tr>
<td>4.c) Poor understanding of a question/comment</td>
<td>A person indicates that s/he does not understand the question directed to him/her.</td>
<td></td>
</tr>
<tr>
<td>5.a) Assistance to another person</td>
<td>“Can someone take the notes?” “I can.”</td>
<td></td>
</tr>
<tr>
<td>5.b) Continued act with dependence on others’ feedback / actions</td>
<td>A person asks whether the screen is clear yet and receives answers before continuing to speak about its content.</td>
<td></td>
</tr>
<tr>
<td>5.c) Two/Three/Four/Five/Most/All members participate</td>
<td>Active discussion among two/three/four/five/most/all members.</td>
<td></td>
</tr>
<tr>
<td>6.a) Poor assistance to another person</td>
<td>Someone asks for help but no one replies.</td>
<td></td>
</tr>
<tr>
<td>6.b) Continued act without dependence on others’ feedback / actions</td>
<td>“So do you have anything to add here – ok, let’s move on.”</td>
<td></td>
</tr>
<tr>
<td>6.c) No one responds / Most members do not respond</td>
<td>“Anything to add here, anyone?” One person responds: “Nope.”</td>
<td></td>
</tr>
<tr>
<td>6.d) Response lag</td>
<td>A person responds to a comment / question with a significant lag.</td>
<td></td>
</tr>
</tbody>
</table>
Overall, high behavioral engagement as well as high psychological involvement were the most frequently occurring social presence dimensions in every meeting. High behavioral engagement was the most commonly occurring dimension of social presence, increasing from 31 to 48 occurrences per hour from the first to the last meeting. The second most coded dimension was the high psychological involvement dimension, increasing from 13 to 35 occurrences per hour from the first to the last meeting. High copresence was far less widespread, with an increase from 3 to 5 occurrences per hour from the first to the last meeting. When accounting for meeting length, all high social presence codes increased rather linearly towards later meetings, except for high psychological involvement that dropped in the seventh meeting to 21 occurrences per hour.

Negative social presence cues occurred far less frequently than positive social presence cues. While low copresence decreased from 5 to 2 and low psychological involvement from 7 to 1 occurrences per hour from the first to the last meeting, low behavioral engagement was steadily around 2 occurrences per hour until the last team meeting when it increased to 10 occurrences per hour.

Figure 3 illustrates the strength of social presence within the group, i.e. the group-level social presence codes during the team meetings, measured in frequencies per hour. The frequencies in the high group and low group social presence categories indicate the number of occurrences in which more than half of the group members were socially present in or socially absent from the situation. The frequencies in the high subgroup and low subgroup social presence categories indicate the number of occurrences in which only some of the group members (half or less than half of the group) were socially present in or socially absent from that particular situation during the meeting. In addition, the occurrences characterized by two group-level codes were the combinations of low group, high subgroup social presence and high subgroup, low subgroup social presence.

Looking at Figure 3 it is evident that the level of social presence varied during the meetings from high to low, as either a subgroup or group phenomena. In all of the meetings, high subgroup social presence was the most common level of social presence observed. As shown in Figure 3, high subgroup codes increased in occurrence rate towards later meetings (from 18 to 36 occurrences per hour), but for the rest of group-level codes, no clear linear direction can be observed. High group social presence was the second most common code, occurring with an average rate of 9 occurrences per hour. In contrast, it was rather exceptional for the entire group to convey social absence, as only 2 occurrences per hour were coded as low group social presence. In addition, it was relatively rare for only a subgroup to show a high
level of social presence in situations requesting the whole group’s attention, generating 3 occurrences per hour on average in the category low group, high subgroup social presence. The occurrence rate of low subgroup social presence was 2 per hour on average, but increased in the last meeting to 7 occurrences per hour. The underlying reasons for these group-level measurements of the strength of social presence are explicated in the next section, which presents the qualitative results.

Qualitative results

Social Presence Dimensions

The social presence dimensions described above were all observational in nature, although psychological involvement and behavioral engagement could be traced more often to the verbal and nonverbal communication among the participants than copresence. High copresence occurrences included interaction in which inclusion or mutual awareness was shown. A typical example of mutual awareness occurred when one or more of the group members entered the VE. An automated notice of the person’s arrival was provided, as well as a cloud signaling that the person’s avatar was downloading, and everybody noticed and greeted one another. Low copresence was indicated when inclusion or mutual awareness was low, such as when someone was not aware that another person had already entered the VE or did not hear or perceive the topics that were under discussion. These situations were often related to technical problems with the audio channel. The following excerpt is an example of low mutual awareness:

[8:07] Jenni (leader): Kim, can you hear us?
[8:08] Kim: jenni?
[8:08] Kim: can you speak again?
Jenni (using audio): So Kim, it would be nice to hear how you are doing, just like, tell everybody how you are doing.
[pause]
[8:08] Jenni: kim, you can always tell how u r doing with chat if its better 4 u!!
[pause]
[8:09] Kim: ok, I guess mine doesn’t work then?
[8:09] Jenni: can’t u hear us?
[8:09] Kim: i can hear you
[8:09] Kim: and tried talking about how I’ve been doing?
[8:10] Heini: kim: i can’t hear you.

Because not all members participated in this discussion, it was impossible to know whether they heard what one of the members, Kim, had been talking about, and those members who participated said that they had not heard what she said. These types of occurrences can also be viewed as increasing the isolation of the dispersed group members.

*High psychological involvement* was observed in the group interaction in, for example, situations in which one or more group members responded empathically to the emotional states of another. Such interaction occurred most often in situations in which group members gave positive feedback or made jokes or used smileys and other emoticons during text chat. At times, the members also utilized the selection of nonverbal communication behaviors available to their avatars, which created an observable, empathetic communication occurrence in VE interaction. The following is a typical example of a subgroup's high psychological involvement via simultaneous text chat and audio channel interaction:

Leader: I think this was the best meeting so far. And one big reason for that was that you guys have been so active during the last days. During the weeks when there has been a little bit less activity, it’s much more difficult, when you don’t know who knows what and who’s getting to what, but now, this time it was so much easier and like, it was a pleasure to do the slides [laugh] and the agenda. So I want to thank everybody for that …

[8:49] Aysha: cheers
Leader: … for the input. It felt very good. And I think we should continue like this -
(Aysha’s avatar claps her hands)
Leader: – because, if we continue like this, we’re gonna be so good-
(Jamal’s avatar claps his hands)
Leader: (laugh) - and we’re gonna do so well.

[8:50] Heini: :D

However, *low psychological involvement* was also observable in the group interaction. It was usually the result of parallel, unrelated discussions that occurred because of the existence of several communication channels, or multitasking, such as the simultaneous participation in offline and online discussions. Sometimes, the members even stated that they had not been able to follow the ongoing discussion as they completed other activities. This was an indicator of information left unnoticed as a result of a lack of cognitive capacity.

*High behavioral engagement* was apparent in the group interaction, particularly in situations in which several group members participated in the discussion or when a group member’s behavior was clearly dependent on others’ feedback or actions. Such high behavioral engagement in the form of interdependent actions was visible when, for example, the team leader asked whether anybody had anything to add or comment at the end of the meeting and waited for answers before beginning to end the meeting:

John: (substitute leader) Okay. Anybody else have anything to add as far as … things to do? This is the last slide, so if anybody has anything to add, that’s the time to do it.
Nonetheless, the interaction among group members in the VE was often low in terms of behavioral engagement. A typical example of low behavioral engagement was a member’s receipt of no answer or only a short answer to a question that was targeted to the entire team. A low behavioral engagement in the form of low dependence on others’ actions was apparent in situations in which a member (most often the team leader) asked if anyone had anything to add but then moved the discussion forward without providing sufficient time for anyone to answer. Such an occurrence was sometimes related to the existence of several communication channels: A member may have begun to type something via text chat but the team leader did not notice because she used mainly the audio channel for discussion.

**Level of social presence within the group**

Group-level indicators of high social presence were observable in the VE interaction in several situations. One example was those instances where the team leader asked something of the entire group and most of the members responded instantly. Arrivals to and departures from the group meeting constituted another typical situation in which social presence was evident among the entire group. Team members used a great deal of small talk, emoticons, and nonverbal avatar signals in their communication before beginning or after completing the official meeting agenda, and usually, all team members participated in these discussions and noticed one another. Furthermore, low group-level social presence appeared in situations in which none or only a few of the members responded to a question that was targeted to the entire group. In some situations, the leader waited for answers from all of the team members but only a few of them replied; in other situations, the leader did not actually provide time for answers.

It was very common that social presence cues were observable in only part of the group members’ communication. In these instances, subgroup social presence was marked as high. For example, in a situation in which two of the members discussed a topic intensively via text chat or voice and nobody else in the group participated, the observable level of social presence in the group was high only in that particular subgroup. Moreover, situations often occurred in which two or three of the members gave positive feedback to one another or made jokes and laughed about something. The level of social presence remained high in that particular subgroup until the topic was changed and another interaction episode began.

Low subgroup social presence cues were traceable much more rarely than high subgroup social presence cues. Typically, these cues included situations in which some of the members did not understand a question directed to them, a participant had not heard what another person had asked him/her because
of technical reasons or a lack of attention, or the person was noticeably doing something else, i.e., multitasking, during the meeting.

Occurrences in which social presence was low among the group as a whole but subgroup presence was still high occurred in particular when two communication channels were in use simultaneously. The intensity of the discussion in which some of the members were participating in one of the communication channels (e.g., text chat) and a simultaneous discussion occurring via the audio channel indicated that the entire team was not able to follow both discussions at the same time with the same intensity. In these situations, the subgroup-level psychological involvement was high but the group-level psychological involvement was low. During the third meeting, the team leader indicated to the team that they should attempt to eliminate these types of parallel discussions. Bringing this to members’ attention could have been one of the reasons for the decrease in the frequency of low group, high subgroup social presence occurrences in subsequent meetings.

Another combination of different group-level dimensions of social presence was apparent in those instances in which subgroup social presence was high for one subgroup and simultaneously low for another subgroup. The reasons for these subgroup social presence occurrences were similar to the reasons behind the occurrences in which the entire group’s social presence was high or low. However, these combinations of high subgroup and low subgroup social presence typically emerged when there were technical problems, such as difficulties hearing other members. Hence, a subgroup was isolated because, for example, their microphones did not work, whereas the others could participate in the discussion.

The duration of these group-level social presence occurrences varied from short to long depending on the discussion topic or the rhythm of the conversation. However, rapid changes from high group- or subgroup-level social presence to low subgroup- or group-level social presence and vice versa were possible.

Discussion

The findings obtained in this study indicate the situational and multi-dimensional nature of social presence in distributed team meetings held in VEs. We found evidence for Biocca and his coauthors’ (2001) categorization of presence into three dimensions: copresence, psychological involvement, and behavioral engagement. We also showed that it is possible to observe these differing dimensions of social presence in group interaction. However, it is important to note that these observations do not cover the psychological states or intrinsic feelings of the team members. Our findings show that social presence is an ongoing process that may vary throughout the team meeting as the result of several factors. These findings have both theoretical and methodological implications.

Theoretical implications

Previous studies on presence as social richness have suggested that the higher the number of communication channels and capabilities provided to the user, the more social presence s/he will experience when using the media (Short et al., 1976; Lombard & Ditton, 1997). However, in our study, social presence was not supported as much by the features of the technology and the richness of the media as by communication. Social presence cues existed both in text and voice chat, but the same cues were also missing at times in both communication channels. The occurrences related to high and low social presence were extensively communicational in nature, indicating that interaction and level of participation play a significant role in the achievement of social presence within a dispersed team. This conclusion, in turn, strongly supports studies indicating that interactivity is positively related to level of social presence (Tu & McIsaac, 2002; Kim, Kwon, & Cho, 2011; Wang & Tai, 2011). In addition, we found that the occurrence rate of positive social presence cues increased in the team’s interaction over time, while negative
Social presence cues decreased. This finding suggests that social presence takes time to develop through mediated communication.

Our study showed that team members used both text and audio channels for communication, which enhanced the amount of parallel discussions. This in turn, resulted in low mutual attention and low social presence within the team as a whole. We thus argue that the media richness perspective may not be the best explanation for social presence within virtual teams. However, individual preferences related to different media, as well as the possibility of sharing ideas and comments simultaneously, may often justify the existence of multiple communication channels in VEs.

Despite the potential of VEs to evoke social presence (Bulu, 2012; Shen & Khalifa, 2008), our findings imply that a rich VE alone is not sufficient for the creation of social presence in distributed teams despite its unique shared three-dimensional space and avatars. For example, copresence, which emerged during team meetings in relation to mutual awareness and inclusion, was rarely observable in avatars’ body positions or status appearances; rather, it was observable in team members’ interaction. Interestingly, our findings show that avatars played a minor role in the creation of social presence in virtual team meetings. The team members hardly utilized the ability to control the view and movements of the avatars and the avatar proxemics and body orientations. This result raises doubts as to the avatar’s importance in the design of VEs. However, the role of technology and avatars may be more crucial if participants are well trained or experienced in the utilization of the nonverbal features and technological possibilities of VEs.

Technical problems can weaken the sense of presence because the focus is on the flaws of the VE (Lombard & Ditton, 1997). We noted that technical problems sometimes caused long pauses in discussion, which were related to a lack of realism. However, low realism did not automatically indicate low social presence. For example, some members used only text chat but still succeeded in maintaining a high level of behavioral engagement.

Many of the episodes in which social presence cues were lacking were related to the structure of the interaction and how the meeting was led. If the team leader or another participant shared a long monologue during the meeting, it often decreased other members’ attention, and no comments were given afterwards although specifically requested. The VE and the dispersion of the team itself could be one of the causes of this type of low social presence, as it may be difficult to follow a long talk without any nonverbal communication or illustrative material. However, such occurrences are often the case in face-to-face interaction as well; participants may not be psychologically involved or behaviorally engaged when sitting around the same table if meetings are not well structured and led. This detail shows the importance of the nature of communication in evoking and maintaining social presence, which is even more crucial in mediated settings.

Finally, it would be important to study the impact of social presence in different types of groups. For example, groups working on decision-making or cowriting tasks may benefit from high group social presence more than groups that need to generate a lot of ideas. Such groups may benefit from the possibility to break out in smaller groups and having a high subgroup social presence during the meeting. Hence, the task of the group may impact on what level of social presence is desired. Further research is needed on the level of social presence during different types of meetings and its impact on group productivity.

Methodological implications

One of the key contributions of our study is our application of qualitative methods, such as participant observation, to the study of the ongoing process of social presence. Our study showed that the level of social presence varied throughout the meetings, which is consistent with Heeter’s (2003) notion that social presence can change from situation to situation. Hence, this study moves social presence research...
beyond previous rather cross-sectional studies, in which it has predominantly been operationalized as a one-dimensional construct measured using a survey (e.g., Axelsson et al., 2001; Hoyt et al., 2003; Sallnäs, 2005; Bente et al. 2008). Furthermore, our study is one of the few studies in which social presence cues have been observed from the group members’ interaction across several meetings. A few studies have measured social presence within a group at several points in time (see e.g. Nilsson et al., 2002; Tromp et al., 1998) but they have not used communication content analysis to identify social presence cues or defined social presence as a group-level phenomenon constructed in social interaction.

Our findings suggesting that positive social presence cues increased in the team’s interaction over time, while negative social presence cues decreased, bring forth the importance of accounting for the temporal dimensions of the virtual team’s lifecycle when studying social presence. More specifically, we show that it is possible to measure social presence through quantitative and qualitative content analysis of team interaction using a coding scheme we derived from the multidimensional construct of social presence theorized by Biocca and his colleagues (Biocca et al., 2001, 2003). The observable dimensions, i.e., copresence, psychological involvement, and behavioral engagement, could all be traced from the team communication rather than the attributions of the medium, underscoring the importance of studying group interaction to assess the fluctuating phenomenon of social presence.

Another methodological contribution of this study is the coding scheme that was created. A high interrater agreement demonstrates the applicability of our coding scheme to other settings and to use by other researchers. As social presence proved to be a phenomenon that is strongly communicational in nature, group dynamics may play a role in its formation and development. Furthermore, group task as well as leadership style may have an impact on social presence during meetings. Future research must validate the coding scheme with different types of groups as well as with different types of tasks and leaders. This study offered an initial take-off point from which others are welcome to continue.

Last, while social presence has earlier been studied as a subjective, personal experience, efforts to aggregate results to the group level are more or less nonexistent. This study has extended earlier measurements of social presence by recognizing it as a group-level construct. Although we agree that social presence is composed of components that are primarily individual (such as feelings of isolation and inclusion), the concept of social presence includes several interpersonal components that focus on participants’ mutual feelings and reciprocity (such as dependent action) (Biocca et al., 2001). Hence, aggregation to the group level is motivated by the theoretical underpinnings of the social presence construct itself. This addition of group-level analysis can provide valuable insights into how social presence is created and maintained throughout group interaction.

Although this study makes several methodological contributions, the application of observational means to the study of social presence is not without limitations. The way we operationalized group and subgroup social presence had an impact on the combinations of social presence we were able to find. For example, high group social presence and high subgroup social presence are mutually exclusive according to our analysis. We assumed that it is not possible to focus on two parallel discussions at the same time; therefore, two parallel discussions have always been coded as subgroup social presence (either high or low). However, experiencing high group and subgroup presence simultaneously may be possible to some individuals, who are for example good in multitasking. Therefore the different combinations of group-level social presence need further study.

Some of the subdimensions of social presence are difficult to observe because of their nature. In particular, aspects related to the cognitive dimensions of social presence were difficult to track by studying the group interaction. For example, participants can experience empathy and mutual understanding without expressing observable reactions. Participants may also express themselves in ways that signal mutual understanding, although in reality, they would have difficulty understanding one another. As our results showed, codes categorized as copresence constituted merely 10 percent
of all codes, whereas psychological involvement constituted 34 percent and behavioral engagement constituted 56 percent. Although this result is caused partly by the nature of the team’s interaction, it is also certainly the result of the methodological shortcomings of observation in the study of social presence. By combining observational means with psychological measures, such as cardiac interbeat intervals (Ravaja et al., 2006) or facial electromyography and respiration (Chanel et al., 2012), one could also tune into the cognitive dimensions of social presence without having an excessive influence on group interaction. The uncovering of both the behavioral and cognitive aspects of social presence is important to the more precise assessment of the underlying dimensions of social presence during VE group interaction. Hence, future studies should focus on developing different ways of studying social presence, utilizing perceptual, behavioral, and physiological methods. By triangulating participant perception of social presence and unobtrusive measures of social presence, we could ensure that social presence is being measured comprehensively. Only by applying clear-cut definitions and measurements can we advance theory and our understanding of social presence as it plays out in group interaction.

Acknowledgements

The authors wish to thank the anonymous reviewers for their insightful comments as well as Marko Hakonen and Petteri Laine for their work on data collection and coding. This research was supported by the Aalto University MIDE Research Program.

References


---

**About the Authors**

**Anu Sivunen** is a Research Manager of the Virtual and Mobile Work Research unit (vmWork) and a Postdoctoral Researcher at the Department of Industrial Engineering and Management, Aalto University School of Science, Finland. Her research examines computer-mediated communication and social identification in distributed teams and the use of communication technologies in new ways of working.  
**Postal address:** Aalto University School of Science, P.O.Box 15500, FIN-00076 Aalto, Finland.  
**E-mail:** anu.sivunen@aalto.fi

**Emma Nordbäck** is a Doctoral Student at the Department of Industrial Engineering and Management, Aalto University School of Science, Finland. Her research focuses on group processes such as computer-mediated communication, coordination, and leadership in distributed (global) teams.  
**Postal address:** Aalto University School of Science, P.O.Box 15500, FIN-00076 Aalto, Finland.  
**E-mail:** emma.nordback@aalto.fi