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Sharing experiences through awareness systems in the home

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Abstract

In the current paper we hypothesize that providing peripheral awareness information to remotely located but socially close individuals will yield affective user benefits. An experiment in a controlled home-like environment was conducted to investigate the effects of providing different levels of peripheral awareness information on these affective benefits. In the experiment peripheral awareness aimed to support groups of friends to jointly watch a soccer match at remote locations. The experiment has shown that providing awareness information increases the social presence and the group attraction felt by individuals towards their remote partners. The experiment has provided concrete quantitative and qualitative evidence for the hypothesized benefits of supporting primary relationships through awareness systems and of the relevance of social presence as a requirement in the design of peripheral awareness displays.
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1. Introduction

In this paper we examine the use of communication technologies in a home context, when they support the sharing of contemporaneous activities of remote individuals,

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as opposed to when the communication itself is the primary activity these individuals engage in. More particularly, we try to explore situations where communication is established between individuals who know each other, and where the communication medium will occupy the periphery of their attention and can easily be attended to or ignored when appropriate. The aspiration of this approach is that while individuals engage in some other activity, this background communication may lead to them sharing experiences in a way that would be comparable to enjoying social activities requiring physical collocation of people, such as jointly watching a televised football match in the pub. The research presented here set out to create precisely such a context and to assess what benefits people perceive from this type of communication. This scenario reflects a trend towards the increasing use of communication technologies for recreational or social purposes outside the work context. Further, it aspires to adhere to the vision of calm computing, where technology does not disrupt our daily lives and demand our constant attention, but stays at the background, readily and easily available when people wish to heed attention to it (Weiser and Brown, 1996).

A rich variety of solutions for supporting peripheral awareness of another person or group of people have been proposed in the literature. Examples that target the home environment include the Presence projects (Gaver and Dunne, 1999), the Casablanca project (Hindus et al., 2001), and the photo-collage for elderly and their grandchildren, discussed by Markopoulos et al. (2003). In such works, potential affective benefits of awareness systems are hypothesized, yet little is known about actual benefits resulting from the use of such systems. With few exceptions, e.g., the ASTRA system for connecting related households (Markopoulos et al., 2004), the social presence experienced through the use of awareness systems has not been assessed. Further, the impact of awareness information on the group relation is not yet known. The present research aims to provide an experimental assessment of social presence and of the hypothesized benefits upon interpersonal relations, pertaining to awareness systems for the domestic environment.

In the following sections we shall introduce some of the psychological constructs that enter this vision. Section 2 discusses social presence. Section 3 discusses affective benefits and especially the notion of group attraction. Section 4 describes our empirical study; its results are presented in Section 5 and a more general discussion and conclusions are presented in Sections 6 and 7.

2. Social presence

The concept of social presence has been introduced by Short et al. (1976) as a means to characterise the subjective experience of using a telecommunication medium, with respect to how close it can emulate face-to-face contacts. Social presence can be defined as 'the sensation of being together' (and communicating) with someone (IJsselsteijn et al., 2001). Biocca and Harms (2002) have recently made significant advances in developing a more comprehensive theory of social presence. In line with most other definitions, they define social presence as a 'sense of being with another in a mediated environment'. They continue their shorthand definition by stating that 'social presence is the moment-to-moment

awareness of co-presence of a mediated body and the sense of accessibility of the other being's psychological, emotional, and intentional states' (p. 14).

Paralleling technological developments in video conferencing and shared virtual environments, the emphasis of social presence research has been on applications where communication is the primary activity in which users are engaged. In such contexts, relevant issues include how social presence might relate to the task performance of communicating partners (Sallnäs et al., 2001), the influence of social presence upon the quality of collaboration (Axelsson et al., 2001), as well as ways of measuring social presence (de Greef and IJsselsteijn, 2001). Social presence has been shown to increase with the richness of the communication medium used. For example, Short et al. (1976) have shown how social presence is enhanced with a video and audio based communication, when compared to audio only. While social presence has been discussed as a relevant yardstick for assessing how communication technologies are perceived by users, little is known as to when social presence is desirable and what interpersonal needs can be satisfied by experiencing social presence in a home context. Our research addresses this apparent gap.

In face-to-face interactions a lot of attention is devoted to non-verbal aspects of the communication. This non-verbal behaviour of people communicates meaningful information, including mutual interest, a shared reference frame for conversation, and a general sense of engagement and identity. It is argued that interpersonal intimacy in an interaction is kept at an optimal, equilibrium level through factors as physical distance, smiling, eye contact, and personal topics of conversation (Argyle and Dean, 1965). Other added intimacy factors include gestures, touching, vocal cues, turn-taking behaviour in dialogues, the use of space, and verbal expressions directly acknowledging the communicative partner. Wiener and Mehrabian (1968) have applied this concept of immediacy (i.e., the psychological distance a speaker puts between him and the hearer), to an understanding of speech. They showed that the choice of 'we...' as opposed to 'I...' or 'you...' imply a feeling of closeness and association. Thus, intimacy and immediacy behaviours seem to be particularly relevant for social presence (de Greef and IJsselsteijn, 2001).

As increasing bandwidth can be offered to people at lower costs, the recreational and social use of computer-mediated communication technologies in a home environment becomes a relevant research theme. A pioneering application in this regard is the Telewindows project by Heeter et al. (2003), where homebound elderly are linked with their social group using an always-on audio–visual connection through which they could observe the activities of their group. However, rich communication media, such as a videophone, can also be experienced as problematic in a home context. For example, Bouwhuis (2000) reports that while elderly adults who interacted with a videophone are very keen on seeing their communication partner, they are quite reluctant to be seen at home, fearing that they will be seen as inappropriately dressed, that potential strangers will be able to see their valuable belongings, or that their home will not be in a state to be viewed in public. This is very similar to the findings reported by Markopoulos et al. (2003). Such issues of experienced vulnerability, social acceptance, and privacy motivated us to explore how lower bandwidth and lower

richness communication media may also help individuals share experiences, while respecting privacy requirements.

3. Group attraction

People are part of many groups they interact with. In general a distinction can be made between two types of groups: primary and secondary (or complex) groups (Cooley, 1909, cited by Forsyth, 1999). Primary groups are small, close-knit groups such as families, friendship cliques, children's playgroups, emotionally close peers and neighbourhoods. Secondary groups, on the other hand, 'are larger and more formally organised and tend to be shorter in duration and less emotionally involving than primary groups.' Members of secondary groups do not necessarily interact directly with each other or know one another: the connections are formal and more impersonal (e.g., professional associations, business teams, religious groups).

Earlier studies have shown that people desire more connections within primary groups. For example, Hindus et al. (2001), Melenhorst et al. (2001) and Markopoulos et al. (2003) provide ethnographic evidence towards the need of individuals to enhance communications with friends and family. This need may be particularly pronounced when primary groups are geographically separated, for example, because adult children migrate away from their family home, because elderly adults become homebound, or simply because people are quite mobile and tend to become separated from their earlier primary groups, etc. Festinger et al. (1950) found that there is a strong relationship between physical closeness and the formation of friendships. When people engage in informal, primary groups they feel connected and close to them. For remote friends, technology could be a great destroyer of distance, allowing them to maintain in closer contact. We hypothesize that an important benefit of experiencing social presence would be to strengthen the ties between remote individuals of primary groups. The question thus arises whether the provision of different levels of information to manipulate social presence will affect the way people feel about their group members.

Cohesiveness is the term used by psychologists to refer to the important property of social groups that may be described by terms such as solidarity, cohesion, comradeship, team spirit, group atmosphere, unity, 'one-ness', 'we-ness', 'groupness' and 'belongingness' (Hogg, 1992). Communication within cohesive groups is better—it is less inhibited and more frequent. Moreover, satisfaction of group members is higher in cohesive groups. Group attraction can be defined as an individual's desire to identify with and be an accepted member of the group (Evans and Jarvis, 1986). The level of a group member's attraction to his/her group contributes to a number of important group outcomes. Members who find their groups attractive are more likely to remain members of the group and to attend gatherings regularly (Sagi et al., 1955). Members who are attracted to their groups also seem more willing to contribute to group discussion and self-exploration.

4. Empirical study

4.1. Problem statement

Consider individuals engaging in some common activity with remote members of a primary group. The research question we address in this empirical study can be phrased as follows:

- Do individuals experience social presence when they are provided with some continuous background information to maintain awareness of their remote friends?
- Does continuous background awareness of the social group influence the attraction experienced towards the social group?

In other words, when people get more information about their friends, do they feel more socially together? Does this in turn influence their attraction towards the group? Do the media allow the remote participant to feel part of the group?

All different levels of information in this study concerned video displays. While we are aware that audio has an important effect on social presence, we did not include audio in the current study for two reasons. First, we were interested in studying the effects of employing different levels of background, or peripheral, visual information, and it was not our intention to achieve the maximum level of social presence possible. Moreover, adding an audio connection would also allow remote participants to discuss the different visualizations amongst themselves, thus obscuring potential effects of the different video conditions. Second, audio awareness displays have been reported to be potentially disruptive to users (e.g. Mynatt et al., 1998), and thus were not in line with the philosophy of a calm, unobtrusive awareness display.

4.2. Setting

The experiment was conducted in the HomeLab, a facility situated at the Philips Research laboratories in Eindhoven, The Netherlands. The HomeLab is a future home-simulation, a test laboratory that looks like a normal house and thus provides us with a relatively natural setting to test the behaviour of participants in the different conditions. The target user group for this research were friends who wanted to share an activity with each other at different (home) locations.

Employing a common scenario of a shared experience, participants were asked to watch a sports event on TV together. The match they viewed was the classic 1974 World Cup soccer final of the national Dutch team against Germany. Since many years, the games of these neighbouring country teams have been among the most interesting and exciting ones for soccer fans in the Netherlands. Because of the average age of the participants in the study, none of them had seen the game live in 1974. Some did know the result in terms of who won the game, but not in terms of what the score was. All participants reported that they found the game to be exciting until the last minute.

4.3. Participants

Thirty-four participants took part in the experiment in groups of three people who considered themselves to be friends (an exception being two groups consisting of two people only). These groups were subsequently divided (2–1) and placed in two different rooms. The participants were selected to have no love relationships (this could possibly bias the measurements of group attraction since love partners would feel more attracted to each other than other group members). All participants were of Dutch nationality. Considering the interest in soccer, all subjects were male.

4.4. Independent variables

A mixed experimental design was adopted. We manipulated two independent variables. The between-subjects variable, concerned the allocation of participants in groups. Two kinds of viewers were distinguished: a single viewer who watched the soccer match by himself at one remote location, and a group viewer who was part of a group of two people watching the game together at the other remote location.

The second variable concerned the type of visualization of the remote location and the participant(s) located there. Three conditions could be distinguished, manipulated within-subjects. These were:

(i) The control condition, where participants watched the same match on TV at remote locations. Participants were not shown any visualization of their friends but they were told that their friends were watching the same match simultaneously. This condition served as a baseline to compare the different visualizations. It can very well be the case that people still experience a certain level of social presence or connectedness when they know about each other being engaged in the same activity at the same time even in the absence of any awareness display.

(ii) The second condition was a sketchy visual condition (see Fig. 1). In this case, participants watched the game on the TV screen at the two remote locations while a processed visual representation of the person(s) in the other location was projected on the wall behind and above the screen. This representation was a black and white image that was updated at real time whenever a movement occurred, effectively only

Fig. 1. Silhouette visualization of three people, portraying their instantaneous movement.

transmitting change information. This visualization thus conveys the amount and nature of movements at the different locations. This way it was possible for viewers to stay aware of the activities/movements of the other persons, while hiding detail that might be considered to threaten privacy. This system does not allow the possibility of the communication between the two sites to become the primary activity in the place of the match viewing.

(iii) In the third condition subjects were shown full video image of their friends while they were watching the match. In this display, full visual detail is shown in colour and the people in the visualization are constantly visible, in contrast to the sketchy visualization, where people only see silhouettes when there is movement.

The trials were counterbalanced to avoid any potential sequence effects. Every group was shown the same match to prevent any effect from differences in the games. Participants were provided with a soft drink during the test to create a relaxed atmosphere.

To summarise, the independent variables were (i) the amount of visual background information available (no visual information vs. silhouette-like information vs. full video) and (ii) the group allocation (single viewer vs. group viewer).

4.5. Dependent variables

After each condition, social presence was measured by using a slightly adapted version of the IPO Social Presence Questionnaire (IPO-SPQ; de Greef and IJsselsteijn, 2001). The IPO-SPQ makes use of two approaches to measure social presence. It uses semantic differential items based on Short et al. (1976), measuring the more affective qualities of the medium. Participants are asked to rate the medium on a series of scales (e.g. 'impersonal–personal', 'cold–warm' or 'inaccessible–accessible'). For the current experiment, two items were excluded from the IPO-SPQ that had previously been shown to score insufficiently in the reliability analysis (de Greef and IJsselsteijn, 2001). In addition to these semantic differential items, the IPO-SPQ includes subjective attitude statements about the media experience using a seven-point agree–disagree scale. For the current experiment, the phrasing of some of these items in the IPO-SPQ was slightly adapted to better reflect the current experimental setting (e.g., the fact that no audio was present).

In addition to social presence, the second main dependent variable was the level of group attraction experienced by the subjects. Group attraction was measured by the Group Attitude Scale (GAS; Evans and Jarvis, 1986). The GAS is a questionnaire that is applicable to a broad range of groups. Its purpose is to measure group members' feelings about a group rather than their behaviour within the group. The GAS is composed of an equal number of positive and negative statements to guard against response set bias. Participants completed the GAS after each condition.

In addition to the IPO-SPQ and the GAS measures, a set of additional questions was posed by means of a custom designed questionnaire. This set included items concerning involvement, interest, how distractive was the visualization, enjoyment, feelings of isolation, etc. Also, all experimental sessions were recorded on video for both locations (including the visualization at each location), allowing for detailed behavioural observation and coding of verbal and non-verbal behaviours. Together, these additional

measures provided a rich set of qualitative data that will be described in the Results, after describing the social presence and group attraction results.

5. Results

5.1. Social presence

Data were analysed by means of the General Linear Model for repeated measures. Fig. 2 illustrates the effects of different levels of visual information on the experience of social presence for the different type of viewers, as measured by the subjective attitude statements of the IPO-SPQ ($F(2) = 119.2$, $p < 0.001$). The condition in which people saw the full visualization was rated higher on social presence than both the sketch and the control condition. The social presence scores for the sketch visualization are only marginally higher than the control condition in which no visualization of the remote communication partner(s) was present. As can be seen in Fig. 2, there was no significant difference between the different types of viewers. Both single and group viewers experienced the different conditions similarly.

Fig. 3 illustrates the results of the manipulations of the independent variables on the experienced social presence of the medium, as measured by the semantic differential scales of the IPO-SPQ, which are sensitive to various affective qualities of the medium. Again, there is a clear and significant difference between the social presence ratings of the medium for the different visualizations ($F(2) = 36.7$, $p < 0.001$). The full video
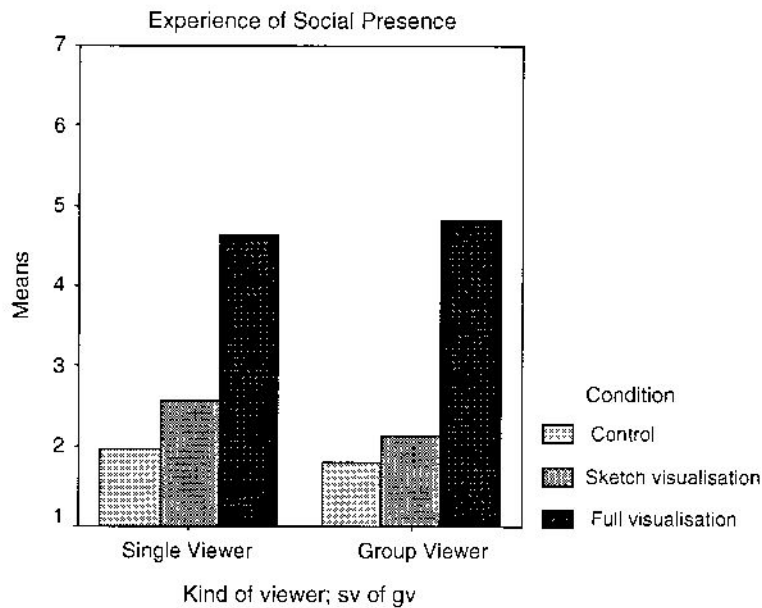

Fig. 2. Social presence as measured by the subjective attitude statements of the IPO-SPQ.
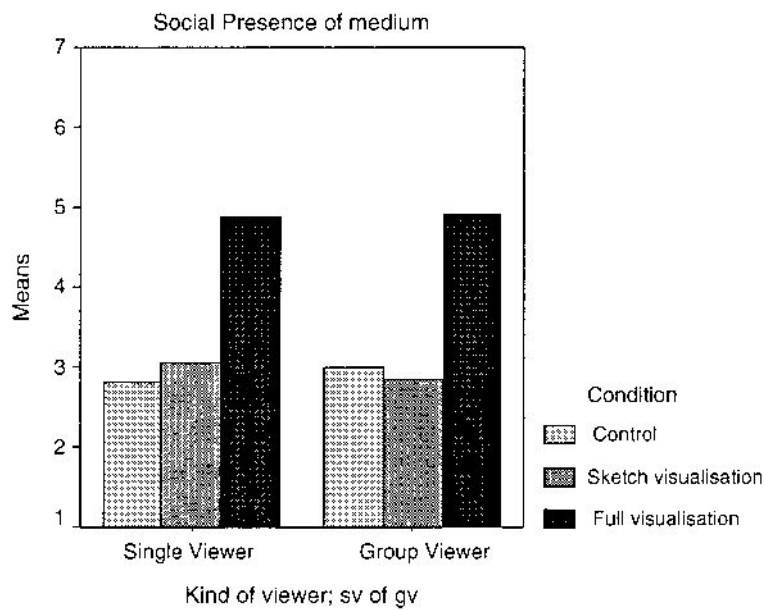
Social Presence of medium

Fig. 3. Social presence of the medium, as measured by the semantic differential scales of the IPO-SPQ.

visualization was rated higher on social presence than the sketch visualization for both the single and group viewer. The full visualization is found more personal, accessible, and warmer compared to the sketch visualization.

There was no significant difference between the control and sketch condition. Both kinds of viewers rated the social presence of the different media the same.

5.2. Group attraction

Fig. 4 illustrates the results for group attraction as measured by the GAS. A significant difference can be observed between the results of the different types of viewers, with group viewers reporting higher group attraction than the single viewer in the control and sketch conditions $(F(1)=4.36, p=0.045)$.

The effect of the full visualization on group attraction is the same for both kinds of viewers. Providing single viewers with full visual information about the rest of the group enhances their attraction to the group.

5.3. Descriptive data

In addition to the measures for social presence and group attraction, other issues have been addressed in the questionnaire, and the video observations of the participants during the sessions. The results of the questionnaire will be discussed in this section. Section 5.4 will address the observational data.
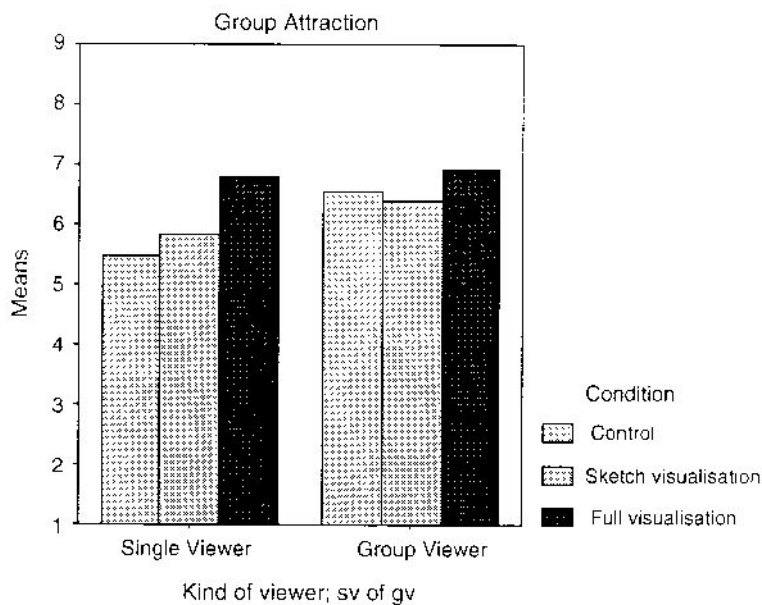
Group Attraction

Fig. 4. Group attraction as measured by the GAS.

One of the motivations for choosing to study TV viewing as a shared experience for individuals seperated by distance is that watching TV is to a large extent a social activity. This assumption was confirmed as most participants reported that they watch television together with at least one person, who is often their partner. Only 6% of the participants reported watching TV alone. Different motivations seem to underlie this tendency including the cosiness or atmosphere when you are together, and the possibility of discussing the contents of the programme together. Participants reported to prefer to watch sport and movies with others (they appreciate their reactions and company), whereas they prefer to watch news and documentaries alone. Currently, participants mentioned using the phone often while they are watching TV. It can be concluded that the participants want to communicate with others at remote locations more than they do now.

On the question whether the participants wanted to use the system, a difference was found between the conditions. The full video visualization scored significantly higher than the sketch visualization. Group viewers scored higher on wanting to use the full visualization at home than the single viewers. The interaction during the full video visualization was rated as much more fascinating for both type of viewers.

As a potential negative effect, during the full video condition people felt they were being watched more than during both the sketch and control conditions. There was no difference between the kinds of viewers in this respect. Despite our assumptions regarding the calmness of the sketch visualization, both the sketch and the full video visualization were rated equally distracting; this was the same for both types of viewers. In line with this result, there was no difference in the attention group viewers reported to devote to their collocated friends (in the same room with them) across the different visualizations.

Both single and group viewers devoted more attention to the full visualization than to the sketch visualization. Participants thought that they devoted more attention to the soccer game during the sketch visualization than they did in the full video condition.

Most people indicated that a system that showed visual information about remote persons would enrich the interaction with their friends. Participants indicated they would like to have a system where they can communicate or interact with each other over distance while they are watching TV. They prefer to see and hear the persons. Most participants valued knowing the (emotional) reactions of the other person, and also wanted to know the opinion of the other person about the activity they are sharing. People's expressions were valued often as well, moreover, many participants liked to see what the environment looks like at the other person's end.

Interestingly, group viewers thought that the single viewer had been feeling more left out and lonelier than was actually reported by the single viewer.

5.4. Observing the participants

The information that was obtained from observing the participants confirms the data of the questionnaires. The video analysis was not done in a structured way with prescript categories. Rather, video material was reviewed to get a feeling for interesting overall and recurring aspects in the behaviour of the different participants.

The participants behaved in a way that seemed natural for a domestic environment, sitting relaxed in the couches with their drinks at hand. Group viewers verbally expressed that they considered the HomeLab living room as a real living room. Some of the group viewers remarked: 'This is a very nice living room' or 'I would like a couch like this at home'.

A recurring behaviour between collocated as well as remotely located parties that was seen in almost every session was making the sign 'cheers' with glasses. Another recurring behaviour was laughing and waving to the communication partner when a player of the opposite soccer team got tackled. During the sketch visualization this was done as well, but not always recognized as such. This sometimes broke the action–reaction principle of communication, as during the sketch condition such actions were not always identified as being an attempt to interact. This was different in the full visualization, where people were able to identify the behaviours and even the intentions of the interaction partner(s).

The urge to communicate with the remote partners was evident in many ways. In all three conditions, participants stated to their collocated friends that they missed audio. Some indicated that they would have liked to know sign language. Many group viewers talked about the fact that they wished they had access to their mobile phone that they had been asked not to use during the experiment. During the full video condition the exchange of messages was relatively easy since people were able to identify detailed movements, facial expressions and the context of the other location.

In the full video condition two kinds of communications were prevalent. First, participants interacted with each other on the basis of events that happened in the game. Examples of this kind of communication are the waving to the other location when a football player missed a shot. Second, people initiated interaction with each other more or less independent of events in the game. Examples of this kind of communications were

making signs of waving with hands to ask if the single viewer wants to join the group viewers, or indicating that the drinks are nice by smiling to the drinks. Participants showed mirroring behaviour during the full video condition. For example, if the single viewer saw that the group viewers were laying back on the couch he sat relaxed as well; when whereas they moved to the edge of the couch, the single viewer bent forward often as well.

Most of the time, in the sketch condition only gross movements (like when a person is drinking) were recognized, and consequently most of the time they were based on a previous event in the game. During the first couple of minutes participants 'tried out' the sketch visualization to see what kinds of images were visible and how the other person(s) would react to their actions. It appears that during the sketch condition the communications were mostly based on events in the game.

In the control condition group viewers talked a lot about the single viewer. Group viewers often communicated that they felt sorry for the single viewer who was totally isolated. 'It is probably frustrating for him to see that we are talking, but not to be able to hear what we say'. In the results of the questionnaire it can be seen that the group viewers overestimated the severity of feeling alone. Group viewers often asked each other what the single viewer might be doing and mentioned that they missed the single viewer in the control condition: 'It is silent without Stephan' one of the group viewers stated. Another group viewer said: 'Now you start to wonder what he is doing'. Overall, group viewers seemed more occupied with the single viewer than the single viewer was with the group viewers. It was also clearly visible that single viewers were more engaged in the game during the control condition. Single viewers were smiling less in the control condition. In the sketch visualization, when there was activity at the remote location, the single viewer would most of the times, even though he did not always know what the others were trying to say.

6. Discussion

An important difference between the current study and studies focussing on computer-supported collaborative work (CSCW), is that in the latter case the cooperative activities require coordination of actions and sharing of resources, thus leading to a substantially more intensive exchange of information, and a potentially higher sense of social presence and group attraction. It is possible to extend the current application to support sharing of leisure activities beyond the fairly passive one of watching TV together. We expect such joint activities of remote parties, e.g., playing a game together, to engender a substantial level of social presence as well, in accordance with the PhotoShare study by de Greef and IJsselsteijn (2001), who examined viewing and talking about holiday snapshots as a joint activity. However, when shared activities require coordination or cooperation, the communication channel will have to be explicitly attended to, thus making the communication itself the primary activity. In contrast, the present study was specifically aimed to investigate the affective benefits of awareness systems, i.e., systems that allow but do not demand the sharing of experiences, and remain as unobtrusive and peripheral as possible, in line with the philosophy of calm computing (Weiser and Brown, 1996).

This study has explored a very simple technology that can provide a background visual communication channel for individuals in remote locations enjoying the same A/V content. Similar technologies that support peripheral awareness of a remote location without compromising privacy have been discussed by Zhao and Stasko (1998). The experiment revealed that indeed social presence can be experienced through such a background communication channel and that higher levels of social presence may also lead to increased group attraction, at least for the single viewer. We consider this to be a significant positive result demonstrating the value of awareness technologies and providing evidence regarding the relevance of social presence as a requirement for such technologies.

In this study, the social presence experienced increased with the richness of the awareness display. This is in line with current literature and demonstrates a challenge for designing awareness systems that also aspire for 'calmness'. A balance has to be found to use both the correct kind and correct amount of information to base the technology on. Further research is needed to investigate what ingredients are needed to design calm technology in the service of social presence. It might be the case that showing the silhouettes that are visible continuously (as opposed to silhouettes that are based on movement) increases social presence; this has to be tested empirically. Also, abstract representations of activity, e.g. indicating a level of movement, might be an interesting option instead of the silhouettes shown in this study.

There was no difference found between the social presence reported by the single vs. the group viewers. This indicates that the single viewer feels socially together with the group at the other location despite the physical distance between them and the isolation of the single viewer. The full visualization is able to create a feeling of being together for the single and for the group viewers that is not significantly different between the viewers. Both kinds of viewers benefit equally from the richness of this medium.

Information from observations revealed that the participants did think there was a difference between seeing nothing from the other location versus seeing the sketch visualization. Conditioned responses, like smiling in reaction of an action of the other location, were visible during the sketch condition and absent during the control condition where viewers seemed more bored. These findings are not portrayed in the data obtained through the social presence questionnaire. This suggests that one useful avenue of further research is to develop a measurement instrument that taps into potential other affective benefits complementary to social presence. Following the present study, we have started developing such a measure, called the Affective Benefits and Costs in Communication Questionnaire (ABC-Q); first results obtained using this questionnaire are promising (van Baren et al., 2004).

An interaction effect was found between the visualization condition and the kind of viewer for group attraction. This can be attributed to a significant difference between single and group viewer in the control condition. Single viewers were less attracted to the group than group viewers in the control condition. This result seems quite logical as single viewers had no access to any information from the group. Both the sketch and the full visualization were capable of increasing the group attraction for the single viewer. The single viewer increasingly identified with the group and felt a more accepted member of the group as more information from the group was communicated. This result is important

as it suggests that emerging communication technologies can impact positively the extent to which people feel part of a group. Even though the sketch visualization did not perform very well on both measures of social presence, it does appear to have an effect on the group attraction experience of the single viewer. This is in line with the observations people made about the visualizations and the observations of the participants during the experiment.

These results can have implications for the findings of Festinger, who argued that physical closeness has a strong relationship with the formation of friendships. The cost of maintaining relationships may decrease when communication media are used that are able to elicit a sense of social presence. Our results already indicate that group attraction increases when a minimal visualization is used to show people during the remote interaction with friends. It might be that the necessity of physical closeness can be lowered in cases where rich communication technologies can be used.

In this experiment, we chose watching a sports game as an activity one would want to enjoy with someone else. It is likely that people prefer different levels of social presence depending on the kind of program they are watching. It may also be expected that people will prefer less distracting media when they are watching a movie as compared to, for example, a sports game (where people value the interaction, both visual and auditory, with each other).

With respect to privacy issues, both the single and group viewers reported a slight feeling of being watched in the full video condition, although this score was not high overall. It is possible that sharing such a communication channel with someone outside the primary group (i.e. not a family member or friend) would contribute significantly to the feeling of being observed unwillingly. Moreover, should the interaction take place in the participants' own home environment, this may also result in more concern over privacy issues, in line with the findings of Bouwhuis (2000). Generally speaking, obtrusiveness and privacy concerns are clearly important issues that may severely limit the widespread acceptance of awareness systems in the home. One way of overcoming this limitation is by allowing an appropriate level of user control, i.e. enabling users to decide, on a case by case basis, the quantity and quality of the information they would like to share with others as part of their social experience.

Participants indicated they wanted to use full visualizations at home but not the sketch visualization. The group viewers were more positive about the full video visualization than the single viewers. This was not in line with our expectations. We expected that the single viewer would be more enthusiastic about a system that would give him the opportunity to feel socially together with remote friends. One possible explanation for this result would be that the group viewers were able to share their fun and enthusiasm related to the system already during the experiment, thus mutually increasing their enthusiasm, whereas the single viewer had no such opportunity.

In the present study, only small groups were used. The extent to which our results will generalise to larger groups of people needs to be investigated in the future. Based on this study we expect that with larger groups the overall level of communication will increase within the group, both locally and between remote sites, and subsequently social presence will be positively affected. Likewise, connecting multiple sites of single or multiple users will be an interesting extension of the current study.

Participants suggested that in the future they would like to be able to communicate more with friends or family at remote locations, while they are watching TV. Of course, participants attributed significant value to being able to hear their communication partner. Expressing ideas and/or opinions about the program one is watching appears to be very important. In general, participants liked the idea of receiving awareness information about their friends while they are watching TV.

The combination of quantitative and qualitative research methods employed in the current study proved to be a fruitful approach in obtaining valuable complementary insights into the users' experiences. The Philips Home Lab provided us with a research environment that successfully balances ecological validity and experimental control. One logical extension of the current study will be to provide participants with the awareness technology at their own homes, thus allowing them to appropriate the technology, and integrate it within their own habits and rhythms of life. A study into the day-to-day use of such a system is also likely to provide valuable insight into emergent, unforeseen uses of this type of technology.

7. Conclusion

We have performed an experiment to investigate the potential affective user benefits that may result from adding peripheral awareness information while remote friends share an activity in a home environment. The results show that providing rich awareness information increases the social presence and the group attraction felt by individuals towards remote partners. This provides concrete evidence of hypothesized benefits of supporting primary social relationships through awareness systems and of the relevance of social presence as a requirement for the design of peripheral awareness displays. Nevertheless, we only found limited affective benefits abstract visualization of the activities of remote parties was supported. The awareness information presented was designed to be less obtrusive than full video communication and to guard the privacy of the connected parties. Clearly, finding the optimal balance between immediacy, relevance and obtrusiveness in designing awareness applications remains a considerable challenge. Additionally, affective benefits other than social presence and group attraction may be considered in designing and evaluating future awareness systems (IJsselsteijn et al., 2003).

References

Argyle, M., Dean, J., 1965. Eye contact, distance and affiliation. Sociometry 28, 289–304.

Axelsson, A.-S., Abelin, Å., Heldal, I., Schroeder, R., Wideström, J., 2001. Cubes in the cube: a comparison of a puzzle solving task in a virtual and a real environment. CyberPsychology & Behavior 4, 279–286.

Biocca, F., Harms, C., 2002. What is social presence? In: Gouveia, F., Biocca, F. (Eds.), Presence 2002 Proceedings. University of Fernando Pessoa Press, Porto, Portugal.

Bouwhuis, D., 2000. Parts of life: configuring equipment to individual lifestyle. Ergonomics 43, 908–919.

Cooley, C.H., 1909. Social Organization. Scribner, New York.

de Greef, P., IJsselsteijn, W., 2001. Social presence in a home tele-application. CyberPsychology & Behavior 4, 307–315.

Evans, N.J., Jarvis, P.A., 1986. The group attitude scale. Small Group Behavior 17, 203–216.

Festinger, L., Schacter, S., Back, K., 1950. Social Pressures in Informal Groups: a Study of Human Factors in Housing. Harper & Row, New York.

Forsyth, D.R., 1999. Group Dynamics, third ed. Wadsworth Publishing Company, Belmont, CA.

Gaver, W., Dunne, A., 1999. Projected Realities: Conceptual Design for Cultural Effect. Proc. CHI 1999 pp. 600–607.

Heeter, C., Gregg, J., Climo, J., Biocca, F., Dekker, D., 2003. Telewindows: case studies in asymmetrical social presence. In: Riva, G., Davide, F., IJsselsteijn, W.A. (Eds.), Being There: Concepts, Effects and Measurements of User Presence in Synthetic Environments. Emerging Communication Series, vol. 5. IOS Press, Amsterdam, pp. 279–293 (Chapter 19).

Hindus, D., Mainwarin, S.D., Leduc, N., Hagström, A.E., Bayley, O., 2001. Casablanca: Designing Social Communication Devices for the Home. Proc. CHI 2001 pp. 325–332.

Hogg, M.A., 1992. The Social Psychology of Group Cohesiveness. From Attraction to Social Identity. Harvester Wheatsheaf, London.

IJsselsteijn, W.A., Freeman, J., de Ridder, H., 2001. Presence: where are we?. CyberPsychology & Behavior 4, 179–182.

IJsselsteijn, W.A., van Baren, J., Romero, N., Markopoulos, P., 2003. The unbearable lightness of being there: Contrasting Approaches to Presence engineering. Proceedings SPIE 5150, pp 61–68.

Markopoulos, P., IJsselsteijn, W., Huijnen, C., Romijn, C., Philopoulos, A., 2003. Supporting relationships through awareness systems. In: Riva, G., Davide, F., IJsselsteijn, W.A. (Eds.), Being There: Concepts, Effects and Measurements of User Presence in Synthetic Environments. Emerging Communication Series, vol. 5. IOS Press, Amsterdam, pp. 261–278.

Markopoulos, P., Romero, N., van Baren, J., IJsselsteijn, W., de Ruyter, B., Farshchian, B., 2004. Keeping in Touch with the Family: Home and Away with the ASTRA Awareness System. Proc. CHI 2004 pp. 1351–1354.

Melenhorst, A.S., Rogers, W.A., Caylor, E., 2001. The Use of Communication Technologies by Older Adults: Exploring the Benefits from the Users' Perspective. Proceedings Human Factors and Ergonomic Society 2001.

Mynatt, E.D., Back, M., Want, R., Baer, M., Ellis, J.B., 1998. Designing Audio Aura. Proc. CHI 1998 pp. 566–573.

Sagi, P.C., Olmstead, D.W., Atelsek, F., 1955. Predicting maintenance of membership in small groups. Journal of Abnormal and Social Psychology 51, 308–311.

Sallnäs, E.L., Rassmus-Gröhn, K., Sjöström, C., 2001. Supporting presence in collaborative environments by haptic force feedback. ACM ToCHI 7, 461–476.

Short, J., Williams, E., Christie, B., 1976. The Social Psychology of Telecommunications. Wiley, London.

van Baren, J., IJsselsteijn, W.A., Romero, N., Markopoulos, P., de Ruyter, B., 2004. Measuring Affective Benefits and Costs of Awareness Systems Supporting Intimate Social Networks. In: Nijholt, A., Nishida, T. (Eds.), Proc. 3rd workshop on social intelligence design. CTIT Workshop Proceedings Series WP04-02, pp. 13–19.

Weiser, M., Brown, J.S., 1996. Designing calm technology. Power Grid Journal. 1.01, July 1996 www.ubiq.com/hypertext/weiser/calmtech/calmtech.htm

Wiener, M., Mehrabian, A., 1968. Language within Language: Immediacy, a Channel in Verbal Communication. Appleton-Century-Crofts, New York.

Zhao, Q.A., Stasko, J.T., 1998. Evaluating image filtering based techniques in media space applications. Proc. CSCW 1998 pp. 11–18.