Social Presence in the PhotoShare Tele-Application

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1. Introduction

Summative evaluations usually concentrate on efficiency and effectiveness. For tele-applications aiming at an informal, home environment however, social presence and satisfaction appear to be more appropriate criteria. We applied these concepts to the evaluation of the PhotoShare tele-application, an application that was developed at IPO for viewing photos (e.g. family or holiday snapshots) together while the presenter and the viewer are at different, remote locations.

The implementation platform of PhotoShare is a distributed version of IPO's interaction platform, which is based on computer-vision input, whilst the computer output is projected onto a normal table surface (see figure 1). Instead of a mouse, the users can use simple wooden bricks to select thumbnail pictures for viewing in the large. The current version of the distributed platform is asymmetrical. Only one side can select photos for viewing in the large. We call this the presenter's area. At this side a brick may also be used as a pointer in the viewing area. Inside the viewing area it creates a red dot that is also visible in the viewer's viewing area. The distributed platform also provides a video communication channel using large (life-size) projection screens and, of course, audio communication between the two places.
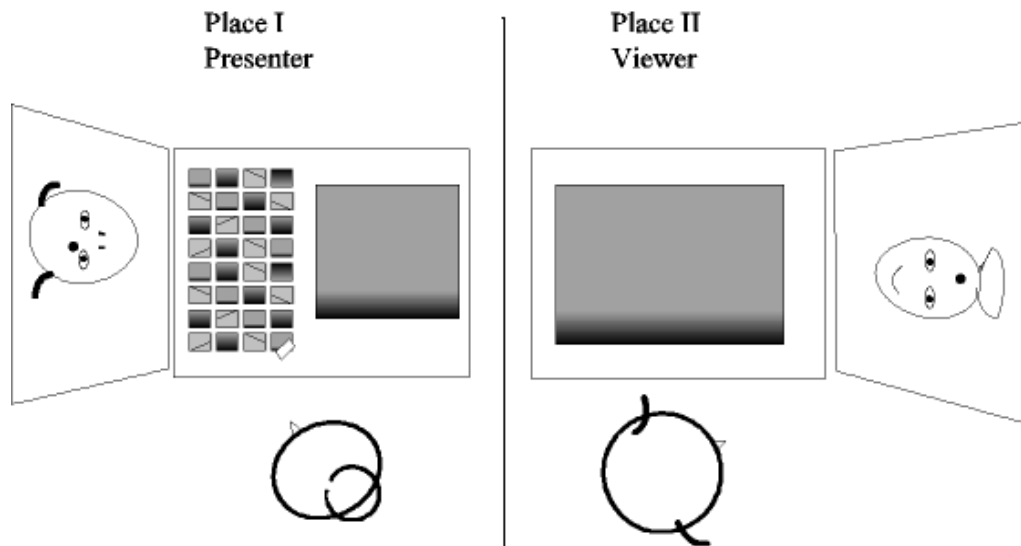
Figure 1. The PhotoShare tele-application

In the context of developing PhotoShare, this study investigates the effects of video communication and pointing on social presence and satisfaction. In the context of presence research, the PhotoShare study also provides information regarding the validity of the IPO Social Presence Questionnaire (IPO-SPQ) which was specifically designed to investigate social presence and satisfaction with telecommunication applications.

It is important to note at this point that social presence, or the 'sense of being together', is quite distinct from physical presence, or the sense of 'being there' in a mediated environment. Although a number of medium manipulations will have a similar effect on both social and physical presence, and a unifying definition has been proposed (see Lombard & Ditton, 1997), the two types of presence can be meaningfully distinguished. For instance, a medium can provide a high degree of physical presence without having the capacity for transmitting reciprocal communicative signals at all (IJsselsteijn, de Ridder, Freeman & Avons, 2000).

1.1 Social presence, nonverbal communication, intimacy and immediacy

When using the concept of social presence to distinguish between different communication media, we need to have a basic understanding of the communication processes that contribute to a sense of social presence. For supporting *informal*, mediated communications, as is the focus in our study, nonverbal communication and intimacy behaviour seem to be of particular importance.

In face-to-face communication, the nonverbal channels are continuously attended to and communicate information that is primarily affective in quality and connected with personal relationships. In this respect, the nonverbal channels seem to be less controllable than the verbal channels, i.e. they are more likely to "leak" information about feelings.

Argyle and Dean (1965) argue that interpersonal intimacy is kept at an optimal, equilibrium level through factors as physical distance, smiling, eye-contact and personal topics of conversation. Other scholars have added to this list of intimacy behaviours to include factors such as gestures, touching, vocal cues (e.g. tone of voice), turn-taking behaviour in dialogues (e.g. frequency of interruptions), the use of space (e.g. moving towards someone) and verbal expressions directly acknowledging the communicative partner (e.g. 'How did you do that?' or 'I see what you mean'). Wiener and Mehrabian (1968) have applied the concept of *immediacy*, i.e. the psychological distance a speaker puts between himself and the hearer, to an understanding of speech. They showed that the choice of 'We…' as opposed to 'I…' or 'You…' connote a

feeling of closeness and association. Thus, intimacy and immediacy behaviours seem to be particularly relevant for social presence.

The broadband video communication channel that is part of the PhotoShare system supports a visually oriented, socially rich, and informal mode of communication. We thereby hypothesise that adding video communication will have a positive effect on the users' sense of social presence.

2. Measurement of Social Presence

There are two general approaches to measuring presence (IJsselsteijn *et al.*, 2000): subjective and objective. Since presence is primarily a subjective experience, subjective assessment methodologies, such as questionnaires or interviews, have most commonly been used in presence studies to date. However, given the potential instability of subjective measures (Freeman, Avons, Pearson & IJsselsteijn, 1999) there has been a growing interest in objective measures that focus on behavioural or physiological responses to media, i.e. responses that are produced automatically and without much conscious deliberation. As has been argued in IJsselsteijn *et al.* (2000), the most fruitful approach to measuring presence is likely to combine both subjective measures and objective corroborative measures, thus yielding different but complementary types of insight into the determinants and structure of the participant's media response.

In the experiment reported in this paper, our subjective measure consisted of a questionnaire (the IPO-SPQ) that combined two different approaches. One is based on the semantic differential, essentially an evaluative or emotional response, the other on agreeing or disagreeing with statements about attitude towards the media experience. The questionnaire will be discussed in more detail in the remainder of this section.

We also made video registrations of all experimental sessions, filming both communication partners, as well as their shared workspace. This enabled us to carefully observe specific social responses (i.e. intimacy and immediacy behaviors) that may constitute an objective corroborative measure of social presence. We are currently in the process of analyzing the video registrations of the experiment in terms of these social responses.

2.1 Semantic differential questionnaires

According to Short *et al*, (1976, p.66), the chief subjective method for measuring social presence is Ogood's semantic differential technique (Osgood, Suci & Tannenbaum, 1957). Subjects are asked to rate the communication media on a series of bipolar scales such as:

<div align="center">

impersonal 1----2----3----4----5----6----7 personal

</div>

Other examples of bipolarities are:

<div align="center">

insensitive-sensitive,
cold-warm,
impersonal-personal,
passive-active.

</div>

Media that support a high degree of social presence are typically judged as warm, personal, sensitive and sociable. Short *et al.* claimed that this measurement was also influenced by aesthetic appeal (ibid. p.66) but their factor-analytical approach on small sets of data that are not independently measured, is not convincing from a modern statistical point of view. They reported an experiment in which 72 managerial civil servants each evaluated three different media (face-to-face, closed-circuit television or an audio system) on 24 bipolar rating scales. Of these only 4 distinguished between the video medium and face-to-face:

<div align="center">
unsociable-sociable,
meaningful-meaningless,
public-private,
true-false.
</div>

From the same data set they concluded that the following 4 scales seem to measure aesthetic appeal:

<div align="center">
small-large,
closed-open,
colourless-colourful,
ugly-beautiful.
</div>

2.2 Statements about system qualities

Users' comments on new media frequently relate to social presence (Champness, 1973, in Short *et al*, 1976, p.74):

- One does not get a good enough idea of how people at the other end are reacting.
- One gets no real impression of personal contact with the people at the other end of the link.
- One can easily assess the other people's reactions to what has been said.
- It provides a great sense of realism.
- One gets a good feel of the people at the other end.
- It isn't at all like a face-to-face meeting.
- It was just as though we were all in the same room.
- People at the other end do not seem real.
- I would be happy to use the system for a meeting in which I intended to persuade other people.
- I could not get to know people very well if I would meet them over this system.

Such statements can be used in attitude test items in which subjects can agree or disagree on a 7-point scale.

2.3 Construction of the IPO Social Presence Questionnaire (IPO-SPQ)

With the above we have two different approaches to measuring social presence, both of which were used in the construction of the IPO Social Presence Questionnaire. The IPO-SPQ was drafted in Dutch, and included, besides items on social presence, a number of items about usability, communication in general and about the audio communication in particular. At the end of the questionnaire three general questions were added to assess the potential customer acceptance of the PhotoShare system:

- How much may the system cost?
- What grade do you give the system as a whole, on a scale of 1-10?
- Would you use or utilise the system?

3. Method

3.1 Design

With the above we have operational definitions of the variables presence and satisfaction. To investigate the effects of video and pointing on these variables, we chose the comparative experiment as research method. The major independent variables were Video (audio-only vs. audio+video), Role (presenter or viewer) and Pointing.

For the experiment a repeated measurements design was used with two trials, with video as within-subjects factor. Each pair of subjects took part in two trials, one with video communication and one without. These trials were counterbalanced to avoid any potential sequence effects. Thus, half the subjects were given the sequence audio-only (AO) / audio+video (AV), and the other half the reverse sequence.

Sex was included as a control variable since it is known that men and women differ in dialogue behaviour.

3.2 Subjects

Thirty-four subjects (15 males, 19 females, age range: 15-59) took part in the experiment, in 17 presenter-viewer pairs. Members of a pair always knew each other beforehand and could be regarded as friends. The pairs consisted of 6 male/male, 8 female/female and 3 male/female combinations. All subjects were naïve to the hypothesis under test.

3.3 Procedure

On arrival, the subject that was going to act as the presenter handed over 20 photos from his/her private collection to the experimenter, which were subsequently scanned to enable display on the PhotoShare system. Both presenter and viewer were then led to a separate room in which the PhotoShare system was set up. All subjects were first made comfortable with the basic functionality of the system. Given its easy-to-use interface, this took in general no longer than 1 minute. The presenter was then asked to start by selecting a photo and talk about it. For both trials (audio-only or audio+video), 10 photos were discussed. After each trial, both viewer and presenter were asked to fill in the IPO-SPQ. As stated earlier, all experimental sessions were videotaped for later analysis.

4. Results

4.1 Measurement Scales

The coding of the item value in the raw data is the number chosen by the subject. With some items, a high score reflects a low judgement and these items are recoded. After this, reliability analysis of the items of each response variable was performed. For this analysis, all 68 questionnaires of the 34 subjects and 2 trials were used. Only a few items were deleted that had a low item-total correlation. Cronbach's alphas for social presence items are good, meaning that the items in each scale are consistently measuring the same quality. Intercorrelations among the response variables show a substantial correlation between the two social presence scales (0.58) and much lower correlations with the other scales. The largest of these are between communication quality and the social presence scales (0.34 with the semantic differential and 0.26 with the agree-disagree questions).

Response Variables	Items in IPO-SPQ	Items removed after reliability analysis	Alpha
Communication Quality	4-7		.89
Audio Quality	8-10		.45
Social Presence (agree-disagree)	12-17	12	.72
Social Presence (sem. dif.)	18-31	27, 31	.90
Ease of use	32-44		.70
System in general	45, 46, 48		

4.2 Effects on social presence

Analysis of the data using the General Linear Model for repeated measures in SPSS 7.5 showed the following effects to be significant:

Agree-disagree
Effect of video $F(1,18)= 9.9$, p= .006
Interaction effect of video and age $F(1,18)= 4.4$, p= .049
Interaction effect of video, sex and trial $F(1,18)= 5.8$ p= .027

Semantic differential
Effect of video $F(1,18)= 9.9$ p= .007
Effect of sex $F(1,17)=5.2$ p= .036

On both measures the effect of video is substantial and in the expected direction. The effect of sex is also substantial. The pattern of the effects for each measure is rather similar and there is a substantial correlation between the two measures. The two measures can be added to form an overall measure of social presence. The profile diagram of the effects of sex*trial*video on this compound measure is shown in figure 2.
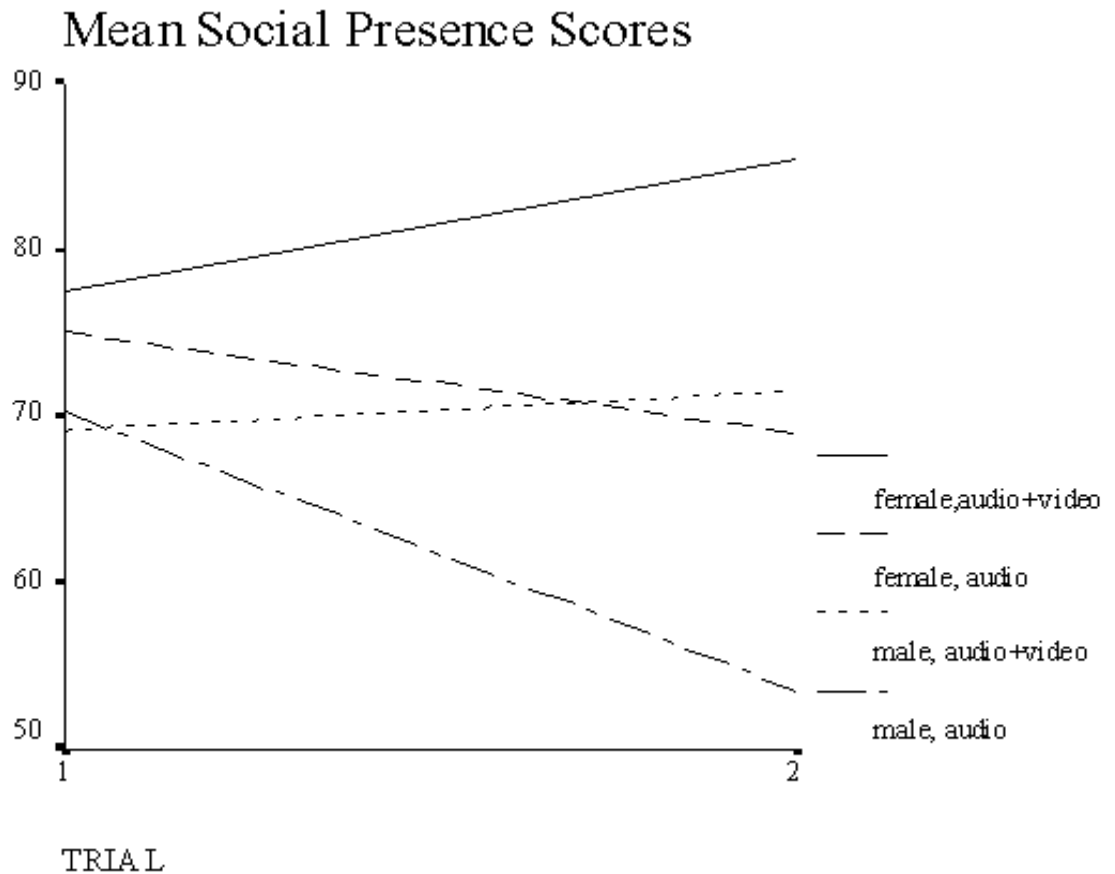
Figure 2. Mean social presence scores.

At the first trial, to the left in the diagram, there is hardly any difference between the social presence mean scores for video and no video in the male group and in the female group. Between males and females, the difference is small. At the first trial, subjects seem to select a baseline level on the presence scales, regardless whether they have video or not. Only in the second trial, to the right, substantial differences in means appear. Those who are in the AO-AV sequence show on the second trial a higher appreciation whilst those in the AV-AO sequence show a drop in their social presence scores. It appears as if subjects make a comparison between the systems experienced in trial 1 and 2, rather than separate absolute judgements of each.

The outcome suggests that difference scores may be used to characterise subjects: Y(video) - Y(no-video)

Using these difference scores, we get rid of the two trials, and thus of the repeated measurements situation. The control variable sequence can be used to check for the effect of sequence on the difference score.

For the factors role (presenter versus viewer) and pointing (yes or no) we do not have within-subject comparisons. We have only between-subjects comparisons. The factor role has no effect and the factor pointer has a small negative effect, at a conventional 5 percent significance level.

5. Discussion

5.1 Measurement and experimental procedure

The construction of the IPO-SPQ, based on various sources in the literature, appears to be successful. Importantly, the difference we found between the results over the two trials strongly suggests that subjects are able to make a comparison judgement between the two media over trials (i.e. a within-subjects comparison), but cannot reliably give an absolute judgement of each medium individually (i.e. a between-subjects comparison). Thus, without some kind of anchor point or calibration of the subjective scale (as is provided through a previous trial or a training session), subjects tend not to differentiate between the different media conditions in terms of social presence. They are however quite capable of providing a comparative judgement of a difference or shift in levels, and it seems fair to say that the within-subjects comparison is thus more sensitive to differences in perceived social presence.

In IJsselsteijn, de Ridder, Hamberg, Bouwhuis & Freeman (1998), subjects performed a continuous judgement of presence level and for this they used a slider button whereby they could continuously adjust their subjective presence level. This method also appears to provide valid results and it relies, as in our case, only on the ability of subjects to detect differences in perceived presence.

We need to be cautious in generalising the methodological implications of our study to questionnaire-based studies of *physical* presence, since the two types of presence are distinct. It is quite possible, for instance, that the sense of physical presence relies more on 'explicit' elements of media form (e.g. screen size), whereas social presence is more likely to rely heavily on picking up 'implicit' social cues from the communication partner, which are to a large extent less consciously perceptible (i.e. automatically processed) and less cognitively accessible when filling out a post-test questionnaire. We hypothesise however, that the analysis of the various verbal and nonverbal communication patterns will reveal a number of indicators that are sensitive to the media manipulations under study, for both within- and between-subjects comparisons, thus providing us with a more absolute, objective measure of social presence.

5.2 Effects on Social Presence

With video, social presence is substantially (and significantly) higher. There is also a substantial effect of sex: women have higher scores on social presence. The effect size of video and sex are about equally large. It is quite possible that women experience a higher level of social presence, considering the large differences in communication behaviour between men and women. However, another possibility is that there is a response bias in that women tend to give higher ratings for the same thing. We hope to be more conclusive on this issue after the planned analysis of the video registration of the behaviour.

The factor role (presenter vs. viewer) did not yield a significant difference. This result could have occurred because it was measured in a between-subjects comparison, which may lack sensitivity as was discussed earlier. Another possibility however is that increased control over the application does not increase social presence judgements, since increased application control may distract the user from the social interaction aspects, as do the addition of extra workspace functions, discussed below. This hypothesis thus diverges from the effect one would expect increased control to have on physical presence judgements, as has been shown by Welch, Blackmon, Liu, Mellers & Stark (1996), thereby underlining the importance of distinguishing between the two types of presence.

5.3 Workspace Functions

The effect of pointing on social presence is small and negative. We must be cautious and cannot draw a firm conclusion. Video is a within-subjects factor and pointing and role are between-subjects factors. We have not offered our test subjects an opportunity to make a comparison between different roles or pointing versus no pointing like we did for video and no video. This might be the reason for the small or negligible

effects found. One possible explanation is that there is less communication with the pointing function present. After the planned analysis of the video registration, we may be able to say more about what happens when the pointing function is added.

To summarise, the main conclusions are that the availability of a video communication channel has a large positive effect on social presence, as was hypothesised. Furthermore, for measuring social presence subjectively, a within-subjects comparison seems to be more valid, since subjects are not well able to provide social presence ratings that differentiate between media manipulations. Extensive workspace functionality seems less important and may even diminish social presence, however, from this study, we cannot draw a firm conclusion about this issue.

6. Acknowledgements

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