

# 6 Measuring Social Presence in Team-Based Digital Games

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**Abstract:** Increasingly, digital games offer sophisticated multiplayer experiences with teams of players able to play against “the computer” in raids or against each other in a variety of team matches. Social presence is therefore an important part of the gaming experience. However, existing measures of social presence in games lack the sophistication to deal with these more diverse gaming situations. This paper describes the development of a new questionnaire to measure the complex nature of social presence in digital games. The resulting questionnaire consists of 39 items with two main modules addressing competitive and collaborative components of social play.

**Keywords:** Social Presence; Questionnaire Development; Digital Games; Competitive & Cooperative Game Play; Gaming experience.

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## 6.1 Introduction to Chapter 6

Computer games are increasingly offering multiplayer experiences. Whereas most games will have an individual player version, often this is but a lesser sibling to the much bigger online experience that the game can offer. It is becoming clear that this social aspect of digital games is an important part of understanding the totality of the gaming experience (de Kort et al, 2007; Cairns et al. 2013). However, measuring subjective concepts such as social presence in these complex multi-user virtual environments is tricky. In order to see the effect of social presence on the gaming experience (or any experience of digitally-mediated interaction), it is important to be able to know what social presence people are experiencing. This is typically done through measuring social presence in some way, often through questionnaires. However, previous research into the measurement of social presence is heavily influenced by the field of study from which it comes, and the underlying theory of social presence the researchers have. This has led to the majority of measures being unsuitable for measuring social presence within prevalent forms of social gaming, such as the collaborative and competitive environments found in current online First Person Shooter (FPS) games. This chapter therefore documents the process of establishing our own measure on social presence based on a number of user studies.

Biocca, Harms, and Burgoon (2003) state that social presence is the sense of being together with another. Social presence is about the social connections one makes to entities within a virtual environment, and the level of social presence one feels in a virtual environment depends upon the strength of these connections (see

also Chapters 1 and 5, this volume). Schouten (2011) argues that social presence is a concept built around the evidence of other humans within a virtual environment, with even simple cues such as the score of other players in a computer game being enough to increase social presence. Alexander, Brunyé, Sidman, and Weil (2005) support this view by stating that in an interactive multi-user environment “greater interaction and presence of others will lead to higher engagement of the individual with the game and the group”.

Our research set out to explore social presence in online team-based games, primarily online FPS games which contain both cooperative and competitive game play, as two or more teams consisting of multiple players compete. These games were chosen over more explicitly social games such as *Second Life*, *World of Warcraft* or other *massive multiplayer online role playing game* (MMORPG) type games to highlight the phenomenon of social presence in less obvious multi-user virtual environments. In an MMORPG, one of the primary reason for logging on is for the social interaction and the feeling of sharing the virtual world with other players, this is the essence of an online role playing game. The Daedalus project, a substantial study of MMORPG players, states that there are many different motivations to play these games, socializing, the accumulation of wealth and tangible power, exploring and being part of a fantasy world, and so on (Yee, 2007, 2009). Yet all these motivations are quintessentially social. It would be therefore quite unremarkable to discover a high level social presence felt by the players of these games.

Previous studies have suggested that as well as competitiveness and challenge, social reasons such as the possibility of cooperation and communication are strong motivators for people to play online FPS games (Jansz and Tanis, 2007, Frostling-Henningsson, 2009). However, while social gaming has been extensively studied, there are few methods for quantifying the level of social presence felt in these team-based online games, which are some of the most popular games available today, with FPS games like *Battlefield 3* gaining a reported 3 million pre-sales and *Multiplayer Online Battle Arena* (MOBA) games such as *League of Legends* having a reported 32 million players per month (Lyons, 2012).

### 6.1.1 Measuring Social Presence

There have been many tools and methods developed for measuring social presence in virtual environments. In a review of various measures of social presence in an online learning context, Kreijns, Kirschner, Jochems, and Van Buuren (2011) cite a number of potential tools, including a ‘Group Atmosphere Scale’ (Fiedler, 1962, 1967), a ‘Work-Group Cohesiveness Index’ (Price and Muller, 1986), and ‘Social Presence Scales and Indicators’ (Gunawardena, 1995, Gunawardena and Zittle, 1997).

De Kort, IJsselsteijn, and Poels (2007) developed a measure for social presence in games, based on the ‘Networked Minds Measure of Social Presence’ (Biocca and Harms,

2002). While the Networked Minds Measure has a strong theoretical underpinning, the questionnaire was primarily designed for teleconferencing, and so is completely unsuitable for games, especially team-based games. While the 'Social Presence in Gaming Questionnaire' (SPGQ) (de Kort et al., 2007) can be used to measure social presence in some circumstances (Cairns, Cox, Daya, Martin, and Perryman, 2013), the questionnaire is unsuitable for team-based games for a number of reasons. The SPGQ appears to be designed for use with only competitive games, including items which refer to 'revenge' and 'schadenfreude', which are not expected components of social presence in cooperative games. In the SPGQ, there is also no distinction between who the other players are in relation to the respondent. This is easily remedied if the respondent is playing one other person who is an opponent in the game, but it is difficult to make the SPGQ suitable for team-based games. In this situation, when there are both opponents and teammates sharing the virtual environment the SPGQ items would either have to be doubled up, asking about both opponents and teammates, or generalized to refer to simply 'others'. Neither of these solutions are favourable; doubling up would significantly increase the length of the questionnaire and thus increasing the likelihood that participants would become bored and fail to complete the questionnaire accurately (Cairns and Cox, 2008). Generalizing the questions on the other hand would create answers which would not clearly refer to any other entity, providing results that would at best be hard to interpret, and at worst so generic as to be meaningless. This makes the SPGQ unfit for studies involving collaborative and competitive team-based scenarios.

In addition to taking inspiration from the Biocca and Harms (2002) questionnaire, the SPGQ was developed using data gathered via a focus group study (Poels, de Kort, and Ijsselsteijn, 2007). The focus group study consisted of 16 participants, half of which were undergraduate students described as infrequent gamers. The first concern with the methodology is the question of whether the participants were an adequate sample of social gamers, and how the sampling has biased the development of the SPGQ. Second is the general weakness of the focus group methodology, for example in focus groups disproportionate attention can be given to some members of the group, groups can be dominated by a single individual, and so on (Lazar, Feng, and Hochheiser, 2010). So what alternatives are there to the SPGQ?

In a comprehensive review of presence measures, van Baren and Ijsselsteijn (2004) set out the details of 28 current presence questionnaires, some original, some developed by combining older telepresence questionnaires, and only 6 of which contained social presence elements. These six questionnaires were the Lombard et al. (2000) Questionnaire, the Nowak and Biocca (2003) Questionnaire, the Schroeder et al. (2001) Questionnaire, the Bailenson, Blascovich, Beall, and, Loomis (2001) Questionnaire, and the 'Temple Presence Inventory' (TPI) (Lombard, Ditton, and, Weinstein, 2009). However once again none of these tools are relevant to team-based games. The Lombard et al. (2000) Questionnaire measured physical and social presence and was developed and tested based solely on previous literature. The study

which sought to test the author's theory of presence was based upon film media, and therefore cannot be considered entirely valid for testing digital gaming. The Temple Presence Inventory (Lombard et al., 2009) was created by combining elements from previous questionnaires such as the Lombard et al. (2000) Questionnaire above, and elements created from studies by the authors. It was developed and tested by exposing participants to 'dramatic television programs' and film. The questions reflect the influence of the chosen media and would be unsuitable for interactive virtual environments such as computer games. For example the TPI included such items as "During the media experience how well were you able to observe the facial expressions of the people you saw/heard?" which, while potentially relevant to non-interactive media, is largely irrelevant to games, particularly team-based online games.

The Nowak and Biocca (2003) Questionnaire was designed to measure presence, however in this questionnaire the term social presence was used to mean social realism and was measured using questions such as "To what extent was this like a face-to-face meeting?", which is irrelevant to social connections in digital games. The Schroeder et al. (2001) Questionnaire focused mainly on the feeling of being physically present with another, rather than feelings of social presence. For example the question "To what extent did you have a sense of being in the same room as your partner?" aims to measure co-presence, but seems to actually be measuring physical presence. The Bailenson et al. (2001) Questionnaire aimed to measure purely social presence and asked five direct and focused questions which would likely be effective in measuring social presence in general virtual environment settings such as virtual meetings, etc. However, the measure lacks the competitive/cooperative elements, which are important to video games and team-based training in virtual environments.

In the Van Baren and IJsselsteijn (2004) report, questionnaires appeared to be the most prevalent method of measuring presence and there are good practical reasons for this, namely, that, where valid, they are quick to use, easy to administer and able to be administered in large numbers. Other methods have been used such as 'Autoconfirmation' (Retaux, 2003) through retrospective video protocols, Content Analysis of transcripts of online text-based interaction (Rourke, Anderson, Garrison, and Archer, 1999), Ethnographic Observation of users of teleremote technology (McGreevy, 1992), and Focus Group explorations (Freeman and Avons, 2000). But these methods are better for small scale studies leading to more qualitative insights and even then may have issues of validity as indicators of social presence. In particular, regardless of whatever data is gathered, there is the need to relate this, through self-reporting, to the subjective experience of the individuals. Questionnaires perhaps simply make this aspect explicit.

In summary then, questionnaires promise to be a useful instrument in researching social presence in digital games appropriate to this early stage of research in this area. However, there is no suitable questionnaire for social presence in team-based online games. The general social presence questionnaires are unsuitable due to the media

used in their development and the subsequent lack of references to interactivity, while the only questionnaire designed to be used with games was unsuitable for cooperative game play. It is this gap that the current questionnaire is intended to address.

## 6.2 Overview of the Questionnaire Development

There are many approaches and techniques that can be applied in the development of questionnaires. And although there is some debate about the correct methods to use in the context of human-computer interaction (see for instance Vol. 25(4) of *Interacting with Computers*), there are nonetheless some established techniques that are widely accepted. We follow the process set out by Kline (2000) where the most reliable techniques are clearly laid out. Kline's (2000) methodology consists of creating an item pool and using item analysis of the responses to questionnaires to reduce the pool to an effective set of items that will constitute the instrument. Factor analysis is then used to validate the questionnaire.

An initial pool of items for our questionnaire was created around a group of concepts which arose from the literature and research conducted into social presence in cooperative and competitive environments (Hudson and Cairns, in press). The research consisted of 5 social presence studies: two online user surveys; a cooperative *Tetris* based experiment; analysis of found user data; and a user experience study using the games *Unreal Tournament* and *Puji*. From this work the concepts that emerged as elements of social presence in team-based games were:

1. Awareness of other consciousness.
2. Theory of Mind (Ratcliffe, 2007), that is, the player is able to theorise about what other players are thinking.
3. Team identity.
4. Motivation to play.
5. Social action and the awareness of the social significance of action within a shared environment.
6. Task and social 'joint commitments' (Clark, 2006).

From the list of concepts above an initial pool of 116 items was created and structured into groups with common themes to aid data analysis. These 116 items were then given to 12 experienced gamers who attempted to respond to all items after having played the team-based online game *Darkest Hour: Europe '44-'45*. Their feedback led to the removal of 36 items because the items were perceived as redundant or meaningless in the context of the playing experience. The remaining 80 items formed the preliminary version of what we termed the 'Competitive and Cooperative Presence in Gaming' questionnaire, CCPIG (pronounced sea-pig), the CCPIG v0.5 (*Table 6.1*).

Three further surveys were used to refine from 80 items in the CCPIGv0.5 to 39 in the final version (CCPIGv1.1). From the first two surveys centred on specific

games, item analysis was used to remove items found to be unsuitable, redundant or irrelevant, leaving a focused set of items and a more succinct measure. *Table 6.1* shows that while much of the original core structure remains similar from the first to the final version of the CCPIG, the extraneous sections and modules have been removed or merged.

In the final CCPIGv1.1, Section 1 is designed to measure what we term ‘competitive social presence’, the social presence felt towards one’s opponents in a digital game. Module 1.1 measures competitive involvement, the perceived interplay between the respondent and their opponents, and the extent to which a respondent felt they used their Theory of Mind. Module 1.2 measures competitive engagement, and the sensations of competitive play with another human. Section 2 is designed to measure what we term ‘cooperative social presence’, the social presence felt towards teammates in cooperative digital games. This section functions as a single component, and a number of concepts cut across the section, including Theory of Mind, and social ‘joint commitments’ (Clark, 2006). However while this section functions as one component we feel the modules in this section can highlight the various elements of cooperative social presence at work. Module 2.1 measures the extent to which a

**Table 6.1:** The structural changes from CCPIGv0.5 to CCPIGv1.1

| <b>CCPIGv0.5 (80 Items)</b>                                 | <b>CCPIGv1.1 (39 Items)</b>               |
|---|---|
| Section 1: General Social Engagement (9 Items)              |   |
| Section 2: Competitive social presence                      | Section 1: Competitive (14 Items)         |
| Module 2.1: Behavioural and Cognitive Involvement (9 Items) | Module 1.1: Awareness (6 Items)           |
| Module 2.2: Competitive Engagement (9 Items)                | Module 1.2: Engagement (8 Items)          |
| Module 2.3: Competitive Sensation (4 Items)                 |   |
| Module 2.4: Competitive Motivation (3 Items)                |   |
| Section 3: Cooperative social presence                      | Section 2: Cooperative (25 Items)         |
| Module 3.1: Team Identification (5 Items)                   | Module 2.1: Team Identification (5 Items) |
| Module 3.2: Team Security (5 Items)                         |   |
| Module 3.3: Cooperative Motivation (11 Items)               |   |
| Module 3.4: Social Action (6 Items)                         | Module 2.2: Social Action (8 Items)       |
| Module 3.5: Social Commitments (7 Items)                    | Module 2.3: Motivation (6 Items)          |
| Module 3.6: Team-mate Value (3 Items)                       | Module 2.4: Team Value (6 Items)          |
| Section 4: Team-based Confirmation (5 Items)                |   |
| Section 5: Task (3 Items)                                   |   |

respondent feels as though they were part of a cooperative team. Module 2.2 aims to measure the level of interplay respondents felt between themselves and their team. Module 2.3 measures the extent to which being part of a team motivated a respondent to play, and Module 2.4 measures how much value the respondent placed on their team-mates, and how cohesive their team felt. A full list of the items and a guide to scoring the CCPIGv1.1 can be found in the Appendix.

The next three sections give details of the survey studies that were used to progress from the CCPIGv0.5 to the CCPIGv1.1. First, though, it is worth making some general points about how items were assessed statistically and the method for collecting data in all the validation studies.

### 6.2.1 Statistical Criteria

Cronbach  $\alpha$  and the measures of sampling adequacy (MSA) and Kaiser-Meyer-Olkin (KMO) scores were the primary statistics used to check the statistical reliability of the questionnaire and its subscales. These indicate the degree to which the items as a whole provide a consistent statistical structure and also how individual items relate to all the other items. Following the guideline thresholds common in the literature (Kline, 2000; Everitt, 1993; Nakazawa, 2007) KMO and Cronbach  $\alpha$  scores of over 0.6 were desirable indicators of statistically reliable items. The correlations between items in modules were also used to identify items which did not fit with their module and if so, if they correlated with any other modules. Examples of very high levels of correlation were also used to identify items which were perhaps too similar and therefore redundant, especially if the two items were similarly worded.

### 6.2.2 Data

The data for the item analysis and PCA was gathered using online user surveys, for which respondents were recruited using calls for participants on game community forums. Game communities were chosen based on a number of factors. First the games around which the communities were based were all team-based online games, which while differing in genre, setting, play style and graphical style, shared the core element of two collaborating teams competing with each other. Another important factor in the specific game communities chosen for these online surveys was the presence of an active forum on which community members could be recruited as participants. When creating the online questionnaire the items were mixed together rather than being structured in their original groups. This was to reduce the risk of participants flatlining their responses (Cairns and Cox, 2008), or producing the “right” answers (social desirability bias (Nederhof, 1985))



### 6.3 Trial 1: Chivalry

The initial 80-item of CCPIG (v0.5) was trialled with players of the game *Chivalry: Medieval Warfare* (for concision referred to henceforth as *Chivalry*), a team-based online first person melée game, much like an online FPS, but with a focus on medieval-esque combat. It was deliberately chosen to contrast with the games used in the previous item analysis by the experienced gamers. Forty-eight respondents were recruited from the community forums to play the game and fill out an online version of the questionnaire.

The primary aim of Trial 1 was to refine and reduce the questionnaire items to form a shorter but still reliable instrument. The item data produced by the respondents, together with their open feedback, was used to analyse and trim the questionnaire. To begin with the largest single cuts were the removal of two whole modules, removing 9 items in total, the ‘General Social Engagement’ module and the ‘Cooperative Confirmation’ modules. These modules were deemed unsatisfactory from a statistical point of view, as well as conceptually unnecessary as they did not directly address

**Table 6.2:** The structural changes from CCPIGv0.5 to the post-Trial 1 CCPIGv0.6

| CCPIGv0.5 (80 Items)  | CCPIGv0.6 (47 Items)                                       |
|---|--|
| Section 1: General Social Engagement (9 Items)              |  |
| Section 2: Competitive social presence                      | Section 1: Competitive (15 Items)                          |
| Module 2.1: Behavioural and Cognitive Involvement (9 Items) | Module 1.1: Competitive Behavioural Involvement (3 Items)  |
| Module 2.2: Competitive Engagement (9 Items)                | Module 1.2: Engagement (5 Items)                           |
| Module 2.3: Competitive Sensation (4 Items)                 | Module 1.3: Theory of Mind (3 Items)                       |
| Module 2.4: Competitive Motivation (3 Items)                | Module 1.4: Competitive Sensation (4 Items)                |
| Section 3: Cooperative social presence                      | Section 2: Cooperative (27 Items)                          |
| Module 3.1: Team Identification (5 Items)                   | Module 2.1: Team Awareness (5 Items)                       |
| Module 3.2: Team Security (5 Items)                         | Module 2.2: Team Security (4 Items)                        |
| Module 3.3: Cooperative Motivation (11 Items)               | Module 2.3: Cooperative Motivation (6 Items)               |
| Module 3.4: Social Action (6 Items)                         | Module 2.4: Social Action & Communication (5 Items)        |
| Module 3.5: Social Commitments (7 Items)                    | Module 2.5: Social Commitments & Team-mate Value (7 Items) |
| Module 3.6: Team-mate Value (3 Items)                       |  |
| Section 4: Team-based Confirmation (5 Items)                |  |
| Section 5: Task (3 Items)                                   |  |



the specific experiences of competitive or cooperative social presence. These sections were therefore prey to being subjective opinions rather than subjective measures of the gaming experience.

A further 29 items were either removed or merged with other similar items. Most modules had one or two items which could be removed, either based on the statistical results, user feedback, or by identifying redundancy. This process of statistical testing and conceptual scrutinization both reduced the items of the questionnaire and led to its restructuring. Though much shorter, the questionnaire had greater focus through addressing only issues relating to competitive and cooperative engagement with others.

## 6.4 Trial 2: Natural Selection 2

The second trial used CCPIGv0.6 to continue the item analysis and achieve the 100 participant minimum that Kline recommends for item analysis. While Trial 1 had worked to heavily reduce the questionnaire, this survey was intended to ensure that the questionnaire retained statistical coherence in a different context. Using the same online questionnaire method as Trial 1, data was gathered from 56 respondents from the *Natural Selection 2* (NS2) online gaming community. This game was chosen in particular because it provides a more complex mix of roles and tasks throughout the two teams than *Chivalry*. NS2 is an asymmetrical team-based online FPS game, in which two teams vie for control of a map. This game has the rather uncommon feature that the two competing teams are functionally completely different, one being a team of humans with guns, while the other is made up of melee-based aliens. Both teams are controlled by a commander who plays the game more like a traditional real-time strategy (RTS), buying upgrades for his forces, instructing them, and so on. NS2 was therefore highly suited to providing a different context in which to trial the CCPIG.

Throughout Trial 2, while the competitive section achieved reasonable KMO and Cronbach's  $\alpha$  scores, it was clear that the individual modules were not reflecting this collective success (see *Table 6.2*). It was concluded that modules 1.1 & 1.4 (Sensation, Ego & Behavioural Involvement) were far too short to stand alone as individual modules after the cuts of Trial 1. As modules 1.1 & 1.2 were conceptually similar, both referring to actions and reactions, these were merged, and this new merged module showed high levels of internal consistency and sampling adequacy (see *Table 6.3*).

When taken as a whole the cooperative section had good sampling adequacy and a strong Cronbach's  $\alpha$  (*Table 6.3*). Only module 2.4 was modified at this stage, removing one item, due to the statistical measures not achieving the commonly accepted thresholds. In Trial 2 the cooperative section also suffered from similar issues as the competitive, with some of the reduced modules not performing well. Modules 2.2 and 2.5 were somewhat less successful than the other cooperative modules, and

**Table 6.3:** The structural and statistical changes from CCPIGv0.6 to CCPIGv1

| CCPIGv0.6   |        |       |       |      | CCPIGv1   |       |       |      |
|-------------|--------|-------|-------|------|-----------|-------|-------|------|
| Section     | Module | Items | Alpha | KMO  | Module    | Items | Alpha | KMO  |
| Competitive |        | 15    | 0.88  | 0.76 |           | 14    | 0.88  | 0.76 |
|             | 1.1.   | 3     | 0.69  | 0.54 | 1.1 + 1.2 | 8     | 0.83  | 0.83 |
|             | 1.2.   | 5     | 0.69  | 0.73 |           |       |       |      |
|             | 1.3.   | 3     | 0.65  | 0.61 | 1.3 + 1.4 | 6     | 0.81  | 0.77 |
|             | 1.4.   | 4     | 0.68  | 0.56 |           |       |       |      |
| Cooperative |        | 27    | 0.95  | 0.81 |           | 26    | 0.95  | 0.80 |
|             | 2.1.   | 5     | 0.74  | 0.77 |           | 5     |       |      |
|             | 2.2.   | 4     | 0.60  | 0.61 | 2.2 + 2.5 | 9     | 0.83  | 0.75 |
|             | 2.3.   | 6     | 0.81  | 0.75 |           | 6     |       |      |
|             | 2.4.   | 7     | 0.86  | 0.81 | 2.4       | 6     | 0.87  | 0.86 |
|             | 2.5.   | 5     | 0.78  | 0.66 |           |       |       |      |

because the modules were conceptually similar (both dealing primarily with team interaction) it was decided to attempt to reorganise the items by merging the modules. This larger module produced a far higher Cronbach  $\alpha$ , produced more consistently high MSA scores, and a higher KMO.

This survey did not substantially reduce the number of items in the questionnaire but did lead to a restructuring to bring greater conceptual and statistical coherence. The fact that many items were retained though having been used in response to data gathered from an entirely different sort of team game is encouraging, suggesting that the items were tapping into robust concepts that were relevant to a variety of team-based games.

## 6.5 Principal Component Analysis

Principal Component Analysis (PCA) is a common method to validate questionnaires. It is used to find the overall relationships between the items of the questionnaire and in particular which items meaningfully group into subscales or components. It is a purely statistical approach that does not assume a prior component structure but rather that the components emerge as a consequence of iteratively conducting the analysis and interpreting the components generated. Following typical practices (Kline, 2000), we used PCA with the oblique rotation method, direct oblimin. Thus

the final components are able to correlate and this can be an indication of the overall coherence of the questionnaire.

### 6.5.1 Data Gathering

Two hundred and thirty eight participants were recruited through posts on several online game community forums to provide a large sample collected over a wide range of games. The games chosen were:

- *Team Fortress 2* (TF2) (57 respondents), a typical FPS game with teams of between 2 and 12 players.
- *Darkest Hour: Europe '44-'45* (102 respondents), a “combined arms” FPS with teams of up to 35 players.
- *Mount & Blade* (50 respondents), a 3rd person medieval/renaissance era game in which players take part in pitched battles, skirmishes and sieges on servers which can hold over 100 players.
- *King Arthur's Gold* (KAG) (18 respondents), a 2D fantasy/medieval setting team-based deathmatch game which features dynamic environments for up to 32 players.
- *Planetside 2* (6 respondents), an MMOFPS (massively multiplayer online first person shooter) in which the players share a server with thousands of others.
- *Dota 2* (5 respondents), a multiplayer online battle arena (MOBA) with teams of up to 5 players.

### 6.5.2 Analysis

The overall dataset was first checked for overall suitability for PCA. The KMO test of sampling adequacy for the whole dataset was 0.92 and the Bartlett test of sphericity was highly significant,  $\chi^2 = 4451.5$ ,  $p < 0.001$ , both indicating that the overall dataset was suitable for further analysis. The MSA for individual items was also examined and these showed that each item was also suitable for inclusion in the analysis.

In the first analysis, the scree plot of the eigenvalues (that is before rotation) was used to see the overall factor structure of the questionnaire. From *Figure 6.1*, it is clear that there is an “elbow” in the eigenvalues at 3 to 4 factors. We might have expected two clear factors, one for collaboration and one for competition in social presence but if those components also have strong factor structure then this seems a reasonable number of overall factors. The presence of a single factor with a very high eigenvalue is typical of a questionnaire with reasonable coherence and with most of the questions positively worded (Kline, 2000), which is the case in the CCPIG. The first two factors accounted for 40% of the variance and the first three for 45%. The rotated two-factor structure was analysed from the structure matrix (Everitt,

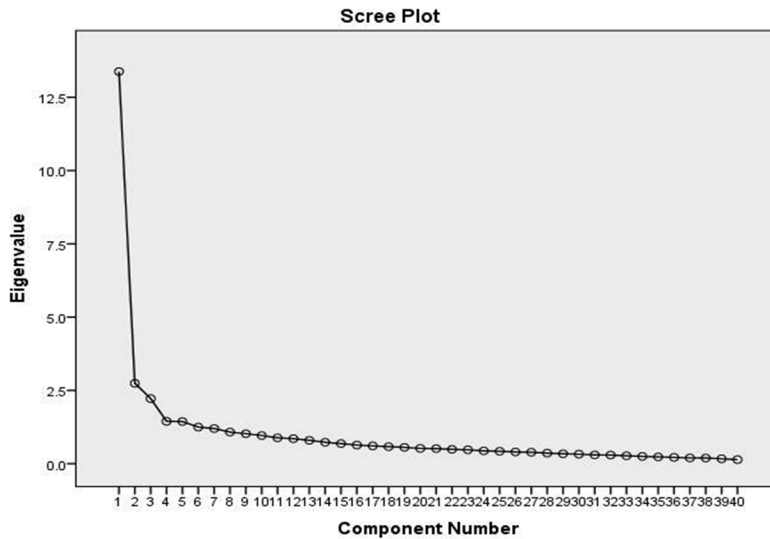


Figure 6.1: The scree plot for the whole questionnaire

1993), and showed two distinct factors consisting primarily of the competition and cooperation modules.

As the competitive and collaborative modules did emerge as stand-alone components of the CCPIG in the overall PCA, they were then analysed separately to see their internal structure. A scree plot for the competitive section showed a breaking point of 2 components, and the structure matrix shows a clear split in components between the two pre-defined modules (*Table 6.4*). However two items in the competitive section did not load as expected, 'My opponents played a significant role in my experience of the game' and 'It seemed as though my opponent was acting with awareness of my actions'. These two items were originally in module 1.1, designed to measure how the interplay between the player and their opponents affected their thoughts and actions, while they load onto module 1.2, designed to measure the competitive feelings of the player. Conceptually these questions are potentially applicable to either module, 'It seemed as though my opponent was acting with awareness of my actions' was created to draw on Theory of Mind. However, the concept of an opponent being aware of one's actions may, in the mind of the participant, be more closely related to the level of challenge an opponent presents. The concept of 'experience' in the item 'My opponents played a significant role in my experience of the game', may also be conceptually closer to module 1.2. While module 1.1 is phrased in a more reflective way, module 1.2 refers to the sensations of competitive play. The results of the PCA lead to a reevaluation of where these items fit conceptually, and it was decided that they would be moved from module 1.1 to module 1.2.

**Table 6.4:** PCA results with component loading over 0.4 highlighted

| Module | Item  | Comp. 1 | Comp.2 |
|--------|---|---------|--------|
| 1.1    | I acted with my opponent in mind  | 0.294   | 0.699  |
| 1.1    | I reacted to my opponents actions                                       | 0.261   | 0.626  |
| 1.1    | My opponents played a significant role in my experience of the game     | 0.400   | 0.298  |
| 1.1    | It seemed as though my opponent was acting with awareness of my actions | 0.634   | 0.392  |
| 1.1    | I knew what my opponent was trying to achieve                           | 0.078   | 0.697  |
| 1.1    | I was aware that my opponent might work out my goals                    | 0.442   | 0.573  |
| 1.1    | The actions of my opponents affected the way I played                   | 0.418   | 0.474  |
| 1.1    | I felt I affected my opponents actions                                  | 0.138   | 0.577  |
| 1.2    | My opponent was challenging   | 0.756   | 0.112  |
| 1.2    | The game was a battle of skill  | 0.639   | 0.123  |
| 1.2    | The game was a battle of wits   | 0.534   | 0.335  |
| 1.2    | I felt tense while playing my opponent                                  | 0.685   | 0.223  |
| 1.2    | My opponent created a sense of urgency                                  | 0.700   | 0.121  |
| 1.2    | The presence of my opponent motivated me                                | 0.555   | 0.442  |

The PCA analysis of the cooperative section was less definitive than the competitive. The scree plot for the section suggested between three and five components which suited the presumed four modules quite well. However in general the structure matrix showed a great amount of cross-loading and no convincing 4 component split. In short the cooperative section seemed to consist of 1 single component. While this may not be as predicted, the single component has a lot of coherence, with the majority of the items loading strongly, the cooperative section as a whole having a KMO score of 0.94, and a Cronbach's  $\alpha$  of 0.94. However this does not mean that the modules will be abandoned in favour of a single huge section. While the PCA has shown the modules cannot be statistically separated from the overall concept of cooperative social presence, they can show the breakdown of difference aspects of the concept. The subscales in the cooperative section also scored high KMO and Cronbach  $\alpha$  which suggests they do work well as subscales to the main section. This single, uni-dimensional component with interpretive sub-scales is similar to that seen in the IEQ (Jennett et al., 2008) and GEngQ (Brockmyer et al., 2009) questionnaires.

## 6.6 Conclusion to Chapter 6

The development of the CCPIG was born of the aim to explore social presence in the complex social environments that are team-based online games. Unlike previous social presence measures the CCPIG was developed for socially complex virtual environments, and was not designed to be a general measure for social presence across multiple media, but a focused measure for social presence in games. Unlike previous game based measures such as the SPGQ, the CCPIG addresses both competitive and cooperative gameplay, and probes concepts specifically related to team-based games. The development processes show a high degree of coherence between the items of the questionnaire and the separation of competitive and collaborative experiences was evident from the factor analysis.

The CCPIG has been developed to the expected standards of good questionnaires and there are therefore good grounds that this questionnaire will be able to deliver the intended insights into social presence in digital games. Of course there remains much validation work to be done, some of which is already underway. The CCPIGv1.1 and more details about its development and the results of future validation studies will be found online (<https://sites.google.com/site/ccpigq/>).

## References

- Alexander, A.L., Brunyé, T., Sidman, J., & Weil, S.A. (2005) From gaming to training: A review of studies on fidelity, immersion, presence, and buy-in and their effects on transfer in pc-based simulations and games. In *The interservice/industry training, simulation, and education conference (I/ITSEC), NTSA, Orlando, Florida*.
- Bailenson, J.N., Blascovich, J., Beall, A.C. & Loomis, J.M. (2001) Equilibrium theory revisited: Mutual gaze and personal space in virtual environments. *Presence: Teleoperators & Virtual Environments*, 10(6), 583-598.
- Biocca, F. & Harms, C. (2002) Defining and measuring social presence: Contribution to the networked minds theory and measure. *Proceedings of PRESENCE*, 2002, 1-36.
- Biocca, F., Harms, C., & Burgoon, J.K. (2003) Towards a more robust theory of social presence: Review and suggested criteria. *Presence*, 12(5), 456-480.
- Brockmyer, J.H., Fox, C.M., Curtiss, K.A., McBroom, E., Burkhart, K.M., & Pidruzny, J.N. (2009) The development of the game engagement questionnaire: A measure of engagement in video game-playing. *Journal of Experimental Social Psychology*, 45(4), 624-634.
- Cairns, P., & Cox, A.L. (2008) *Research methods for human-computer interaction*. Cambridge University Press, Cambridge.
- Cairns, P., Cox, A.L., Daya, M., Martin, H., & Perryman, T. (2013) Who but not where: the effect of social play on immersion in digital games. *International Journal of Human Computer Studies*, 71(11), 1069-1077.
- Clark, H. (2006) Social actions, social commitments. In. Enfield, N.J., & Levinson, S.C. (Eds) *Roots of human sociality: Culture, cognition and interaction*, (pp. 126-150) Berg, Oxford.
- de Kort, Y., IJsselstein, W.A., & Poels, K. (2007) Digital games as social presence technology: Development of the social presence in gaming questionnaire (SPGQ). *Proceedings of PRESENCE 2007: The 10th International Workshop on Presence*, 195-203.

- EA (2011) Battlefield 3 launched with record-breaking force. EA.com, <http://www.ea.com/news/battlefield-3-launches-with-record-breaking-force>. Retrieved Dec.1, 2013.
- Everitt, B.S. (1993) *Making sense of statistics in psychology: A second-level course*. Oxford University Press, Oxford.
- Fiedler, F.E. (1962) Leader attitudes, group climate, and group creativity. *Journal of Abnormal and Social Psychology*, 65(5), 308-318.
- Fiedler, F.E. (1967) *A theory of leadership effectiveness*. McGraw-Hill, New York, USA.
- Freeman, J., & Avons, S.E. (2000) Focus group exploration of presence through advanced broadcast services. *Proceedings of the SPIE, Human Vision and Electronic Imaging V*, 3959-3976.
- Frostling-Henningsson, M. (2009) First-person shooter games as a way of connecting to people: "brothers in blood". *CyberPsychology & Behavior*, 12(5), 557-562.
- Gunawardena, C.N. (1995) Social presence theory and implications for interaction and collaborative learning in computer conferences. *International Journal of Educational Telecommunications*, 1(2/3), 147-166.
- Gunawardena, C.N., & Zittle, F. (1997) Social presence as a predictor of satisfaction within a computer mediated conferencing environment. *American Journal of Distance Education*, 11(3), 8-26.
- Hudson, M., and Cairns, P. (In press) Interrogating social presence in games with experiential vignettes. *Entertainment Computing*.
- Hussain, T., Weil, S., Brunyé, T., Sidman, J., Ferguson, W., & Alexander, A. (2008). Eliciting and evaluating teamwork within a multi-player game-based training environment. *Computer games and team and individual learning*, 77-104.
- Jansz, J., & Tanis, M. (2007) Appeal of playing online first person shooter games. *CyberPsychology & Behavior*, 10(1), 133-136.
- Jennett, C., Cox, A., Cairns, P., Dhoparee, S., Epps, A., Tijs, T., & Walton, A. (2008) Measuring and defining the experience of immersion in games. *International Journal of Human Computer Studies*, 66(9), 641-661.
- Kline, P. (2000) *A Psychometrics Primer*. Free Association Books, New York.
- Kreijns, K., Kirschner, P.A., Jochems, W. & Van Buuren, H. (2011) Measuring perceived social presence in distributed learning groups. *Education and Information Technologies*, 16(4), 365-381.
- Lazar, J., Feng, J.H., & Hochheiser, H. (2010) *Research methods in human-computer interaction*. John Wiley & Sons Ltd., Chichester.
- Lombard, M., Ditton, T.B., Crane, D., Davis, B., Gil-Egui, G., Horvath, K., Rossman, J., & Park, S. (2000) Measuring presence: A literature-based approach to the development of a standardized paper-and-pencil instrument. *Third International Workshop on Presence, Delft, The Netherlands*.
- Lombard, M., Ditton, T.B., & Weinstein, L. (2009) Measuring presence: The temple presence inventory. In *Proceedings of the 12th Annual International Workshop on Presence*.
- Lyons, S. (2012) League of Legends has 32 million monthly active players. Destructoid.com, <http://www.destructoid.com/league-of-legends-has-32-million-monthly-active-players-236618.phtml>. Retrieved Dec. 1, 2013.
- McGreevy, M.W. (1992) The presence of field geologists in mars-like terrain. *Presence: Teleoperators and Virtual Environments*, 1(4), 375-403.
- Nakazawa, M. (2007) R practice: Factor analysis. [minato.sip21c.org, http://minato.sip21c.org/swtips/factor-in-R.pdf](http://minato.sip21c.org/swtips/factor-in-R.pdf). Retrieved Sept. 1, 2013.
- Nederhof, A.J. (1985) Methods of coping with social desirability bias: A review. *European Journal of Social Psychology*, 15(3), 263-280.
- Nowak, K.L., & Biocca, F. (2003) The effect of the agency and anthropomorphism on users' sense of telepresence, copresence, and social presence in virtual environments. *Presence: Teleoperators & Virtual Environments*, 12(5), 481-494.



- Poels, K., de Kort, Y. & Ijsselstein, W. (2007) It is always a lot of fun!: exploring dimensions of digital game experience using focus group methodology. *Proceedings of the 2007 conference on Future Play*, 83-89. ACM.
- Price, J.L., & Muller, C.W. (1986) *Handbook of organizational measurement*. Pitman Publishing, Marshfield, MA, USA.
- Ratcliffe, M. (2007) *Rethinking Commonsense Psychology*. Palgrave Macmillan, Hampshire/New York.
- Retaux, X. (2003) Presence in the environment: theories, methodologies and applications to video games. *PsychNology Journal*, 1(3), 283-309.
- Rourke, L., Anderson, T., Garrison D.R., & Archer, W. (1999) Assessing social presence in asynchronous, text-based computer conferencing. *Journal of Distance Education*, 14(3), 51-70.
- Schouten, D.G.M. (2011) Shared Experience: The influence of the in-game social connection on the player experience in digital gaming. tue.nl, <http://alexandria.tue.nl/extra2/afstversl/tm/Schouten%202011.pdf>. Retrieved Feb. 25, 2014.
- Schroeder, R., Steed, A., Axelsson, A., Heldal, I., Abelin, A., Widestrom, J., Nilsson, A., & Slater, M. (2011) Collaborating in networked immersive spaces: as good as being there together? *Computers & Graphics* 25(5), 781-788.
- Toups, Z. O., Kerne, A., Hamilton, W. A., & Shahzad, N. (2011) Zero-fidelity simulation of fire emergency response: improving team coordination learning. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 1959-1968. ACM.
- Van Baren, J. & Ijsselstein, W. (2004) Measuring presence: A guide to current measurement approaches. *Deliverable of the OmniPres project IST-2001-39237*.
- Yee, N. (2007) Motivations of play in online games. *Journal of CyberPsychology and Behavior*, 9, 772-775.
- Yee, N. (2009) *Motivations of Play. The Daedalus Project*. [http://www.nickyee.com/daedalus/gateway\\_motivations.html](http://www.nickyee.com/daedalus/gateway_motivations.html). Retrieved Feb. 25, 2014.

# Appendix

## CCPIGv1.1P

The items which form the Competitive and Cooperative Presence in Gaming Questionnaire (CCPIG) are listed below. The CCPIG is designed to measure the social presence felt by gamers in competitive and cooperative virtual environments. The version shown here is the ‘plural’ version of the CCPIG, and is worded to be used in a scenario in which a participant has more than one opponent and team-mate. A version worded for dyads can be found online: [sites.google.com/site/ccpigq](https://sites.google.com/site/ccpigq).

In the items are to be used with 5 point Likert scale and items within sections should be mixed up, not appearing in their original order, nor grouped into their modules. This is essential to aiding validity of the data as it reduces the risk of participants flatlining their responses or producing the “right” answers (social desirability bias).

The CCPIG is split into two sections, Section 1 measures competitive social presence, that is the level of social presence felt by a participant towards their opponent(s). Section 2 measures cooperative social presence, the level of social presence experienced by a participant towards their team-mates. The two sections of the CCPIG measure separate components, therefore it would be possible to use them independently to measure, for example, cooperative social presence in a game which has only cooperative gameplay.

Section 1 is made up of two modules. Module 1.1 measures the extent to which participants feel their thoughts and actions were dependent on their opponent, and the extent to which the participant’s theory of mind was at play. Module 1.2 measures how engaging the participant felt their opponent was. Section 2 is made up of 4 modules. Module 2.1 measures how strongly the participant identified with their team and how much they felt a part of something. Module 2.2 measures the level of social actions which supported their team a participant felt was occurring during the game. Module 2.3 measures how motivated a participant was towards helping their team succeed, and Module 2.4 measures how much value a participant placed upon their team.

The CCPIG is scored as follows:

### Section 1: Competitive Social Presence

#### Awareness

- I acted with my opponents in mind
- I reacted to my opponents’ actions
- I knew what my opponents were trying to achieve
- I was aware that my opponents might work out my goals

The actions of my opponents affected the way I played  
I felt I affected my opponents' actions

### **Engagement**

My opponents were challenging  
The game was a battle of skill  
The game was a battle of wits  
I felt tense while playing my opponents  
My opponents created a sense of urgency  
The presence of my opponents motivated me  
My opponents played a significant role in my experience of the game  
It seemed as though my opponents were acting with awareness of my actions

## **Section 2: Cooperative Social Presence**

### **Team Identification**

I was aware of my team  
I acted with my team-mates in mind  
I considered my team-mates' possible plans/thoughts  
I felt like I was part of a team  
I felt a social connection to my team-mates (camaraderie)

### **Social Action**

I felt my team-mates were looking out for me  
I felt I contributed to the team  
I felt the team helped me  
I felt my actions made a difference to my team-mates  
The actions of my team-mates affected my thoughts and actions  
My team-mates played a significant role in my experience of the game  
My team communicated well  
The team had a mutual understanding

### **Motivation**

I put the performance of the team over my personal performance  
My actions were determined by the objectives of the team

I wanted my team to value me  
Being part of a team motivated me  
I felt responsible for achieving the objectives of the team  
I did not want my team to think I had let them down

**Team Value**

I felt my team was committed to working together  
I made an effort to work with my team-mates  
I felt my team shared a common overall aim  
I felt my team shared common short term goals  
It was as much about the team as about my own game  
My team-mates were useful