THE EFFECT OF AVATAR REALISM AND LOCATION AWARENESS ON SOCIAL PRESENCE IN LOCATION BASED MOBILE GAMES

by

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ABSTRACT

Location-Based Games (LBGs) have been gaining both academic and industrial interest in the past few years. Utilizing location information, LBGs enable users to extend their social game-play from cyberspace to the real-world. However, sharing personal information particularly the physical location of users is likely to raise privacy concerns resulting in eroding players' social experience. To further explore this issue, I investigated the impacts of two attributes of privacy, avatar realism and location-awareness, on the players' perceived social presence during a designed LBG. The results indicated that the social presence was not significantly affected by the applied privacy configurations. However, players' negative feelings decreased when photographic images of players were used as their avatars. Further, players desired to share their physical location and sacrifice location privacy in order to track other players. My findings suggest that a well-designed LBG can lessen users' location privacy concerns.

Keywords: Avatar realism, Location awareness, Social presence, Location-based game, Location privacy, Location-based service

"To My Parents and My Only Sister"

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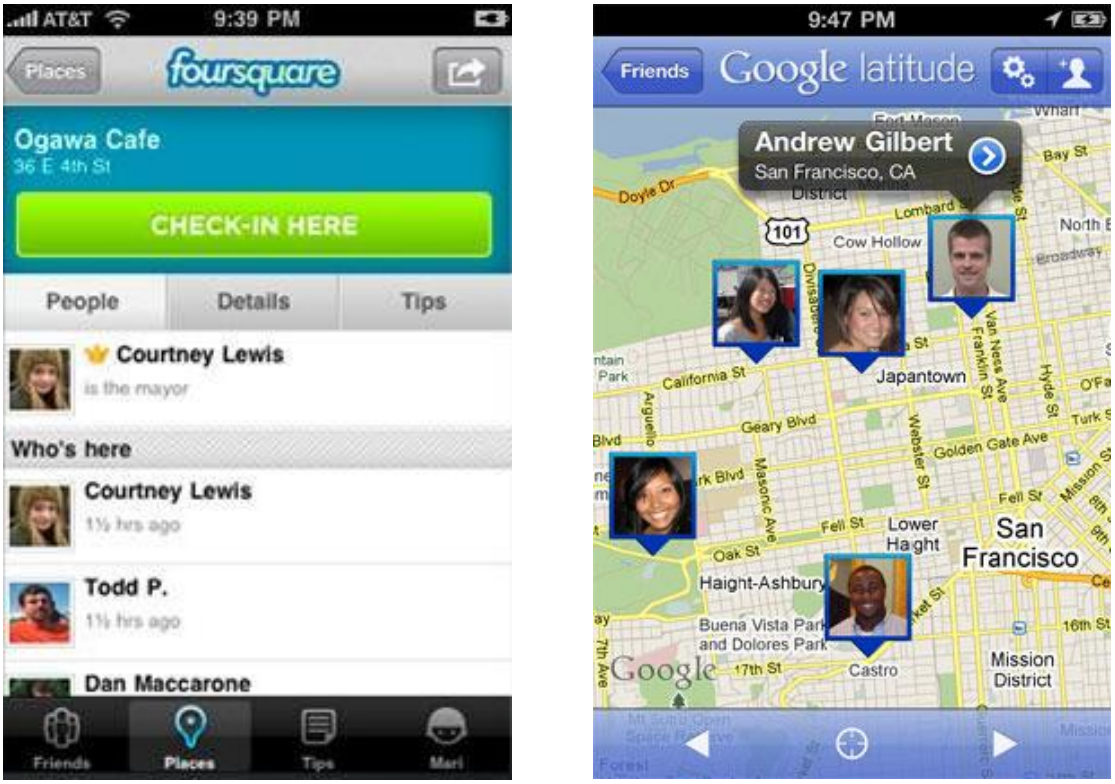
1: INTRODUCTION

Location sharing applications, such as Foursquare (Foursquare, 2009) and Google Latitude (Google, 2009), provide users with the tools to facilitate automatic broadcasts of a user's location for different purposes (Fig. 1.1). Evolving social networks and social games that use these tools allow people to share location-tagged information with other parties. This publicized information either fosters their social connections or is utilized for entertainment purposes. On the other hand, disclosing personal information (including physical location) can raise privacy concerns (Culnan and Armstrong 1999; Barkhuus and Dey 2003). People may want to share some sensitive information with close friends, but are less likely to desire to share the same information with unknown parties.

This thesis explores the influence of two distinct attributes of privacy: location awareness and avatar realism, on users' perceived social presence in a location-based mobile game. Location awareness is as an essential factor of privacy in studies of location-based services. By location awareness in the context of location-based games, I mean that players are aware of location of other involved players during their game-play sessions.

Avatar (or iconic) representation, as the virtual embodiment of users, is a means to convey social cues and depict the real user in a virtual environment. In the context of my thesis, "avatar realism" refers to an avatar icon's level of representational fidelity and

also to the isomorphic visual correlation between the avatar and the user's "real" appearance.



a b

Figure 1.1: Examples of location sharing applications a) Foursquare b) Google Latitude

A location-based game, called "Catch Treasures", was specifically designed for this study, using a simple treasure hunt mechanics, which have been previously used successfully in games and Alternative Reality Games (ARGs). I have designed Catch Treasures with different privacy configurations to measure the impact of the aforementioned privacy attributes on social presence. I used a standard questionnaire to gauge social presence measure, which players filled out at the end of their play session.

I chose to measure ‘Social Presence’ as the basis of measuring the quality of social experience in this study for the following reasons:

- Social presence represents a psychological variable indicating the phenomenon of subjective connectedness within a mediated communication platform (F. Biocca 1999).
- A sense of behavioral engagement “where actions are linked, reactive, and interdependent” is expected in higher levels of social presence (F. Biocca, Harms, and Gregg 2001). As a result, a higher social presence can represent a higher behavioral engagement in a mediated social experience.
- Social presence can be measured through the current subjective self-report measures of social presence without any specific instrument such as an eye-tracker or a physiologic sensor. Therefore, social presence can be simply measured in social mobile experiences (location-based games in this thesis).
- Social presence is closely related to “interpersonal trust”, which is a significant factor in privacy studies (Cyr et al. 2007) such as my study. Bente et al. (2008) considered “interpersonal trust” and social presence as complementary concepts: *“Whereas trust is generic to human communication and implies evaluative aspects, social presence is aiming at mediated communication and is more disruptive by nature. Thus, in combination, both variables can be expected to cover a wide range of relational media effects”.* (Bente et al. 2008, p. 2).

Consequently, social presence can be a good indicator of the quality of social experience in this study which primarily focuses on the privacy in a social-driven mobile service.

1.1 Problem Definition

A location-based game (LBG) is a new class of entertainment that bridges between real and virtual environments. In LBGs, players are usually required to move (change their geographical locations) in the real environment to follow some virtual cues (such as virtual treasures) provided by their hand-held devices.

The emergence of GPS-enabled mobile devices such as Apple iPhone and Google Android phones introduced a broad range of location-based services (henceforth referred to as LBSs) such as LBGs which allowed the users to sense and collect information related to their current physical location (see Fig. 1.2).

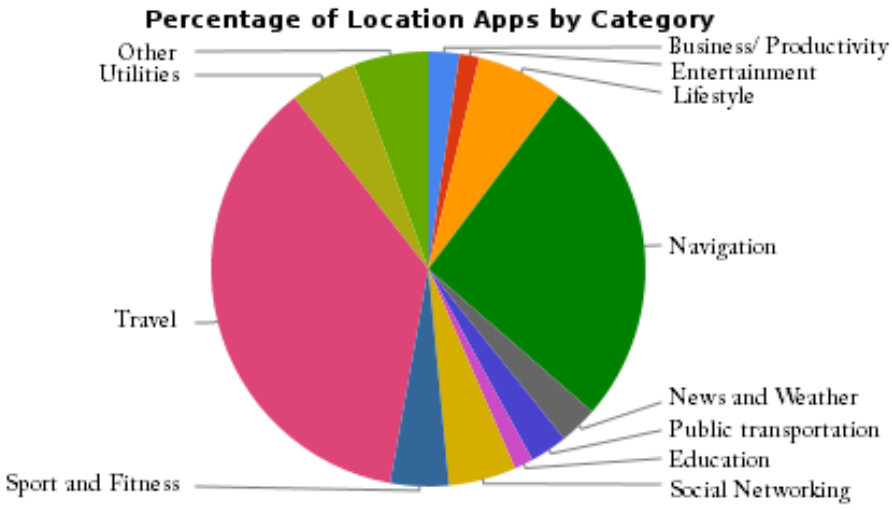


Figure 1.2: The distribution of LB apps on iPhone (Skyhook, 2011)

As indicated in figure 1.2, LBGs do not constitute a big portion of LB applications. Three factors can explain this issue:

- Location-based games can be the secondary purpose of a more general category such as social networking or education and therefore are not considered as a separate category. For example, Foursquare is a location-based social network in which players are also able to play a location-based game.
- The social-driven location-based applications (including LBGs) have been recently emerged comparing to purpose-driven location-based applications (such as navigation category) which have been developed since the location-based technology was introduced.
- Another possible significant reason (which is the main focus of this thesis) is that the players' privacy concern of sharing location with other users can adversely affect their interest in playing location-based games.

Regarding the similar characteristics between LBGs and location-sharing applications as well as the growing popularity of the latter, in the following subsections, I generally explore the concept of privacy in location-sharing applications but with the particular focus on LBGs.

1.1.1 The growing popularity of LBSs

Prior to proliferation of GPS-enabled mobile devices, people relied on location self-disclosure techniques using phone conversations, text messages (Translink, 2010), and instant messaging to report their location either to receive the desired services or to

socialize with friends. The widespread adoption of smartphones capable of sensing accurate real-time location information, using agile technologies like GPS-based or signal triangulation based technologies (Hightower and Borriello 2002) enabled various LBS opportunities. By 2010, there were over 6,400 released location-based applications in the iPhone App Store (Fig. 1.3) and 1,000 on Android marketplace (Skyhook, 2011).

Figure 1.3: The growing number of LB applications in App Store (Skyhook, 2011).

The pervasive reach of mobile users along with the ubiquity of these GPS-enabled mobile devices enabled a new class of LBSs called location-sharing applications (LSAs) in which users are allowed to share their geographical information with other users.

LSAs were primarily purpose-driven applications for specific domains such as military or first-aid services in which the users shared their locations with one person or a very small group of people. The advent of location-based social networks shifted LSAs from purpose-driven one-to-one sharing to socially-driven one-to-many sharing applications.

The following scenario is formulated to help explain the future prevalence of socially interactive location-based services.

Alice plans to attend a dance performance competition with a group of friends. She will meet them at the event. She opens up the "Map" application on her iPhone to find the shortest transportation path to the event's location. As Alice is on the train, she logs into her Facebook account and finds that there is a virtual Starbucks badge very close to the next station. She has already gathered four badges and if she gets another one, she can have a free coffee at Starbucks. She is still ahead of her schedule, so she decides to get off the next station and gather the fifth badge. There is a Starbucks branch right beside the flagged badge. She goes there and releases all of the five gathered badges and receives a free coffee. Alice reopens the mobile Facebook application and shares her adventure and achievement with her social connections. She leaves the coffee shop and takes another train to the destination. As she is passing the Vancouver Harbour Centre tower, she logs into her Foursquare account and checks into this particular place. She knows if she can keep checking into Harbour Centre for another week and maintain her "mayorship" position, she will be allowed to have a free sightseeing ticket on top of the tower. Finally, she reaches the destination but it is so crowded that it is almost impossible to find her friends. Therefore, she opens up another application allowing her friends to see her exact location. As the dance competition ends, spectators are asked to

download an application allowing people within the immediate vicinity to vote for the best dancer and have a chance to win a lottery draw. She checks into the application that reveals her information and votes. The results are announced and Alice is one of the fortunate winners. She receives a lot of congratulation messages on her phone from nearby people who can see her information on their phones.

Some of the above services have already been implemented and the other ones are expected to go to market shortly. This scenario demonstrates various location-sharing policies in different kinds of LBSs:

- Sharing with a small group of friends vs. with a huge number of unknown people.
- Sharing for a purpose, to play a game, or to socialize with friends.

The growing evolution of social networks allowed users to share their photos, activities, and other personal information with a larger community of friends and disseminate their thoughts to other worldwide users. Activities such as “status updating” or “micro-blogging”(Gaonkar et al. 2008) represent the sharing of user-generated content in a social network. The extremely popular social-networking site, Facebook, has over 500 million active users (as of January 2011) with over 60 million status updates daily (Allfacebook, 2010). The considerable potential of social networking in maintaining social connections and building *remote intimacy* motivates the users to reveal more personal information. Particular online social networks like Facebook and Twitter took a step further by allowing users to disseminate location-tagged information to their social connections.

GPS-enabled phones provide social networks with the novel opportunity to access the physical location of individuals by revealing nearby friends and places of interest. With location-based social networks, users are now informed of local social public events, friends' activities, and many more location-based services in close proximity to them. It is expected that fully location-based social networks will gain 82 million subscribers by 2013 (ABI research, 2008).

In addition to social networks, digital gaming has also tried to adopt location sharing technologies to extend its game-playing boundaries outside of cyberspace and into real world. Location-based massively multiplayer online (LBMMO) games utilized the social potential of location-sharing technologies by allowing users to have an entertaining experience in the physical world (Nicklas, Pfisterer, and Mitschang 2001). Unfortunately, to this time, I am unaware of any reliable statistics on the overall distribution and popularity of location-based games, but I believe it is a growing market and will be booming in the next few years.

1.1.2 Privacy Issues with LBSs

Privacy is reported as one of the major issues and concerns hindering the popularity of social-driven location-based services (Beresford and Stajano 2005; Snekkenes 2001; Bisdikian et al. 2001). Despite the growing popularity of these location-based social environments, some researchers reported that people are reluctant to actively disseminate their location information (Barkhuus and Dey 2003).

In online gaming, people are often willing to be actively engaged in the game and effectively communicate with other players, but they might not wish to publicly share

their identities with other involved parties. In this condition, players can share fabricated information and play the game or interact with other unknown players for a certain amount of time. However, in a location-based game (LBG), players are usually required to disseminate their current physical location to be able to play the game. This location sharing makes privacy issues and concerns of major importance as such technologies increase in popularity.

The privacy notion covers a wide range of concepts with several aspects defined by the context of study. Westin (1967) defines privacy as: *"The claim of individuals, groups, or institutions to determine for themselves when, how, and to what extent information about them is communicated to others* (Westin 1967)*."* In this definition, privacy is defined in terms of sharing information (about the current entity) with other outside entities. In most studies of social environments, identity is the core of discussions about privacy (Langheinrich 2002). In the context of privacy in location-based services, location identity and location privacy are bases of discussions.

1.1.3 Previous work on privacy within LBSs

In studies of privacy in LBSs, location information is considered as the most significant privacy factor, which should be carefully preserved. One of the key reasons is that the precise location information can identify the person even more so than names and genetic profile (Duckham and Kulik 2006). A person can be easily accessible by broadcasting his/her physical location.

In recent years, there have been an increasing number of scholars investigating location privacy in the domain of LBSs (Cvrcek et al. 2006; Barkhuus et al. 2008; Minch

2004; Duckham and Kulik 2006). Almost all of the literature in this area focuses on location privacy as an essential issue which should be addressed.

However, they mostly base their studies on *security* technologies and approaches preserving the user's location information from unauthorized entities. Various algorithms and models have been proposed to reduce the known location privacy threats and/or provide a high level of location anonymity (Gedik and Liu 2005; Hoh and Gruteser 2006; Schilit, Hong, and Gruteser 2003). Surprisingly, there are few studies which empirically examined the effect of users' *feeling of location privacy* on their experience (Cvrcek et al. 2006; Barkhuus and Dey 2003; Tang et al. 2010).

Location privacy is basically an important issue in the design of location-based applications with high social potential such as location-based social networks and games in which the social experience of the users plays a very important role in popularity of the service. Also, previous studies have not looked at other privacy measures and their effect on gaming experience within an LBG.

In this thesis, I examine the effect of revealing both physical location and users' identity through a realistic avatar picture on the quality of the experience of playing a location based game. While there has been some studies on location privacy, there is no work, I am aware of, that tackled other attributes of privacy (such as revealing facial identity through avatars) and its effect on the quality of game experience in LBGs.

1.2 Methodology and Research Question

Those few studies exploring the effects of privacy on social interactions in location-based social services are usually based on qualitative approaches (Barkhuus

2004) and users' self-report attitudes towards their privacy concern (Barkhuus and Dey 2003). I believe that this approach is insufficient since direct questioning can raise concerns of privacy and skew the results. It is reported that survey responses of Internet users about privacy concerns is not necessarily matched to privacy practices (Jensen, Potts, and Jensen 2005).

Given partially contradictory results on the potential effects of privacy and revealing information on social experiences in online environments, I cannot propose a directed hypothesis for my study. Furthermore, the lack of supporting knowledge on potential social experiences in LBGs is another reason that can make any research hypothesis invalid in this context.

Instead, I based this study on a general research question that hinges on location-based computing as the core media.

Research Question*: How is the social experience of players in a location-based game affected by the amount of privacy provided for the players during the game?*

The proposed research question includes general concepts such as "privacy" and "social experience" which should be carefully defined to pursue a precise exploratory response. As described in the previous section, in my study, I focus on "location awareness" and "avatar realism" as attributes of the privacy and social presence as the basis of measuring the quality of social experience.

Therefore, I subdivide the above question into more deliberate research questions:

RQ1: How does the location-awareness of players in a location-based game affect the social presence of players?

RQ2: How does the amount of avatar realism (using more realistic avatars) in a location-based game affect the social presence of players?

In order to address the above questions, I conducted an between-subject study following a quantitative approach. I designed a specific LBG for this research, called "Catch Treasures", and manually implemented different privacy configurations in terms of avatar realism and location awareness. Participants were asked to play the game in these privacy configurations without any prior knowledge about the actual study's intended purpose. After the game-play session, they reported their perceived social presence by filling the social presence gaming questionnaire proposed by de Kort et al. (2007).

1.3 Contribution

Considering the novelty of empirical research studies on LBSs and lack of sufficient literature investigating social practices in LBGs, this thesis makes several significant contributions to the scholarly community. First, this thesis presents a first study of its kind in conducting an empirical study investigating the relationship between privacy and social presence within the LBG domain.

Second, the conducted study contributes the following findings. (a) The study indicated that preserving/disclosing players' location and facial identity in an LBG did not significantly affect players' social presence in an LBG. (b) Disclosing players' facial identities decreased the players' perceived negative feelings towards other players. (c)

In addition, the results showed that players were willing to disclose their location information and sacrifice their location privacy in order to track other players during the game.

It is worth mentioning that although this research provides an insight to possible impacts of privacy on emergent social practices in LBGs, it is NOT aimed to judge the essence of preserving privacy in any condition or to provide a framework for a more privacy preserving location-sharing application.

1.4 Thesis Organization

Chapter 2 illustrates the theoretical foundations of this thesis by discussing the definitions of presence and in particular social presence in details. It also provides a general overview of definitions of avatars and avatar realism in the related literature.

Chapter 3 tackles related literature about avatar realism and its impacts on social communications. It also outlines some of the previous work, in terms of studies on the concept of privacy in social-driven location-aware applications.

In **Chapter 4**, I discuss the design principles that I followed to develop Catch Treasures for the research investigation around LBG and privacy. Further, I explain how the design requirements of the game were addressed through the conducted pilot study.

Chapter 5 details the conducted experiments and applied methodology for this research study.

In **Chapter 6**, I demonstrate the collected data and the analyzed results from the experiments.

Chapter 7 explores the results in more detail followed by discussions about the limitations of the conducted study.

Finally in **Chapter 8**, I present the future work and potential applications of this research.

2: THEORETICAL FOUNDATION

This chapter presents the most significant theoretical grounds of my thesis. I will give a general overview of different virtual environments and their characteristics followed by the related definitions of avatars and avatar realism in the literature. At the end, I discuss the concept of presence and particularly social presence which is one of the fundamental elements of this thesis.

2.1 Mediated Environments

Loomis (1992) defines mediated environment as opposed to physical environment as an environment where *the "perception is mediated by a communication technology, one is forced to perceive two separate environments simultaneously, the physical environment in which one is actually present, and the environment presented via the medium"* (p. 114).

Mediated environments can provide users with the opportunity to "virtually" present themselves in a non-physical space, called the "virtual environment", and even to share this environment with physically remote users. In this distinction, even a phone call or a text-based chat communication can create a virtual environment since users present themselves through voice or text messages to the other physically remote users.

For example, in a text chat communication, two or more users can present themselves and interact with other involved users through sending text messages to a shared virtual environment (chat room here).

The advances in computer and cyber-oriented technologies enabled mediated environment designers to create more realistic experiences for the users by simulating physical presence in either the real or imaginary world. These computer-simulated environments are usually referred as “Virtual Reality” (VR).

2.1.1 Virtual reality (VR)

Virtual reality (VR) is usually referred to a computer-simulated environment where a virtual replica of a real environment is presented to the user. In the first years of emergence of VR, head-mounted displays (HMDs) were the most dominant technologies used in VR systems (Fig. 2.1-a). Nowadays, VR systems have been equipped with more advanced and expensive technologies such as CAVE-type displays (Fig. 2.1-b) to immerse users in the more realistic virtual environment that it provides.

a

b

Figure 2.1: Virtual reality technologies a) Head-mounted display (HMD) b) CAVE (photos from Wikipedia)

Most seminal definitions of virtual reality involved using a particular hardware system such as head-mounted eye goggles (Coates 1992). However, Steuer (1992) believes that “a device-driven definition of virtual reality is unacceptable” (p. 73). He defines virtual reality based on the concept of telepresence (see section 2.3 of this thesis for a detailed discussion on telepresence): *“telepresence is the extent to which one feels present in the mediated environment by means of a communication medium....A virtual reality is defined as a real or simulated environment in which a perceiver experiences telepresence”* (Steuer, pp.76-77).

However, this definition cannot explain the social implication of the new VR technology. In Schroeder (1996)’s definition of a VR technology, he emphasizes telepresence and the possibility of interaction with the virtual environment for one or multiple users. A VR technology is *“a computer-generated display that allows or compels the user (or users) to having a feeling of being present in an environment other than the one that they are actually in and to interact with that environment”.*

He also defines shared virtual reality technology, or shared virtual environment as *“VR systems in which users can also experience other participants as being present in the environment and interacting with them”* (R. Schroeder 2002)

More discussion on the concept of virtual reality and its related technologies is out of the scope of this thesis and can be found in literature of virtual reality (Steuer 1992; Palmer 1995; F. Biocca and Levy 1995; R. Schroeder 2002). However, related concepts to social interactions in the shared virtual reality or shared virtual environment will be further discussed in this chapter.

From this point onward in this thesis, the term “virtual environment” (without any additional prefix or qualifier) refers to a shared computer-generated virtual environment or *“shared desktop virtual environment”* such as a chat room or a massively-multiplayer online (MMO) game.

2.1.2 Virtual worlds

The ever growing internet and online communications allowed designers to create shared multi-user desktop virtual environments in which the users are able to simultaneously interact with other users and with the environment. These shared virtual environments are referred as “virtual worlds”.

The growing popularity and unique characteristics of virtual worlds enabled researchers to study various aspects of these virtual environments. However, lack of a common agreed definition of a virtual world in the literature has caused various views when analyzing different functions of these environments.

Bell (2008) reviewed the existing definitions of the virtual worlds and defined a virtual world based on the essential elements of previous definitions as *“a synchronous, persistent network of people, represented as avatars, facilitated by networked computers”* (p. 2).

He argues that each virtual world should address some essential characteristics including:

Synchronous: a virtual environment should provide a real-time communication.

Persistent: It should exist even without the (virtual) presence of the user.

Network of people: Users should be able to communicate with other users in the environment.

Represented as avatars: Users should be represented by their avatars (see section 2.2)

Facilitated by networked computers: Bell claims that a virtual world should be managed through networks of computers.

In this definition, most video games, with exceptions of MMOs, are not considered virtual worlds because the environments that they provide are not persistent. Further, online social networks like Facebook and Twitter are not virtual worlds because of the lack of avatars and synchronousness. On the other hand, Second Life (Linden Research Inc, 2003) and World of WarCraft (Blizzard Entertainment, 2004) are popular examples of virtual worlds.

2.1.3 Mobile virtual environments

The emergence of mobile devices allowed people to experience a new class of mediated communication. The social acceptance and growing popularity of mobile phones has tremendously changed the social interaction among users. Mobile users are accessible almost anytime and anywhere through their mobile devices. In addition to phone calls, they can also communicate with other users via diverse services such as text messages, multi-media messages, and Bluetooth technology.

Furthermore, the mobile hand-held devices can be entry points to the virtual worlds by providing the users with an opportunity to interact with virtual agents and avatars. However, the limitations of mobile devices such as limited power, storage and

small screens can impose more limitations on the design of mobile virtual environments. For example, a mobile device might not be able to render realistic 3D graphical objects or complex animations.

Consequently, a mobile virtual environment may be restricted to the less realistic 2D replica of a computer-generated virtual environment with no or very simple animations. These design restrictions can cause different interaction experiences for the users of mobile virtual environment comparing to the users of desktop virtual environments.

Another difference between the mobile and desktop virtual environment is the recent location-based services offered by smart phones and PDAs. These services will bridge between the real and the virtual world. Utilizing location-based services, users can extend their virtual experience to the actual physical world. For instance, in a location-based game, a player is able to achieve virtual items while playing in a real environment. On the other hand, the desktop virtual environment users are usually interacting in a virtual environment while seated behind their displays.

2.2 Avatars

As it is not currently possible for human beings to be fully immersed in these virtual environments, humans are represented by a digital embodiments called “Avatars”. Through avatars, users can embody themselves and inhabit virtual worlds. Furthermore, avatars are access points to social interaction and engagement in virtual environments by allowing users to present their behaviors and identities.

In fact, these virtual bodies provide the means for users to construct an identity (sometimes completely different from the identity they have in the walking world) to digitally exist in the virtual worlds (R. Schroeder 2002; Bartle 2003; Turkle 1994; Taylor 1999). In this chapter, I elaborate on the concept of 'avatar' and discuss the effects of avatar realism on the quality of social interaction in virtual environments.

2.2.1 What is an Avatar?

Despite the considerable amount of literature discussing the concept of avatars, there is no unified definition of the term avatar in virtual reality studies. Avatars are literally defined as the models representing users' behavioral and/or embodiment (Bailenson et al. 2006). Avatars can be as simple and non-realistic as static icons in internet chats or very realistic such as shown in depictions of users in live-video feeds.

a

b

Figure 2.2: Extreme levels of abstraction a) non-realistic 2D avatar b) a realistic 3D avatar in Second Life

Figure 2.2-a shows a 2D smiley used in internet chats, on the other hand, figure 2.2 presents a very realistic fully embodied avatar in Second Life.

It should be noted that there is a distinction between the concepts of Avatar and Agents in the virtual reality studies. A virtual agent is an embodied being controlled by an artificial intelligent (AI) component whereas avatars are mutually driven by a real-time person. Avatars are considered as digital models of the humans they are representing. This model can indicate the appearance similarity or even the behavioral characteristic of the human.

Bailenson and his colleagues (2006) provided a framework to classify the representation of a human in both physical and virtual space (see Fig. 2.3). In the figure, the axes represent the amount of behavioral similarity and resemblance to a real person. The figure on the left shows the person's form and behavioral similarity in real time. The right figure indicates a person's form or behavior asynchronously. In their presented framework, the shaded area corresponds to the space in which the concept of avatars in the virtual reality is usually discussed.

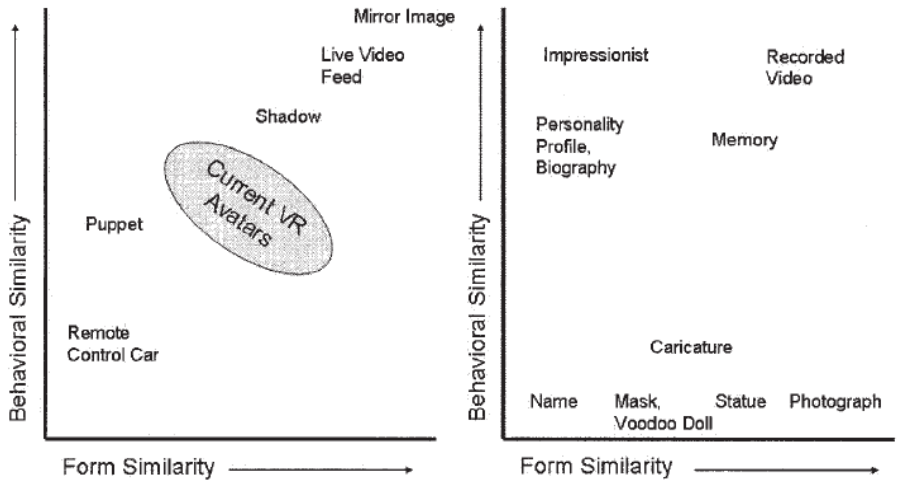


Figure 2.3: Representation of a human in physical and virtual space (Bailenson et al. 2006)

2.2.2 Social implications of avatars

Through avatars, people can express their emotions and engage in social activities. People also construct virtual identities by embodying themselves via digital avatars. They may spend a considerable amount of time in customizing their avatars as a representation of their chosen identities. Interestingly, some users may believe that their avatars are better representative of themselves than their real body (R. Schroeder 2002).

2.2.3 Avatar realism literature

Berger's uncertainty reduction theory (Berger and Calabrese 1975) posits that people's primary goal when interacting with another is to reduce the uncertainty about their interaction partner or to increase predictability about the future behavior of all involved people (including themselves) in the interaction. This uncertainty is basically reduced by the perceived quality of information gathered in a perceptual process.

In the real (non-mediated) environment this information is acquired by the cues of natural body language in a physical interaction. Once physical information is accessed, people shape a behavioral model of the other interactant and can fairly predict the other's personalities. Whether the provided information is accurate or not, people can judge the others based on the initial interaction or even the basic glimpse of the other (Ambady, Hallahan, and Rosenthal 1995).

In mediated environments in which physical information is not available to users, avatars play the role of physical bodies and can affect their people's perception. A similar process to the impression formation process, which usually occurs in real life, happens in mediated environments. People may judge their interaction partner based

on the physical appearance of avatars considering these digital bodies as the visual representations of involved people in the communication (Taylor 2002; Steve Benford et al. 2001). Despite the potential influence of avatar appearance on interactions in shared virtual environments, more research is still required to explore this influence (R. Schroeder 2002).

There is contradictory literature exploring the influence of anthropomorphic avatars on social interactions. Although Koda and Maes (1996) reported that more personified avatars have been rated more engaging and likable, Nowak (2004) showed that people perceived less anthropomorphic images more credible and likeable. Schroeder (2002) also suggested that people might prefer the representation of avatars which is neither very cartoonish nor very realistic. However, it should be noted that the characteristics of avatars rather than their appearance might be the explanatory reasons for this discrepancy (Nowak and Rauh 2005).

Behavioral realism refers to the extent to which avatars (or any other virtual object) in virtual environments act like humans (or familiar objects) in the real world. Aside from the verbal channel, many scholars have addressed the significance of rendering non-verbal behavior in virtual environments. In virtual worlds, these non-verbal cues such as facial expression, body posture, arm gestures, and etc. are represented through avatars to express the emotions and serve an effective conversation.

This thesis is only concerned with avatar realism in terms of an appearance of a simple icon within a smart phone display. Therefore, issues of human morphology and behavior, although important, are not addressed and are not considered as part of this

work. Thus, in regards to this thesis, a more realistic avatar is a realistic 2D image depicted in an icon within a smart phone display.

2.3 Presence

There are various definitions and dimensions of presence proposed in literature related to virtual environments. I will highlight some definitions here and switch to the concept of social presence which is the concept germane to the work discussed here; for more comprehensive treatment of this subject, readers are referred to Schuemie et al. 2001.

One of the highly cited taxonomy of presence in virtual environments is that of Lombard and Ditton (1997). They identified six conceptualizations of presence based on a broad review on a wide body of related research:

- *Social richness*: to what extent a medium is perceived capable of providing rich verbal and non-verbal when used to interact with other people.
- *Realism*: the extent to which a medium is perceived realistic.
- *Transportation:* the users' sensation of "being there" in the virtual environment.
- *Immersion:* the degree to which people perceive that they are immersed in a mediated environment.
- *Social actor within medium:* the extent to which people respond to social cues provided by the mediated presentation of another person even in the lack of "true social interaction" with that person.

- *Medium as social actor.* the extent to which the medium itself provides social cues.

IJsselsteijn and Riva (2003) divided Lombard and Ditton (1997)'s conceptualizations of presence into two broader categories: *physical presence*, which refers to sense of "being physically located in a mediated space" and is very related to telepresence (defined below), and *social presence*, as a reference to the sense of "being together, of social interaction with a virtual or remotely located communication partner". In this category, co-presence is at the intersection of the two categories (further defined below).

2.3.1 Telepresence

Telepresence, also known as "spatial presence", "presence as transportation and "mediated presence", is generally defined as the sensation of being immersed inside of a virtual or mediated environment (Witmer and Singer 1998). With telepresence, people feel transported and located in a virtual environment represented by a medium (Witmer and Singer 1998; K. Nowak 2001). It is up to the affordance of a particular medium to provide a compelling sense of immersion and "being there" when considering mediated environment where the physical body is not located. The experience of users in a virtual reality system can be highly affected by the sense of being in a mediated environment that the medium provides. There is a design imperative underlying virtual reality construction that focuses on enhancing the tele-present ontological state of the user.

The concept of presence discussed in literature of virtual environments mainly covers "telepresence" or sense of "being there" in a virtual reality. In such works,

researchers are concerned with providing users with a high sensation of being present in the virtual environment.

2.3.2 Social Presence

Most communication technologies are designed with an aim towards increasing social interaction. Simply defined as a “sense of being together”, social presence is a key factor in success of these communication technologies, which are sometimes called “social presence technologies” (F. Biocca and Harms 2002). Despite the long-term efforts in measuring and evaluating social presence, defining a comprehensive conceptualization of social presence is still in the early stages.

Social presence (SP) is among several other topics in the social sciences disipline that seem easy to understand and define. However, there is still no consensus on a clear definition or a standard measurement protocol. Most current definitions are dependent on the context of study (Tu 2002b; de Kort et al. 2007) or the medium by which the social interaction occurs. The diversity of definitions and lack of a standard measurement may discredit findings with unclear definitions of social presence and vague scope. This chapter outlines the most relevant definitions of social presence and its measurements. At the end, I discuss those appropriate characteristics regarding satisfactory measurements of SP that fulfils the purpose of the study presented here.

2.3.2.1 Social presence definitions

The emergence of new technologies with a high potential for social interaction has revolutionarily altered the ways that people communicate and socially interact with others. People may feel more socially active and present in online and virtual worlds

than the physical world. For example, avatar meetings in virtual environments may now replace traditional face-to-face communication. Consequently, social presence definitions have also considered “Mediated Environments” as the spaces by which people can socially communicate through a medium. Even a line of text appearing in a chat room or a simple image of “smiley” face can provide the “sense of being with another” (Biocca et. al. 2003). However, unmediated face-to-face communication is still credited as the strongest social communication protocol with the highest social presence (F. Biocca et al. 2001).

The seminal and intuitive definitions of SP involve the physical presence of interaction partners within a shared unmediated environment. In this binary (whether the other interaction partner is physically present or not present) unproblematic definition, social presence is treated as sense of “being there with another person”. Considering this simple canonical definition, for example, social presence can be represented by the presence of a corpse that is physically present but socially inactive. However, some researchers have argued that even in unmediated interactions, the binary conceptualization of social presence is unable to describe the person's sense of salience of the other. The concept of social presence is definitely more problematic if extended into any mediated environment. Therefore, this conceptualization requires more subtle psychological elaborations. Most researchers believe that social presence cannot be explained without considering the physiological and behavioral characteristics of involved interactants.

2.3.2.2 Social presence and copresence

The term “Copresence” was originally explained in Goffman’s work (1966) as the sensation of mutual awareness of both user/observer and mediated other. Copresence exists when people feel the ability to perceive others and those “others” are able to perceive them. More specifically, co-presence is explained beyond just the mutual awareness and the sense “being together” as defined when the mutual awareness is followed by the reaction of the other to the self or user as a validation of awareness existence.

Although some researchers differentiate the notion of co-presence and social presence, there is no clear distinction between these concepts. On the other hand, newer theoretical definitions consider co-presence as a single dimension of social presence (F. Biocca et al. 2001). Nowak (2001) asserted that there is a possible correlation between the measured social presence and co-presence. The question remains, however, as to whether social presence can be related to the concept of co-presence?

The highly credited definition of social presence pioneered by Short et. al.(1976) explains social presence as *“the degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationships”* (p.65). They measured SP as “a subjective quality of the communication medium”.

Biocca and his colleagues (2003b) believe that the simple presence of another body or awareness of it may not be a satisfactory definitional basis for social presence. Consequently, a more comprehensive definition should elaborate additional levels of psychological involvement beyond “attention”. Biocca and his collaborators provided a

subtle definition conceiving social presence as the sense of “access to another intelligence” (2003b). In their definition, the body (virtual or physical) is a medium representing cues to the intelligence animating the body. Moreover, social presence is not activated unless the users sense a minimal intelligence through the other’s reactions to the user and surrounding environment (either mediated or unmediated). Some definitions relate social presence to oscillating levels of intimacy and immediacy.

Kang et. al. (2008) defined social presence and copresence as complementary notions and proposed “Social Copresence” in order to expediently elaborate on the engaged involvement between those intelligent interactants that were mutually aware of each other. On both a psychological and emotional level, each interactant implicitly sensed the other intelligent being within the mediated environment.

Biocca and Harms (2002) have developed a conceptualized framework of social presence and made a significant advancement in elaborating a comprehensive definition of social presence. They succinctly defined social presence as “the moment-to-moment awareness of co-presence of a mediated body and sense of accessibility of the other being’s psychological, emotional, and intentional states”(p. 10). Their “Networked Mind Theory” is grounded on three distinct levels of social presence elaborated in their work.

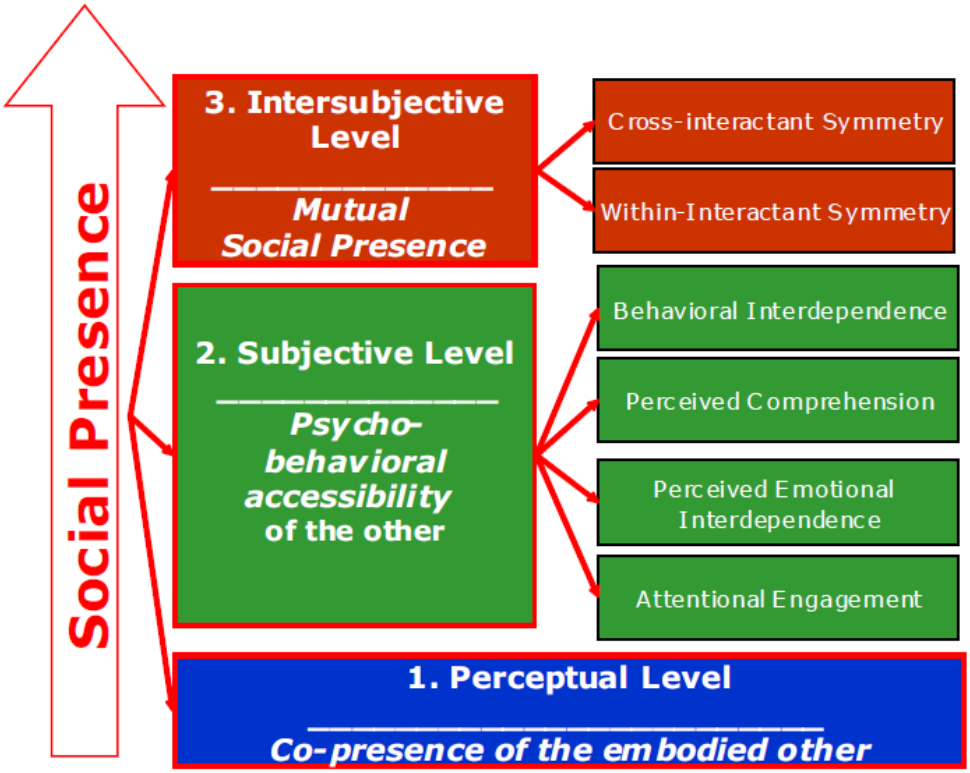


Figure 2.4: Dimension of Social Presence (F. Biocca and Harms 2002)

In figure 2.4, Level 1 described the requirement for the most superficial level of social presence. In this level, the requirement is the detection and awareness of the co-presence of an embodied other via a mediated environment. In this level, even a collection of moving points simulating human motion (Johansson 1976) can be considered as a cue indicating the co-presence of a mediated intelligent body.

Determining whether another body is co-present does not tell much about the behaviour of another. Unlike the first, mostly "perceptual" level, level two comprises the psychobehavioral accessibility to the other's intentional state. After the users (mutually) perceive each other, they simulate the minds of other users to model the emotional states and attention of others. This simulation of the minds can occur in reaction to the

“facial displays” and avatars’/agents’ body movement. As the interaction degree of a communication increases (e.g. through verbal and physical behavior), the automatic process of “reading of other minds” becomes easier.

Finally, the third level (intersubjective level) entails the perceived symmetry between interactants. The symmetry between the user’s sense of social presence and the user’s perception of the other’s sense of social presence (within-interactant symmetry) and also the symmetry between the user’s sense of social presence and the other’s perception of the user’s sense of social presence (cross-interactant symmetry).

In within-interactant symmetry, the subject wants to know if there is a correlation between his/her perception of his/her interaction partner and the partner’s perception of him/her. For example using a smiley in a text chat can clarify that the other partner can understand the subject.

In cross-interactant symmetry, there should be a correlation between the subject’s perception of social presence and the partner’s perception of the subject social presence. This correlation exists when the partner has access to the “subject’s emotional states and intention” (and vice versa) which occurs in higher levels of social presence.

2.3.2.3 Measures of social presence

A comprehensive measure of social presence should not rely upon a vague conceptualization. Since the definitions vary and are even contradictory in some cases, there is no widely accepted robust measure of SP in the literature. Due to the wide

range of proposed measures, I focus my attention to the more cited and related indicators.

Although social presence is a psychological concept as described above, very little effort was spent on an explicit measure of social presence utilizing psychophysiological indicators such as heart rate, fMRI, etc. This may be due to unidentified social presence dimensions and also difficulty in associating “a consistence psychological signature simply for the presence of another”(F. Biocca et al. 2003b). Articulating these approaches in depth is well beyond the scope of this thesis. However, most researchers have found subjective self-report measures of SP satisfactory enough for their purpose of study.

The most commonly used measure of SP was proposed by Short et al. (1976). In this measure, people are directly asked to judge on the communication medium itself (Table 2.1). Short et al.’s research relies on the subjects’ feeling of the medium’s ability to provide the sense of connectedness to the interaction partner. This measure is argued to be inappropriate for social presence since the respondents are directly asked to judge the ability of the medium instead of the characteristics of the experience (F. Biocca et al. 2003b). Although a large number of researchers are using their measure or a variation on it, in my opinion there are some serious concerns about the usefulness and effectiveness of this approach.

Considering media as an extension of a human’s sensorial apparatus (McLuhan and Lapham 1994), it is very likely that a mediated interaction is influenced by the medium. But if social presence is merely an attitude towards the medium, indirect and problematic self-report judgments may not accurately measure this ability and more

valid measurements are required. Further, the sense of connection with another mind is not dependent on the awareness of media interference and consequently is not fully affected by the medium (K. Nowak 2001). Other measures should be applied if researchers intend to find whether people feel connected to other minds during the interaction instead of asking them to judge the ability of medium in providing such a feeling.

Item
To what extent was this like a face-to-face meeting?, A lot like face to face, not like face to face at all
To what extent was this like you were in the same room with your partner? ,A lot like being in the same room, not like being in the same room at all.
To what extent did your partner seem "real"?, very real, not real at all
How likely is it that you would choose to use this system of interaction for a meeting in which you wanted to persuade others of something?, very likely, not likely at all
To what extent did you feel you could get to know someone that you met only through this system?, very well, not at all

Table 2.1: Short et al. (1976)'s measure of Social Presence

Biocca et al. argued that a more comprehensive measure, based on more effective factors like knowledge of others, content of communication, environment, and social context (F. Biocca et al. 2003b) is needed.

These measures should be carefully applied in the studies of social presence. If these measures lead to the judgments about the feeling of social connectedness, they can be mentioned as part of a social presence study. Alternatively, if they are solely used for a specific social judgment of a part of an interaction, they should not be extended to a social presence study.

In an effort to measure social presence based on the experience other than the judgment of medium, Biocca et. al. (2001) developed a conceptualization and measure of social presence titled *"Networked Mind Measure of Social Presence"* (NMMoSP). They believe that social presence is a part of *"reading mind"* and having access to another mind's knowledge in a social communication interaction. As a process of reading mind, users can socially respond to another mind (or no mind) no matter how the other is represented.

Based on a comprehensive review of the existing theories of social presence, they identified three underlying conceptual dimensions of SP: co-presence, psychological involvement, and behavioral engagement. In their conceptualization, higher social presence is caused by a deep sense of co-presence, psychological involvement, and behavioral engagement. Since the metric measures *"the degree to which individuals feel interconnected to each other through networked telecommunication interfaces"*, they called it *Networked Minds measure of SP* (F. Biocca et al. 2001). This measure tried to address some limitations of previously proposed measure of social presence such as incomprehensiveness and context dependency (F. Biocca, Harms, and Burgoon 2003a) by introducing a theoretical construct incorporating reliability, content and construct validity.

Social presence in games

Despite the numerous research that conflates digital games with other forms of social technology (Selnow 1984; Phillips et al. 1995; Colwell, Grady, and Rhaiti 1995; Stenros, Paavilainen, and Mäyrä 2009) with high potential of social interaction (de Kort et al. 2007), there are few studies investigating the social presence in digital gaming.

Meanwhile, gaming literature associating with social presence rarely applies any methodological approach in measuring social presence.

On the other hand, widely used measures in other contexts are usually inapplicable and inefficient within the context of digital gaming. Almost all proposed measures of social presence are constructed based on theories in a direct communication between two interactors in a mediated environment. de Kort and her colleagues (de Kort et al. 2007) mentioned three major differences between digital gaming and communication technologies which should be considered when applying any current social presence measure to gaming experiences:

1. The majority of digital games are primarily designed for a single user with the opportunity of playing with or against some other players added later on. On the other hand, communication technologies aim to facilitate social interaction between users.

2. Communication technologies are initially intended to transfer the user's thoughts and ideas and then to present a task, whereas in digital games, the task accomplishment is prioritized more highly than the communication part.

3. Digital games are developed to fascinate and engage players. On the other hand, communication technologies are not primarily intended to motivate and fascinate the involved users.

de Kort et. al. (de Kort et al. 2007) developed a Social Presence Gaming Questionnaire (SPGQ) based on the NMMoSP to characterize and measure social presence in game experiences. They have evaluated their measurement on different

genres (such as FPS, RPG, action adventure, sports games) played on PC, a console, or even mobile phones and reached a satisfactory sensitivity and validity.

Their questionnaire (appendix II), inspired by Biocca et. al.'s study (F. Biocca et al. 2001), consists of three subscales: *"Psychological involvement – Empathy"*, *"Psychological involvement – Negative feelings"*, and *"Behavioural involvement"*. However, there are key differences between their questionnaire and the one proposed by Biocca and his collaborators (appendix I). Since the digital games are not primarily designed to transmit any social communication cues and augment the players' awareness of each other, co-presence (simply defined as "sense of being together") was not considered as a separate dimension in SPGQ.

3: RELATED WORK

This chapter discusses the related literature on the influence of avatar realism on social interactions and social presence in online and mobile virtual environments. Further, I present the related studies on location awareness and location privacy particularly in social-driven location-based applications.

3.1 Avatar Realism, Anonymity, and Social Presence

Nowak and Biocca (2007) reported that in term of visual realism, people feel more social presence and co-presence when interacting with more anthropomorphic images. They conducted a between-subject study with 134 undergraduates age 19-33 in which participants verbally interacted with a partner represented by either a female face (high anthropomorphic), a very abstract face with just a mouth and eyes (less anthropomorphic), or no image (Fig. 3.1). Participants could also choose an avatar from a collection of anthropomorphic (3D human face) or low-anthropomorphic (abstract face with eyes and mouth) images no matter they were interacting in high or low-anthropomorphic condition.

The verbal interaction was a simple exchange of information about a scavenger hunt task in which the participant should get to know “their partner who may work with them in the future on a scavenger hunt on the World Wide Web”.

a b c

Figure 3.1: Level of abstraction in avatar realism a) high anthropomorphic b) low anthropomorphic c) no image condition (K. Nowak and F. Biocca 2007)

The conversation was a turn-based speaking session. In all three conditions, participants were hearing a pre-recorded female voice as their virtual communication partner. On participants' turns, they were speaking about their skills followed by pressing a "done" button to indicate the end of conversation.

Nowak and Biocca applied a two-dimension measure of social presence. The first dimension was measuring the perceived ability of medium to connect people based on Short et al. (1976)'s measure of social presence. As the second dimension, they asked whether participants perceived their interaction partners *impersonal*, *personal* and *sociable* or *unsociable*.

Using a quantitative analysis on the participants' answers to their measure of social presence, they found that there was a positive effect of anthropomorphism on social presence and participants reported a lower social presence in the low-anthropomorphic condition.

However, it is not clear whether this finding transfers to other contexts. The study discussed above used anonymous icons as avatars for participants. It is unclear if the

use of real images or videos will result in different findings. In this thesis, I explore this aspect in more detail.

It should be noted that an avatar is considered not only as a means to establish social connections with other people in a shared virtual environment, but also it can mask the visual identity of the communicators. Using a photographic image or video of the communicator as an avatar impairs the role of avatars in preserving anonymity.

Kang et. al. (2008) reported that there is no effect on the anonymity of avatars on copresence in their conducted study. They tested 5 avatar types in terms of visual realism; Non-anonymous condition (including a photographic image of the communication partner) and anonymous condition (including processed images, high humanoid avatar, or low humanoid avatars). Participants underwent a procedure required to disclose personal information to the conversational partner. They found no significant difference of anonymity conditions upon the apparent “co-presence” of involved partners.

In this thesis I look at the influence of using photographic image of a person as his/her avatar in a game (other than a conversation) in a mobile platform (other than a shared virtual environment).

3.2 Location awareness and location privacy

Mobile computing is highly tied to location information (Satyanarayanan 2001). People are widely using their mobile devices to communicate where they are or arrange social activities. The development of location-aware technologies allowed users to automatically share their physical locations with other parties to receive real-time value

added services in close proximity. Location-aware services employ the technologies that can either utilize the position of the device or track the current location of the user. However, users' privacy concerns and usability issues are listed as factors hindering the wide adoption of these services (Barkhuus et al. 2008).

Whilst numerous user studies have been conducted to investigate people's attitude on issues of privacy in online environments, few studies have focused on the influence of privacy in the domain of location-aware computing. Most of the current literature emphasizes the essence of preserving location privacy and provided location-based privacy preserving solutions.

Minch (2004) identified thirteen privacy issues that should be considered when developing location-aware services. However, he did not conduct any studies to explore the effect of enumerated issues on the quality of user's interaction with the service. Duckham and Kulik (2006) discussed some strategies to manage location privacy. Their strategies were mainly technology and regulatory oriented; they rarely discussed the users' attitudes towards location privacy.

Location privacy is even more concerned with location-based social applications. Social applications basically rely on revealing information to strengthen social ties or to establish a more engaging social activity. Hence, it is expected that social location-aware applications are highly based on users' dissemination of location information. On the other hand, location is a sensitive attribute since a person can be easily accessible through his/her current (or past) location information.

Some researchers tried to address this paradox by conducting user experiences on location-based services that focused primarily on privacy issues and social

interactions. Barkhuus et al. (2008) studied a social location-awareness system called "Connecto" in which users were able to either manually or automatically tag their location information and share this tagged data amongst a group of friends. They could blur out their location by choosing a generic name for their current location such as "restaurant". Interestingly enough, no participants expressed any privacy concerns during the interview sessions that occurred after the experiment. It was reported that manual location setting was mainly used to "freeze" location(s) for others. Barkhuus et al. argued that the usefulness of the system might be the reason that no privacy concern was reported even when participants were directly questioned about their privacy. However, their study was aimed for a socially-driven location sharing in a small group.

In an effort to study privacy concerns in location sharing applications that allow users to share their location with a wider range of people, Tang et al. (2010) conducted a similar study. They created hypothetical sharing scenarios for socially-driven (vs. purpose-driven) conditions and asked participants to disclose their locations by using semantic and geographic labels. They observed that most participants were willing to "forego some privacy if there is a clear benefit". However, their findings are limited by the small sample of nine subjects in their experiment. In addition, they also used hypothetical scenarios instead of real conditions which might discredit the ecological validity of their findings.

In addition to literature in social location-sharing applications, there is a growing number of scholars on the location-sharing applications designed for gaming. However,

to my knowledge, there is no prior work specifically focusing on the privacy aspect of location-based games and its influence on social experiences during the game.

One factor that makes location-based games (LBGs) unique is their focus on providing users with the opportunity of playing with or against some other players utilizing location information. However, other types of social location-sharing applications mostly aim to facilitate social interaction between users using location information. Furthermore, it is very likely that players do not know other players before and after their game-play sessions. Conversely, there are other, more intimate types of social applications, where people usually interact with their friends or families. This distinction can be particularly important in studies of location privacy in social location-sharing applications.

Regarding these distinctions between location-based games and other social location-sharing applications and the significance of privacy (and particularly location privacy) in all social location-sharing applications, specific studies should be conducted to explore the potential effects of privacy in the LBGs.

To the current time, there are a few studies regarding the impact of location-awareness on social behaviors within the context of LBG. Of these studies, Nova et al. (2006) explored the effect of disclosing location information on the performance of collaborative tasks in a location-based game. Participants were divided into two groups, one with a location awareness tool by which players could see their teammates' location, and another without any location awareness. With this second group, players could just see their own characters on the map. However, they could still communicate with their teammates through the chat system. Players were asked to find a virtual

object and surround it with a triangle made by the position of each group member. Players in the group who were relying just on the self-reported positioning system were more engaged in communication with each other to express information about their location and their decisions.

Although they did not try to investigate privacy in a location-based game, their findings indicated that revealing location information does not necessarily improve a task performance in a social experience in an LBG. However, it is worth noting that in their experiment, players knew their teammates before the experiment leading to a less concern of privacy.

The other research into LBGs are mostly based on deploying a game for a specific purpose such as education (S. Benford et al. 2004), to show the potential of a specific positioning technologies in designing a game (Drab and Binder 2005), or to propose a principle for designing a more engaging location-based game (Rashid et al. 2006). These studies did not consider the possible effect of the players' feeling of privacy on their social experience during an LBG.

4: THE DESIGN PRINCIPLES OF “CATCH TREASURES”

To explore the influence of privacy on the social experience of the players in a location-based game, I designed a treasure-hunt LBG, called “Catch Treasures” on the iPhone platform. This chapter describes the game and design requirements I made to fulfil the research study requirements.

In section 4.1, I introduce the required features that the “Catch Treasures” should provide in order to address the research purposes of this study. The initial design was tested by conducting a pilot study. Section 4.2 discusses the pilot study and its outcome.

4.1 Game Design

I designed a multi-player location-based game on the iPhone platform. I chose the iPhone for several reasons which I will discuss in section 4.1.4. In designing this game, I started with the following three basic requirements to constrain the design space:

- *Easy to learn:* The game should be as simple as possible so that players do not spend extra time learning the game-play mechanics. On the other hand, these simple mechanics should not hinder players from an engaging gaming experience.

- *Always-on service:* The game should be available all the time and players should be aware of the updated status of other players such as their scores and location.
- *No communication channel:* In order to restrict the analytical bias exclusively towards matters of privacy configuration, no communication facility such as chat-protocols between players should be implemented throughout the game.

For the following subsections, I will explain how these aforementioned principles were addressed.

4.1.1 Treasure hunt location-based games

To keep the game simple, I used a simple treasure hunt mechanic where players are asked to collect as much treasure as they can through navigating in the physical environment and collecting virtual coins distributed on a virtual map mimicking the real physical location of players. In treasure hunt games, a single player or a group of players mostly try to acquire as many points as possible by collecting hidden items (treasures) in the game environment. The game can be played in a real environment, a fully virtual environment or in a combination of both virtual and real environments.

Since locating the treasures (placed in a virtual or physical location) is vital for operation of these games, treasure hunt games have been among the most popular types of location based games. In treasure hunt location based games, the position of a real or a virtual treasure is mapped to a geographical location. The players should find the treasures through their GPS-enabled hand-held devices or any other device capable of getting location information.

Catch Treasures is a multi-player treasure hunt game in which players use their iPhone devices to find and collect the virtual treasures and also to track the other players on the game map.

Similar many other treasure hunt LBGs, Catch Treasures represents the location of treasures and other players as symbols on a geographic map of the game area (Fig. 4.1).

Figure 4.1; A sample screenshot of the Catch Treasures (The rewards are randomly scattered in the environment. To receive each reward, users are required to walk to the location of that reward).

4.1.2 Scoring system

There are three types of rewards considered in the game: positive, negative, and chance-based rewards. All rewards are randomly scattered on the map and the player should walk to the physical location of the virtual elements to receive each reward.

The three virtual elements include:

 *Coin:* Player receives 10 pts by gathering each virtual coin. All coins are shared between all players and located on random places.

 *Bomb:* The bombs are negative rewards which randomly move around the game screen. Players will lose 10 pts in case of collision with any bombs.

 *Magic box:* The magic boxes are chance elements of the game. They can contain either a collection of coins or bombs. It is not possible for the players to know the content of each box unless they reach the location of a placed box. If a player encounters the case that contains the hidden box of bombs, that player loses 50 pts. However, if a player locates a case containing a box of coins, that player receives 50 pts. The magic boxes can act either as positive reinforcement (i.e. when the top player opens a box of coins or the bottom player opens a box of bombs) or as negative reinforcement (i.e. when the top player opens a box of bombs or the bottom player opens a box of coins).

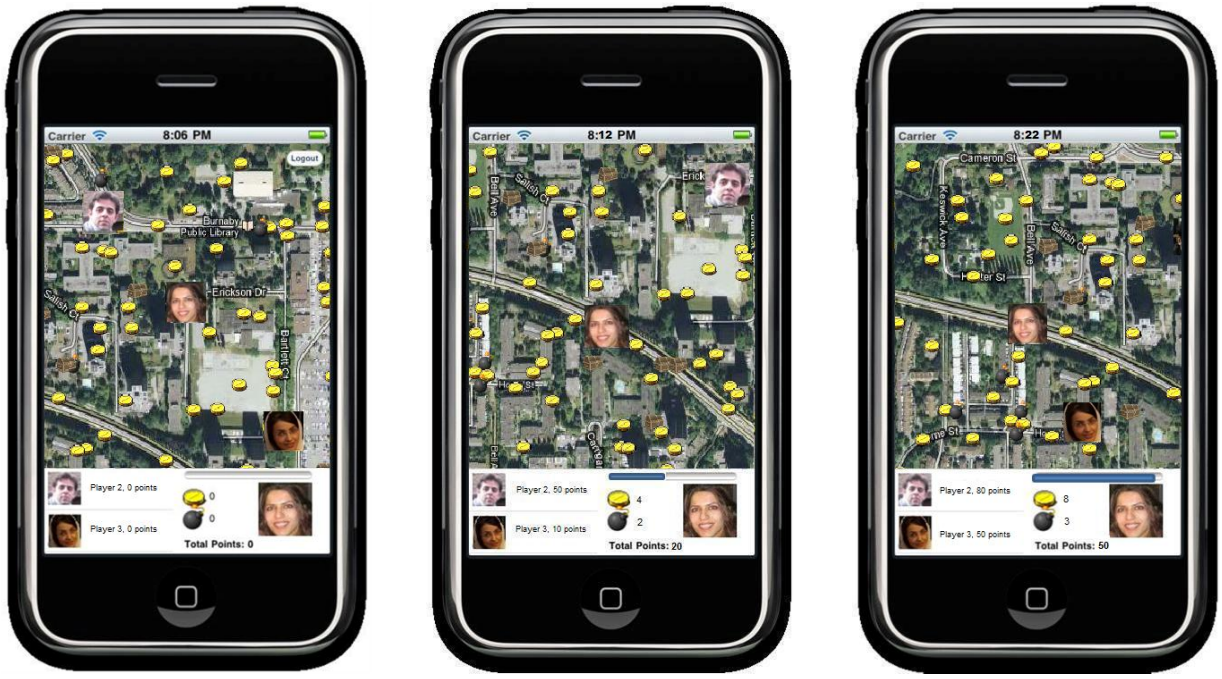
All rewards are randomly scattered on the map and are shared among all players. Therefore, a treasure is removed from the game when collected by a player.

4.1.3 Game progress

Each player is able see the number of collected coins and bombs and the total points (10 pts for each coin and -10 pts for each bomb). Furthermore, each player can see the other players' scores on the screen. Players are also aware of time progressing via the progress bar placed underneath the game map (Fig. 4.2).

Players should walk to the physical location of rewards elements (represented on the map) to capture them and increase their scores. It is worth noting that players are not aware of the content of "magic boxes" until they move to the location of each box. The content of each box (can be a collection of either bombs or coins) will be revealed when captured by a player.

An active player's avatar is always located at the center of screen. As the player moves, the game map also moves to update the current location. However, players are able to zoom in/out and pan the map. These players are aware of the updated location of other players on the map when they are walking in the environment.



a b c

Figure 4.2: The sample game screenshots: a) at the very beginning b) at the middle c) close to the end of the game

4.1.4 Positioning technology

Requiring that the player carries a physical device while exploring this virtual environment, the mobile phone platform was chosen to facilitate the player's movements. Furthermore, mobile phones are the most ubiquitous portable device. In order to obtain the phone's location, the most widely commercialized positioning technology, GPS, was selected. GPSs can provide positional accuracy within 10 meters of a surrounding (open) area (Wing, Eklund, and Kellogg 2005). Ultimately, this GPS implementation was necessary for the purposes of the game.

The game was targeted at the Apple iPhone 3GS platform (running on iOS 3.1 at the time of study) which has a built-in GPS technology. iPhone uses GSM triangulation

and GPS data to precisely locate the user. In addition, iPhone is able to leverage Skyhook technology (MHT, 2008) which utilizes Wifi signals for positioning. Skyhook relies upon a database including the locations of over 23 million access points mostly in North America (MHT, 2008) to roughly position the portable device. The shortcoming of Skyhook technique is its reliance on position of private Wifi antennas which may change during the time.

As a promising combination, the iPhone can provide hybrid positioning (GPS, and Skyhook WPS) resulting in faster and more accurate positioning. This hybrid positioning allows an accurate positioning when a GPS solution might not be available (i.e. inside buildings or underneath thick ceilings).

In order to reach the *"Always-on service"* principle, a hybrid positioning scheme – despite inefficient energy consumption - was applied. It is worth noting that in areas without the Wifi coverage (e.g. far from buildings), GPS data was the only means of positioning.

4.1.5 Multiplayer approach

People perceive a more public medium as less private. Since I was studying the effect of players' privacy concerns on their social experience, the designed game should raise some privacy concerns among players. Therefore, I designed Catch Treasure as a multi-player game. In a multi-player game, users are playing with others. I also manipulated several privacy attributes with respect to seeing the other player. This will hopefully arouse some sense of privacy issues when playing against unknown others.

Although the game was potentially a multi-player game, there was only one active player really playing the game at a time. The other players were actually “fake” players. I decided to use fake players for several reasons, which are summarized as follows:

Possible technical difficulties: Since a central server application was responsible to synchronize the whole game’s data with all players, there was a possibility that low mobile internet connectivity (e.g. in bad weather conditions) can cause either delays in updating the game status or other unexpected problems.

Limited apparatus: If we consider one iPhone device for each participant, then at least three devices will be required in a real multi-player condition (considering three players). However, the only available iPhone for the study was the experimenter’s device.

Possibility of previous familiarly of players with each other: To ensure that the social presence of players can be sufficiently affected during game-play, players should not know each other before the experiment. Otherwise, if the players are aware that they are playing with their friends or known parties, they might feel less concerned about privacy and experience a different type of social presence. Since the participants were mostly undergraduate students studying in the same department, it was highly possible that they had previous social connectedness.

Using fake players (presented through either photo-realistic avatars or red circles), I attempted to avoid such an undesirable scenario. Images of all “fake” players were collected from four graduate students (including two male and two female images) of a different department in a separate campus.

Furthermore, the game was designed such that if the distance between two players (e.g. between the real and the fake player) is less than a minimum distance, the avatar of the opposite player disappears. This approach prevented any potential face-to-face connection which can cause skewed social presence.

The reason that I chose the term “fake players” instead of “non-player characters” (NPCs) was that NPCs are mostly controlled by non-human programs. In the game that I designed, I developed the behaviour of the fake players using human’s behaviours captured through several runs of the game with other humans. Thus, I use the term fake player to denote this type of AI.

In order to simulate the movements of fake players in the experiment (against the actual player), two tested players were asked to play the game alone before the study. The game recorded all of their movements and achievements and replayed these movements in the actual gameplay during participants’ experiments. In all game sessions, fake players had the same movements. The biggest downside of this approach is the possibility that the actual players know that they are playing against non-human entities. This was tested through the interview sessions after the game-play sessions; results showed that participants didn’t know that they were playing against an agent. Thus, showing the believability of the simple AI developed here.

4.2 Pilot Study

I primarily conducted the pilot study to refine the study design for the target participants in the final study. One of the most significant reasons to conduct the pilot study was to realize whether the active players can notice whether the other people

playing simultaneously are actually fake players. It was important that the active players think that they are sharing their personal information with real parties. Meanwhile, the pilot study could help me ensure that all the game requirements are properly addressed.

4.2.1 Participants

I recruited three student participants (two female, one male) for this study. They voluntarily participated in the study. Their age range was 24-27 years. The participants were unaware of the research goals of the study. None of them had any previous experience with any social-drive location-based application before the pilot study.

4.2.2 Procedure

I conducted the pilot study in Fall 2010 on the SFU Burnaby campus. Prior to the experiment, participants filled out the pre-study questionnaire (appendix III) asking about their previous gaming background, previous experience with any location-based services, and their usage frequency of any social network.

They separately played Catch Treasures for about 15 minutes against two other fake players. During the game, the experimenter was following each participant to ensure their safety and observe their game-play.

After the game was over, participants filled out a post-questionnaire (appendix IV) measuring the social presence they perceived during the game. In addition I asked the participants for an informal interview session about their experience during the game, whether they noticed that they were playing against fake players, and the possible improvements for the future version of the game.

I received the following feedback. It should be noted that this feedback is collected through both observation and the post-session interview:

- None of them noticed that they were playing against fake players. They were shocked when they were told the truth in the interview session.
- I observed that the 15 minute gameplay was not adequate for players to actually enjoy playing the game. The subjects spent the first 5 minutes of the game understanding the navigation strategy in the real environment while looking at the virtual map. Therefore, I decided to increase the gameplay time to 20 minutes for the final experiment.
- I also found that although a hybrid map (a satellite map indicating the names of streets and buildings) was used to help navigation, participants were still experiencing difficulties in finding their direction on the map. So, in the final version of the game, a compass button was added in order to help players find the direction they were heading.
- Two players were totally disappointed when they opened a box of bombs and lost 50 pts. One of the participants ended the game with a negative score as a result of opening two boxes of bombs. Thus, I found out that 5 bombs may be too severe punishment and decided to decrease the number of bombs per box. I also decided to increase the overall number of coins on the map.
- In one case, the subject had a problem understanding the actual meaning of some words in the social presence questionnaire. To avoid any

misunderstanding, the definitions of the most troublesome words were included aside the corresponding question.

4.3 Summary of design decisions

To summarize the final design decisions, the list of game features are organized regarding to design principles mentioned in section 4.1:

Easy to learn: The very basic game mechanics as well as simple design allows players to quickly learn how to play the game. The game is designed so that the amount of user interaction with the game is limited to the times when the player wants to use compass or to zoom/pan the game map. Even without these simple operations, a player can still play the entire game. Furthermore, the compass capability combined the hybrid map considerably helps players navigate in the environment to achieve rewards.

Always-on service: The hybrid positioning approach provides a fast and highly accurate positioning mechanism to locate the actual player on the map. In addition, the fake player approach removed the connectivity and synchronization barriers resulting in an almost 100% of availability of service during the game. As a promising result from the pilot study, I found out that the time limit for updating the player's position on the map is less than 10 seconds.

No communication channel: As previously mentioned, there is no chance of communication (face-to-face or by using any messaging service) for players in the game.

5: METHODOLOGY AND EXPERIMENTAL DESIGN

This study used a between-subject experimental design with the manipulation of two attributes in regards to privacy. The first was “avatar realism” with two levels; whether players were presented through a photo-realistic avatars or simple circles. The second is “location awareness” which was manipulated through two conditions where players could either see or not see the exact physical location of other players on their mobile phones.

After the pilot study introduced in previous chapter, I identified and addressed the major game design drawbacks. Thus, I iterated the game’s design. Based on this revised game, I then conducted the final experiment which will be discussed in Section 5.1. In section 5.2 the approaches to collect the experimental data are briefly discussed.

5.1 Final Study

After revising the game and the questionnaires through the pilot study, the final experiment was conducted to investigate the effects of different privacy configurations on players’ social presence.

5.1.1 Participants

28 students (aged between 19 and 30 years old) participated in the experiment. One participant accidentally logged out the game during his play session and could not finish the experiment so his data was excluded from the analysis. Thus, I only had 27 participants for this study. Participants were recruited from a participant pool and

received course credit as an appreciation for their participation. Twelve subjects (44% of participants) were familiar with at least one social-driven location-based service (Facebook Places, Google Latitude, or Foursquare). There was also one person who had previous experience with a location-based game (Geocaching).

5.1.2 Groups of privacy

I implemented four different privacy conditions in the studied game. The privacy categorization depended on whether players were able either to locate other players or to see their iconic images on the map. These conditions are as follows (sample screenshots of the game in each privacy condition present the distinction between the applied privacy configurations (Fig. 5.1)):

- ***Avatar-realism, Location-awareness*** **(AL)**: considered as the least private situation, people could see both the physical location of other players and their facial image. Seven participants were assigned to this group, however, one subject accidentally left the game before the end of the game-session.
- ***Avatar-realism, No location-awareness*** **(AN):** players could just see the real image of other players on a separate panel in the left-bottom corner of screen. Players were not aware of another player's location on the map. Six subjects were assigned to this privacy group.
- **"No *avatar-realism, Location-awareness"* (NL)**: a player could see the location of other players on the map. However, other players were

represented by a small red circle instead of a static image. This group contained eight participants..

- **No *avatar-realism, No location-awareness* (NN):** has the least amount of information sharing. This was because players were left unaware of another players' location and their associated images. The small red circles on the left bottom corner of the screen represented those other players their corresponding total scores. Seven participants were playing in this category.

5.1.3 Procedure

A week before the experiment, participants were asked to email the experimenter an iconic image of themselves showing their distinguishable face so that this image could be imported directly into the game as their avatar icon. Before the experiment day, participant's name, image, and the assigned user ID and privacy group were imported to the game.

The experimenter met each participant in front of the campus library which was the start point of the game. Participants signed the consent form and completed a five-minute questionnaire (appendix III) regarding their demographic information and previous gaming background (see section 5.2 for more details). Afterwards, they received their user ID to log in the game. They were also given instructions about the game-play and the goals which they should accomplish to win the game.

AL

AN

NL

NN

Figure 5.1: Privacy configurations of the game

As mentioned in the previous chapter, “Catch Treasure” was a simple treasure hunting game in which players should collect as many virtual coins as they could during the game. The player with the highest score was considered to be the winner of the game.

Once the player logged in the game with their previously disclosed ID, s/he was assigned to one of these privacy conditions. Depending on the privacy-category assigned to the participants, they could see a screen very similar to one of the conditions in figure 5.1.

The experimenter was virtually following subjects during the game to ensure their safety and to prevent any external distractions from occurring during game-play. The experiment was conducted on SFU Burnaby campus and took about 45 minutes including the 20 minute game-play. After finishing the game, subjects were asked to complete a post-study questionnaire measuring social presence and asking about their experiences during the game.

5.2 Methodology and Instrument

In order to explore the effect of different privacy configurations on social presence, a valid measure of social presence is required. In the following subsection, I present the questionnaire which I finally applied in this study to measure social presence.

5.2.1 Measures of social presence

Biocca et al. (2001) developed a validated questionnaire based on their theory of social presence (appendix I) which has been a basis for many other social presence

studies. In this study, I used the social presence gaming questionnaire developed by de Kort et al. (2007) which is inspired by Biocca et al. (2001)'s measure of social presence. de Kort et al.'s questionnaire is available at appendix II.

5.2.2 Questionnaires

Pre-Questionnaire: The pre-questionnaire that each subject completed before the experiment contained questions mostly about:

- Previous gaming background
- Use of social networks and policies in sharing information
- Previous background in using location-based services

These questions helped me find any possible influence of the participant's background upon their social presence and experience during the game. The complete list of questions is available in Appendix III.

Post-questionnaire: A twenty-one item Likert-type scale was adopted from de Kort et al. (2007)'s questionnaire of social presence with 5-point metric for items (0 = Strongly disagree to 4 = Strongly agree) to measure the social presence of players. In addition to the social presence questionnaire, my post-questionnaire contained one-item question about the participants' preferred [privacy] configuration of the game and another question asking their desire to play the game again. Further, participants shared their opinions about the game and the possible improvement in the game design. The complete list of questions is available in Appendix IV.

6: DATA ANALYSIS AND RESULTS

This chapter describes the outcome of the final study. In Section 6.1, I demonstrate the findings of players' social presence through different privacy configurations. Finally, in Section 6.2, players' preferences and attitudes towards the game and the experimental design are presented.

6.1 The Influence of Privacy Configurations on Social Presence

As mentioned in the previous chapter, there were four groups of privacy depending on levels of "Avatar Realism" and "Location Awareness":

- Players were able to see both photo-realistic avatars and physical locations of other players on the map (*AL*, least level of privacy).
- Players were only able to see the photo-realistic avatars of other players. These players were not aware of the other players' physical locations (*AN*, medium level of privacy).
- Players were able to see just the physical locations other players. Players were represented as avatars that resembled small circles (*NL*, medium level of privacy).
- Players could see neither the photo-realistic avatars nor the physical location of other players (*NN*, highest level of privacy).

The players' social presence measured by participants' answers to the social presence for gaming questionnaire de Kort et.al. (2007) is demonstrated in figure 6.1.

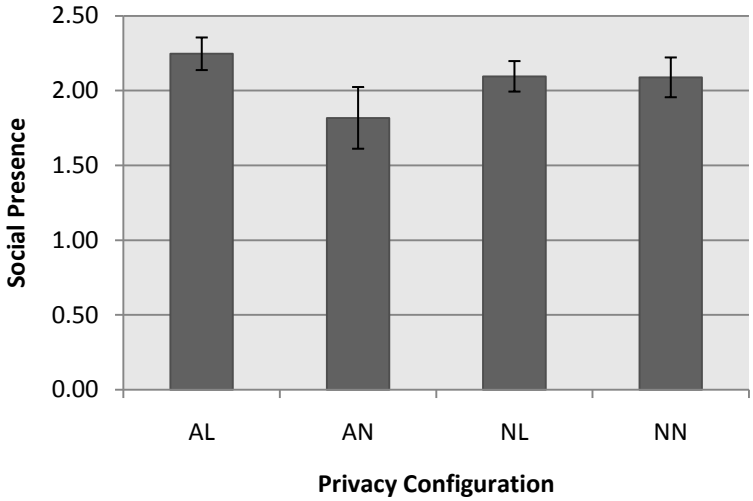


Figure 6.1; The perceived social presence of players in each privacy configuration

The social presence varies from 0 (very low) to 4 (very high) in this measurement. The results indicate that participants did not perceive high (close to 4) social presence in any condition during the game. Participants averagely reported 2.25 (out of 4 as the highest score of social presence) in AL condition, 1.82 in AN condition, 2.10 in NL condition, and finally 2.09 in NN condition.

The one-way ANOVA conducted for privacy configurations indicated **no significant** effect of factor "Privacy Configuration" on "Social Presence".

Investigating de Kort et.al. (2007)'s measures in more detail revealed interesting findings. According to de Kort et al.'s instrument, social presence consists of three components: Psychological involvement components including Empathy and Negative feelings and Behavioral involvement components. Figure 6.2 demonstrates the effect of privacy configurations on components of social presence.

To test for any effect of privacy configuration on each component of social presence, an ANOVA test with privacy configuration as the between subject variable was performed separately on each component of social presence.

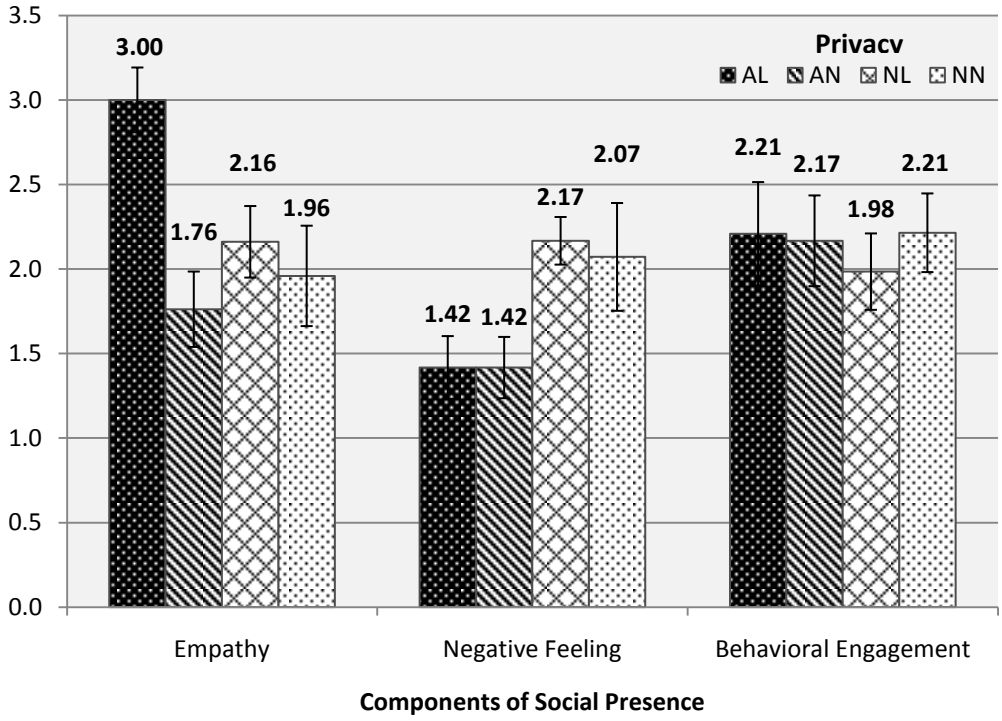


Figure 6.2: Effect of privacy configuration on the components of social presence. The score of each component can vary between 0 (very low) and 4 (very high) depending on participants' answers.

6.1.1 Empathy

The ANOVA test indicated a significant effect of privacy configuration on Empathy ($F=4.592$ $p=.012 < .05$). The post-hoc analysis on privacy configurations using Tukey α statistics indicated significant differences between AL and AN conditions ($p= .012 < .05$) and between AL and NN conditions ($p=.031 < .05$). The findings suggest that players with the least private conditions had more empathy towards other players during the game-play session.

6.1.2 Negative Feelings

Since there was a violation of the assumption of homogeneity of variances (see table 6.1), a traditional ANOVA cannot determine any significant difference between privacy configurations. Instead, I used the Welch test which indicated a significant difference ($p = .008 < .05$) between configurations of privacy (table 6.2). The post-hoc analysis using Games-Howell test also showed a significant difference between AL and NL conditions ($p = .039 < .05$) and also between AN and NL conditions ($p = .007 < .05$). Results suggest that photo-realistic avatars may decrease the negative feelings of players towards other players in the tested game.

Negative

Levene Statistic	df1	df2	Sig.
3.042	3	23	.049

Table 6.1: The test of homogeneity of variance rejects the hypothesis that the variances are equal ($p < .05$). Therefore, ANOVA analysis is not suggested for statistically comparing the groups of privacy.

Negative

	Statistic[a]	df1	df2	Sig.
Welch	6.373	3	12.202	.008

a. Asymptotically F distributed.

Table 6.2: The Welch test indicated a main effect of privacy configurations on negative feelings

6.1.3 Behavioral Engagement

The ANOVA test on “behavioral engagement” indicated no significant effect of privacy configuration on this component ($F = .193$, $p = .900$) suggesting that aspects of

behavioral engagement were not significantly affected by the applied privacy configurations.

6.2 User Preferences

In the post-study questionnaire, participants were asked to choose their preferred [privacy] condition to play the game. The results of players' preferences are represented in figure 6.3. As indicated, 85 percents of participants (23 out of 27) preferred either the AL or NL condition in which they were sharing their location with other players and were also able to track the other players on the game map. The result suggests that participants were willing to share more location information during their gameplay session to be able to locate other players on the map.

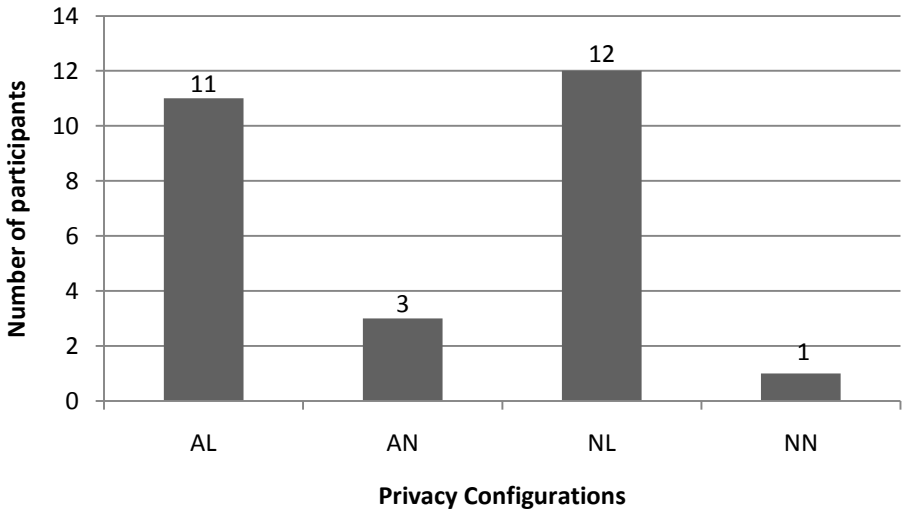


Figure 6.3: Participants' preferred game-playing condition

6.3 Players' engagement

In addition to privacy conditions, participants were asked about their desire to play the game again. Surprisingly, all of participants showed an interest in playing the

game for a second time. However, 22 percent of players preferred to play the game in a better weather condition and 19 percent reported other reasons as their preferred conditions to play the game at another time (Fig. 6.4).

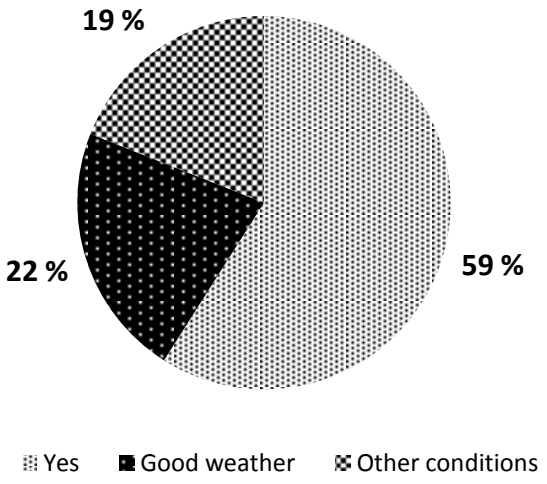


Figure 6.4: The participants' desire to play the tested game for another time

The other mentioned conditions by participants included:

- When new features such as a chat communication system are added (3 participants).
- If the game is played in a different location (one person).
- If a user is playing against friends instead of unknown people (one person).

6.4 Experimental Observations

Since avatars of other players' disappeared on the game map when the distance of players fell behind 150 meter, theoretically, there was no chance for players to meet each other during the game (it is worth noting that as mentioned before other players were fake).

Whilst the fake players' paths were chosen with the least possibility of collision with the actual players' path, the experimental observation showed that other players (except one) were not also eager to choose a path close to other players.

7: DISCUSSION

My main research goal was to investigate the influence of two defined attributes of privacy: location awareness and avatar realism, on perceived social presence in a location-based mobile game. The previous chapter presented the quantitative analysis of the study I conducted. In this chapter, I discuss and reflect on the findings in detail.

7.1 Privacy and Social Presence

Social presence is highly dependent on social cues in the social experience. Lack of communication channels (either verbal or non-verbal) can erode social presence. One of the potential benefits of using avatars in mediated environments is to convey social cues and reduce uncertainty in interactions (K. Nowak 2000). However, understanding how people perceive them is not quite addressed in the literature.

It is argued that people may evaluate a person based on the physical representation of his/her avatar (Rauh, Polonsky, and Buck 2004) to decrease the uncertainty in an interaction. This suggests that using more anthropomorphic avatars can lead to greater social presence in an interaction (Kristine L. Nowak and Frank Biocca 2003).

In the study, using the photographic images of the participants, as their avatars, did not significantly affect their perceived social presence. My findings also indicated relatively low social presence in all conditions even in presence of photo-realistic avatars.

This can be explained by lack of implemented interpersonal communication channels such as a chat system in the game. I deliberately did not include any communication facility for the players in the game to ensure that social presence is mostly affected by the applied configurations during the game. The only available social cues for participants were the players' static avatars on the screen and/or their movements. However, those avatars were unable to interact with the other players' avatars during the game.

In the absence of any social feedback among players, a possible discrepancy between the high expectation of a person from the realistic avatars and their low social cues can disappoint the user (Hindmarsh et al. 2001) and decrease social presence.

In addition, players had no prior knowledge about other players involved in the game which might lead to the low amount of perceived social presence. It has been argued that lack of previous familiarity of participants with other involved people in a social task can lead to the less social presence (Tu 2002a) in online environment.

As previously mentioned, in the high avatar realism condition in the experimental game, I used the facial images of the players as their avatars. One might expect the higher social presence and less uncertainty in presence of more realistic avatars. Alternatively, revealing participants' real identities through using real images could raise privacy concerns leading to decreased interest in establishing more social engagement.

However, social presence is a multi-dimensional concept without a widely accepted definition; thereby, a comprehensive understanding of the impacts on social presence cannot be simply derived by few potential factors, communication channel and avatar realism in this context. To further explore the possible influence of the applied

privacy configurations on players' social presence, I investigate the effect of each configuration on the subscales of the applied measure of social presence.

7.1.1 Empathy

Empathy is considered one of the two psychological scales of social presence (along with negative feelings) in the de Kort et al. (2007)'s measure. They described empathy as the *"positively toned emotions towards co-players"* (p. 7).

The findings of my study indicated positive effect of the least privacy condition (AL) in which players were sharing both their physical location and photo-realistic avatars in the game-play session. This could be explained by the mutual trust between the players as a result of revealing more information by other players. It is been demonstrated that revealing more personal information can lead to decreased uncertainty in mediated communications resulting in mutual trust. However, the results suggest that empathy (as one of the scales of the social presence measure) can be affected when both location and appearance information are revealed.

7.1.2 Negative Feeling

Findings of my experiment also indicated a negative impact of "Avatar realism" on negative feelings of players during the game. Participants who were aware of other players' photographic images (AL and AN conditions) reported the least amount of negative feelings regardless of their awareness of other players' location.

Surprisingly enough, the results showed the potential effect of revealing location information on empathy (positive feelings) while the negative feelings of the players were not significantly affected by revealing location information.

These results are virtually consistent with findings that people playing against a *"locally co-present other"* reported higher empathy than those playing against a mediated opponent (de Kort et al. 2007). Interestingly, they also found that negative feelings were not significantly affected by physical distance.

It should be noted, that by locally co-present players (vs. mediated players), they meant players sharing the same physical location with the possible chance of mutual eye-contact and emotionally communicative signals. Players in a location-based game are between these two extremes. They play in a mediated environment, but on the other hand, in a shared physical (and virtual) environment. This particular characteristic makes LBG experience distinct from gaming experiences in either virtual or physical presence of co-players

However, articulating the effective factors on empathy and negative feelings in further depth calls for more research and is well beyond the scope of this thesis.

7.1.3 Behavioral involvement

Biocca et al. (2001) define behavioral engagement as *"The degree to which the observer believes his/her actions are interdependent, connected to, or responsive to the other and the perceived responsiveness of the other to the observer's actions."* (p. 2). Behavioral engagement is considered in higher levels of social presence where *"actions are linked, reactive, and interdependent"* (F. Biocca, Harms, and Gregg 2001, p. 2). Behavioral involvement in measure of social presence in gaming describes *"the degree to which players feel their actions to be dependent on their co-players actions"* (de Kort et al. 2007, p. 7). Therefore, it is well expected that in the absence of active social

verbal/non-verbal interpersonal communication in the tested game, behavioral involvement is hardly affected.

7.2 User Preference

In previous works, people reported to have more concerns with privacy in location-tracking services compared to position-based ones (Barkhuus and Dey 2003). Conversely, in my experiment setup, players were positive towards constantly sharing their locations during the game. Figure 6.3 indicates that around 85% of the participants preferred to play in the conditions where all players were aware of other players' locations. Although, one might argue that the players just participated in one privacy condition and their comments on the other conditions were not valid, I believe that the description of each privacy condition was clear enough for participants to imagine the game in other conditions and decide on their desired condition.

However, one important factor which can contribute to the participants' desire to reveal their location information is the location-sharing context. One significant difference of social applications and games is that in the majority of games, the task accomplishment is prioritized more highly than the communication part. On the other hand, social applications are primarily designed to facilitate social interaction between users. It is likely that players were fascinated and engaged enough in the game tasks such that they were less concerned about social interactions, information sharing, and consequently their privacy during the game. In a competition LBG, players might be more eager in location awareness of other players than making social connections to pre-plan a winning strategy. For instance, imagine a player finds another player very

close to a collection of coins. This situation might motivate the player to open a magic box (chance element) to avoid the possible lost condition.

On the other hand, Barkhuus and Dey (2003) found that people remain willing to use a location based service as long as they consider the service as “useful”. They related the usefulness to the number of daily usage of the service. In my conducted study, all participants indicated their desire (59 percent without any condition) to play the game again. I believe that the novelty of this type of the games as well as the fascinating experience of playing in the real environment motivates participants to play the game in other times. Considering that the high number of using a service or interest in using a service in other times leads to less concerns of privacy during usage, the high willingness of players in sharing their physical location during the game is justified.

7.3 Social Presence Questionnaire

Although de Kort and her colleagues tested their social presence gaming questionnaire on different platforms (PC, console, and mobile) for various game genres (such as first person shooter, action adventure, and strategy), they did not test their questionnaire in a location-based mobile games. Moreover, there are some vague questions in the questionnaire which might require further explanation to the participants.

In order to observe the effect of the problematic questions on the final measure, I removed five questions (1, 2, 3, 7, and 11) from the social presence questionnaire (appendix III) and re-plotted the results. The obtained results were consistent with the

previously gained findings suggesting that those problematic questions are less likely to bias the results.

7.4 Limitations

My goal was to investigate the influence of privacy on the players' perceived social presence in a location-based game. Privacy is a very general concept with diverse aspects in different contexts. I confined the privacy notion to revealing photographic image and location information. However, a comprehensive discussion of people's feeling of privacy is not possible without considering other potentially effective factors such as gender, nationality, and age.

Despite the general focus on social location-sharing services, this thesis particularly explored two aspects of privacy in a location-based game. Although various similarities between social LB services and LBGs can be encountered, the findings of this study might not be directly extensible to other social LB services without further investigations. Meanwhile, my designed game was based on a competition among individual players. Even in the context of LBGs, contrary results might be observed when other possible social interactions such as collaboration among players exist.

In addition, I posited the concept of social presence as the ground to explore the social experience of players during the game; however, social presence might not be the best measurable indicator of the quality of a social experience.

I am aware that a comprehensive understanding of a concept (privacy in LBGs in this context) cannot be inferred by the obtained results from a limited number of participants (28 people) in a specific population (students aged 19-30). However, I

believe that people even in this specific age are still good representatives of potentially social applications and are likely to constitute a considerable portion of active users in future LBGs. As a supporting example, it is worth noting that over half of facebook users in US by 2010 were aged 18-34 (Smith, 2010).

Finally, if people play this game in the real life, different results might be obtained when they play against their friends, or against total strangers. In my experiment participants knew that all players are actually student in the same campus (even fake players' images were images of some students).

8: CONCLUSION

Emergence of location-aware technologies allowed people to share their physical location to receive value-added services or enhance their social connections. The pervasive use of GPS-enabled phones capable of automatically obtaining location-information provided a novel opportunity for digital games to extend their game-playing boundaries outside of cyberspace and into the real world. However, sharing location information with other parties (other players in the context of location-based games) can raise privacy concerns for users.

Most previous studies on location-based services implied that people are concerned about their location privacy and information sharing in social location-based applications (Barkhuus and Dey 2003; Consolvo et al. 2005; Smith et al. 2005). However, few studies empirically explored privacy and its influence on the social experiences in location-based games.

Although location identity is the major privacy element in social-driven location-based services, other factors of identity (such as facial identity) are hugely overlooked in the privacy related literature on location-based applications.

In this thesis, I explored two attributes of privacy, avatar realism and location awareness, in a location-based game and examined their potential impacts on the players' perceived social presence. A location-based game, Catch Treasures, was particularly designed to place participants in different privacy configurations, whether

players shared photographic images (high avatar realism vs. simple circles in low avatar realism) as their avatars or location information (high location-awareness).

The findings indicated that the participants' perceived social presence was not significantly affected by the applied privacy configurations. However, the results showed that players in the least private condition who shared the highest amount of information (their photographic images and the current location) expressed higher empathy towards other players. Further, I found that using photorealistic avatars (figure 4.1) decreased the players' negative feelings regardless of their location sharing condition.

Another important finding from the observed data was the players' interest in active location sharing. Participants desired to share their real-time location and also to be able to track other players during the game. It might suggest that people are willing to sacrifice their location privacy during their game-play in a short-time location-based game.

Despite the limitations mentioned in the previous studies, my findings indicate that the potential enthusiasm towards game-play in an LBG might lessen the privacy concerns of players particularly in terms of location privacy. Furthermore, this study implies that the mere sharing more personal information cannot enhance the potential social connectedness among players.

8.1 Implications and Future Directions

This research adds to the growing knowledge of the impact of privacy on users' social experience in social-driven location-sharing applications, particularly multi-player location-based games. From the findings of this research, I speculate that an engaging

location-based game can decrease the users' concern of privacy leading to more popularity of the game. this suggests that location-based game designers should put more effort on the design of the game to make it more exciting for the players and consequently to lessen the users' concern of privacy.

Further, the results implied that sharing more personal information leads to players' more empathy and less negative feelings towards other players. This finding suggests that the location-based game designers should prepare a mechanism in their games to motivate people to share their personal information without the high concern of privacy. If players feel safe when sharing personal information, they may enjoy playing the game without worrying about the side effect of information sharing.

On the other hand, if an LBG is primarily designed as the leverage to enhance social connections between players, aspects other than the game design such as communication facilities among players should also be considered. However, further research is required to investigate factors other than amount of information sharing that can noticeably affect players' social experience.

Exploring the impacts of other aspects of privacy such as gender, nationality, and age on social experience among the players in a location-based game is a future research priority. To reach this goal, a larger number of participants with diverse demographic should be recruited.

Future studies should also focus on more socially-driven tasks such as collaboration in various situations, for example, when the players are playing against friends, family members, or unknown parties either in real-time short game sessions or in wider time-span sessions.

In addition to questionnaires, the players' movements should be logged in future studies to observe any possible behavioral patterns of players in different situations.

APPENDICES

Appendix I: Networked Mind Measure of Social Presence

Co-presence
Isolation/aloneness
I often felt as if I was all alone I think the other individual often felt alone.
Mutual Awareness
I hardly noticed another individual. The other individual didn't notice me in the room. I was often aware of others in the environment. Others were often aware of me in the room. I think the other individual often felt alone. I often felt as if I was all alone.
Attentional Allocation
I sometimes pretended to pay attention to the other individual. The other individual sometimes pretended to pay attention to me. The other individual paid close attention to me I paid close attention to the other individual. My partner was easily distracted when other things were going on around us. I was easily distracted when other things were going on around me. The other individual tended to ignore me. I tended to ignore the other individual.
Psychological Involvement
Empathy
When I was happy, the other was happy. When the other was happy, I was happy. The other individual was influenced by my moods. I was influenced by my partner's moods. The other's mood did NOT affect my mood / emotional-state. My mood did NOT affect the other's mood / emotional-state.

Mutual Understanding
My opinions were clear to the other. The opinions of the other were clear. My thoughts were clear to my partner. The other individual's thoughts were clear to me. The other understood what I meant. I understood what the other meant.
Behavioral Engagement
Behavioral Interdependence
My actions were dependent on the other's actions. The other's actions were dependent on my actions. My behavior was in direct response to the other's behavior. The behavior of the other was I direct response to my behavior. What the other did affected what I did. What I did affected what the other did.
Mutual Assistance
My partner did not help me very much. My partner worked with me to complete the task. I worked with the other individual to complete the task.
Dependent Action
The other could not act without me. I could not act with the other.

Appendix II: Social Presence for Gaming Questionnaire

Psychological involvement – Empathy
- When the others were happy, I was happy - When I was happy, the others were happy - I empathized with the other(s) - I felt connected to the other(s) - I admired the other(s) - I found it enjoyable to be with the other(s) - I sympathized with the other(s)
Psychological involvement – Negative Feelings
- I tended to ignore the other - The other tended to ignore me - I felt revengeful - I felt malicious delight - I felt jealous of the other - I envied the other
Behavioral Engagement
- My actions depended on the other's actions - The other's actions were dependent on my actions - What the others did affected what I did - What I did affected what the other did - The other paid close attention to me - I paid close attention to the other - My intentions were clear to the other - The other's intentions were clear to me

Appendix III: The Pre-Questionnaire

Please read each question carefully and answer as accurately as possible. If you have any questions, please ask the experimenter. Please highlight or write the answers.

Participant ID: _____

1. Gender:

A. Male *B. Female*

2. Age:

A. Under 21 *B. 21-25* *C. 25-30* *D. 31-35* *E. Above 35*

4. How often do you work with a computer? (per week)

A. Less than 3 hrs *B. 3-8 hrs* *C. 8-12hrs* *D. 12-16hrs*
E. More than 16 hrs

5. How often do you use a social network per week? (Facebook, Twitter, etc.)

A. Almost never *B.Less than 3hrs* *C. 3-5 hrs* *D. More than 5hrs*

If your answer is B,C, or D, please specify the name of social network you use: …….

6. How often do you update your profile on any social network? (like changing status, profile picture, commenting on other posts, sharing a video, posting a message,….)

A. Almost never *B.Very rare* *C. Occasionally* *D. Almost in every visit*

7. How strict are you in accepting friend requests on social networks?

A. I accept almost every friend request

B. I accept if the person has some friends in common with me even if I haven't met him/her

C. I accept if I have met that person before.

D. Any other policy, please specify……..

8. How often do you share a picture of yourself on the social network?

A. Almost never *B. Occasionally* *C. Every Week*

9. How many hours do you usually spend per week for playing a social network game?

A. Almost never *B.Less than 1hrs* *C. 1-3 hrs* *D. More than 3hrs*

Please specify your most favorite social network game……..

10. Do you consider yourself to be an active video game player? (Yes/No)

I consider myself:

A) A non-video game player *B) A novice video game player*

C) An occasional video game player *D) A frequent video game player*

E) An expert video game player

11. During an average week, how many hours do you spend playing video games?

A. Almost never *B.Less than 3hrs* *C. 3-5 hrs* *D. More than 5hrs*

12. How do you typically play? (check all that apply)

a) Single player Alone *B) Single player with others in the room*

C) Multiplayer in the same room Co-operative *D) Multiplayer in the same room Competitive*

E) Multiplayer on the internet Co-operative *F) Multiplayer on the internet Competitive*

13. Do you own a cell-phone?

If yes, please specify what kinds of action you usually do with your phone? (circle all that apply)

A. Playing Games Never Very rare Occasionally Often

B. Online Social Networking Never Very rare Occasionally Often

C. Checking emails Never Very rare Occasionally Often

D. Browsing Internet Never Very rare Occasionally Often

14. What type of a portable device do you usually use for playing a game? (If applicable)

A. Smart phone *B. Regular cell-phone* *C. PSP* *D. DS* *E. Other, Please specify……*

15. Have you played any location-based game before? If yes please specify……..

16. Have you used any of the following services? (Please circle all that apply)

A. Facebook Places B. Google Latitude C. Foursquare

16. To what extend are you familiar with Online “Google Maps”(like finding your address, direction, zooming, panning) ? *Not at all 1 2 3 4 5 Very much*

Appendix III: The Post-Questionnaire

Participant ID: ----------

Please read each question carefully and answer as accurately as possible. If you have any questions, please ask the experimenter. Please highlight or write the answers.

Questionnaire 1 – SP Measure

1. When the others were happy, I was happy

Strongly Disagree 0 1 2 3 4 Strongly Agree

2. When I was happy, the others were happy

Strongly Disagree 0 1 2 3 4 Strongly Agree

3. I empathized with(understood the feelings of) the other(s)

Strongly Disagree 0 1 2 3 4 Strongly Agree

4. I felt connected to the other(s)

Strongly Disagree 0 1 2 3 4 Strongly Agree

5. I admired the other(s)

Strongly Disagree 0 1 2 3 4 Strongly Agree

6. I found it enjoyable to be with the other(s)

Strongly Disagree 0 1 2 3 4 Strongly Agree

7. I sympathized(shared feelings) with the other(s)

Strongly Disagree 0 1 2 3 4 Strongly Agree

8. I tended to ignore the other

Strongly Disagree 0 1 2 3 4 Strongly Agree

9. The other tended to ignore me

Strongly Disagree 0 1 2 3 4 Strongly Agree

10. I felt revengeful

Strongly Disagree 0 1 2 3 4 Strongly Agree

11. I felt malicious delight (I was happy because of others' failures)

Strongly Disagree 0 1 2 3 4 Strongly Agree

12. I felt jealous of the other

Strongly Disagree 0 1 2 3 4 Strongly Agree

13. I envied the other

Strongly Disagree 0 1 2 3 4 Strongly Agree

14. My actions depended on the other's actions

Strongly Disagree 0 1 2 3 4 Strongly Agree

15. The other's actions were dependent on my actions

Strongly Disagree 0 1 2 3 4 Strongly Agree

16. What the others did affected what I did

Strongly Disagree 0 1 2 3 4 Strongly Agree

17. What I did affected what the other did

Strongly Disagree 0 1 2 3 4 Strongly Agree

18. The other paid close attention to me

Strongly Disagree 0 1 2 3 4 Strongly Agree

19. I paid close attention to the other

Strongly Disagree 0 1 2 3 4 Strongly Agree

20. My intentions were clear to the other

Strongly Disagree 0 1 2 3 4 Strongly Agree

21. The other's intentions were clear to me

Strongly Disagree 0 1 2 3 4 Strongly Agree

Questionnaire II – User experience during the game

1. In which of the following situations do you prefer to play the same game?

A. All players are aware of exact location of other players and they can see the real image of each other.

B. All players are aware of exact location of other players but they can see a circle representing each player.

C. Players do NOT know the exact location of other players (they know that they are in vicinity) but they can see the real image of players in the vicinity.

D. Players do NOT know the exact location of other players (they know that they are in vicinity) and they see just circles representing players.

2. To what extend did you like to meet the other players face-to-face?

Not at all 1 2 3 4 5 6 7 Very much

3. To what extend did you like to make friends with other players?

Not at all 1 2 3 4 5 6 7 Very much

4. What extra features did you expect that were not available during the game?

5. What extra feature do you think should be added to engage and entertain the player more?

6 . What features of the game did you feel that were not required in the game?

7. What difficulties did you experience during the game?

8. Would you like to play the game again?

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