

The Effect of Privacy on Social Presence in Location-based Mobile Games

Pooya Amini Behbahani¹, Magy Seif El-Nasr¹

¹ School of Interactive Arts and Technology, Simon Fraser University, Surrey, Canada
{paa12, magy}@sfu.ca

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, we 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. Our 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

1 Introduction

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. 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 the real world.

Location-based games (LBGs) are in 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 publicized information in above social location-sharing applications can either foster their social connections or is utilized for entertainment purposes. On the other hand, disclosing personal information (including physical location) can raise privacy concerns [3], [7]. 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.

In recent years, there has been an increasing number of scholars investigating location privacy in the domain of location-based services [2], [8], [10], [13]. 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. Surprisingly, there are few studies which empirically examined the effect of users' feeling of location privacy on their experience [3], [8], [19].

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. However, to our 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 is 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 concerns in the LBGs.

In this study, we examined the effect of revealing physical location and users' facial identity on the quality of the experience of playing a location based game. While there have been some studies on location privacy, there is no work, we are 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. We chose social presence as the basis of measuring the quality of social experience in this study.

1.1 Social Presence

The highly credited definition of social presence pioneered by Short et. al. [18] 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 [5] 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" [5]. 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).

Almost all proposed definitions and measures of social presence are constructed based on theories in a direct communication between two interactors in a mediated environment. The question remains to be answered is whether the current measures of social presence can be applied to gaming context. de Kort and her colleagues [12] 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. [12] developed a Social Presence Gaming Questionnaire (SPGQ) based on the Biocca's work [6] 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.

1.2 Avatar and Avatar Realism

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 [1]. Through avatars, people can express their emotions and engage in social activities. People also construct virtual identities by embodying themselves via digital avatars.

There is contradictory literature exploring the influence of anthropomorphic avatars on social interactions. Although Koda and Maes [11] reported that more personified avatars have been rated more engaging and likable, Nowak et. al. [16] showed that people perceived less anthropomorphic images more credible and likeable.

This study 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 study, a more realistic avatar is a realistic 2D image depicted in an icon within a smart phone display.

1.3 Location Awareness and 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. [2] 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. Interestingly enough, no participants expressed any privacy concerns during the interview sessions that occurred after the experiment. 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. [19] 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.

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. [14] 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. 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 [4], to show the potential of a specific positioning technologies in designing a game [9], or to propose a principle for designing a more engaging location-based game [17]. These studies did not consider the possible effect of the players' feeling of privacy on their social experience during an LBG.

2 Method

To explore the influence of privacy on the social experience of the players in a location-based game, we designed a treasure-hunt LBG, called “Catch Treasures” on the iPhone platform.

2.1 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. Participants were recruited from a participant pool and received course credit as an appreciation for their participation.

2.2 Groups of Privacy

We 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:

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.

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.

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.

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.

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.

Since the participants were undergraduate students studying in the same department, it was highly possible that they had previous social connectedness. Therefore, to ensure that the social presence of players can be sufficiently affected by the designed configurations, we decided to use “fake players” competing with our real player.

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 the experiment. The results of a pilot study indicated that players could not notice that they were playing against fake players. Thus, showing the believability of the simple AI developed here.



Fig. 1. Privacy configurations of the game

2.3 Procedure

Participants signed the consent form and completed a five-minute questionnaire about their demographic information and previous gaming background. 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. Players were required to walk to the physical location of rewards elements (represented on the map) to capture them and increase their scores.

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 Fig. 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.

2.4 Measure

In this study, we used the social presence gaming questionnaire developed by de Kort et al. [12] which is inspired by Biocca et al. [6]’s measure of social presence.

3 Results

The players’ social presence measured by participants’ answers to the social presence for gaming questionnaire [12] is demonstrated in Fig. 2.

The social presence varies from 0 (very low) to 4 (very high) in this measurement. The one-way ANOVA conducted for privacy configurations indicated no significant effect of factor “Privacy Configuration” on “Social Presence”.

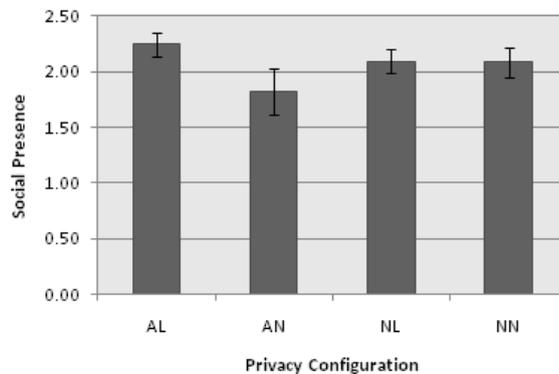


Fig. 2. The perceived social presence of players in each privacy configuration

Investigating de Kort et.al.’s measure [12] 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. Fig. 3 demonstrates the effect of privacy configurations on components of social presence.

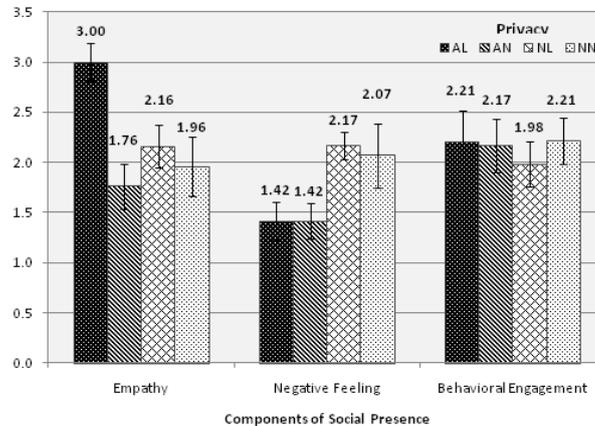


Fig. 3. Effect of privacy configuration on the components of social presence

3.1 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.

3.2 Negative Feelings

Since there was a violation of the assumption of homogeneity of variances a traditional ANOVA cannot determine any significant difference between privacy configurations. Instead, the Welch test indicated a significant difference ($p=.008 < .05$) between configurations of privacy. 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.

3.3 Behavioral Involvement

The ANOVA test on “behavioral involvement” indicated no significant effect of privacy configuration on this component ($F=.193$, $p=.900$) suggesting that aspects of behavioral involvement were not significantly affected by the applied privacy configurations.

In the post-study questionnaire, participants were also asked to choose their preferred [privacy] condition to play the game. The results of players' preferences are represented in Fig. 4. 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 game-play session to be able to locate other players on the map.

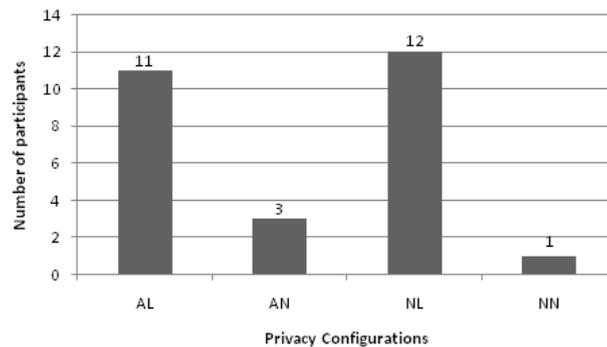


Fig. 4. Participants' preferred game-playing condition

4 Discussion and Conclusion

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 [15]. In this study, using the photographic images of the participants, as their avatars, did not significantly affect their perceived social presence. Our 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. We 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 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 [20] in online environments.

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, we investigate the effect of each configuration on the subscales of the applied measure of social presence.

4.1 Empathy and Negative Feelings

de Kort et al. [12] described empathy as the “positively toned emotions towards co-players” (p. 7). The findings of our 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.

Findings of our 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, 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 [16]. Interestingly, they also found that negative feelings were not significantly affected by physical distance.

Players in a location-based game are between these two environments. 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

4.2 Behavioral Involvement

Behavioral involvement in measure of social presence [12] in gaming describes “the degree to which players feel their actions to be dependent on their co-players actions” (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.

4.3 Privacy Sacrifice

In previous works, people reported to have more concerns with privacy in location-tracking services compared to position-based ones [3]. Conversely, in our experiment setup, players were positive towards constantly sharing their locations during the game. Fig. 4 indicates that around 85% of the participants preferred to play in the conditions where all players were aware of other players' locations.

One important factor which can contribute to the participants' desire to reveal their location information is the location-sharing context. One of the significant differences 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 try different strategies to avoid the possible lost condition.

4.4 Limitations

Despite the general focus on social location-sharing services, this study 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, our 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, we 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.

We are 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, we 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.

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.

Despite the mentioned limitations of this study, our 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. We 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.

References

1. Bailenson, JN., Yee, N., Merget, N., & Schroeder, R. "The Effect of Behavioral Realism and Form Realism of Real-Time Avatar Faces on Verbal Disclosure, Nonverbal Disclosure,

- Emotion Recognition, and Copresence in Dyadic Interaction.” *Presence: Teleoperators and Virtual Environments* 15:359-372 (2006).
2. Barkhuus, L., Brown, B., Bell, M., Sherwood, S., Hall, M., & Chalmers, M. “From awareness to repartee: sharing location within social groups.” Pp. 497–506 in *Proceeding of the twenty-sixth annual SIGCHI conference on Human factors in computing systems*. (2008)
 3. Barkhuus, L., & Dey, A. “Location-based services for mobile telephony: a study of users’ privacy concerns.” Pp. 709–712 in *Proc. Interact*, vol. (2003).
 4. Benford, S., Hull, R., Morrison, J., and Clayton, B. “Savannah: Designing a location-based game simulating lion behaviour.” in *International Conference on Advances in Computer Entertainment Technology* (2004).
 5. Biocca, F., Harms, C., & Burgoon, J. K. “Toward a more robust theory and measure of social presence: Review and suggested criteria.” *Presence: Teleoperators & Virtual Environments* 12:456–480 (2003).
 6. Biocca, F., Harms, C., & Gregg, J. “The networked minds measure of social presence: Pilot test of the factor structure and concurrent validity.” in *4th annual International Workshop on Presence*, Philadelphia, PA (2001).
 7. Culnan, M. J., & Armstrong, P. K. “Information privacy concerns, procedural fairness, and impersonal trust: An empirical investigation.” *Organization Science* 10:104–115 (1999).
 8. Cvrcek, D., Kumpost, M., Matyas, V., & Danezis, G. “A study on the value of location privacy.” Pp. 109–118 in *Proceedings of the 5th ACM workshop on Privacy in electronic society* (2006).
 9. Drab, S. A., & Binder, G. “Spacerace: A Location Based game for mobile phones using Assisted GPS.” in *Workshop on Pervasive Gaming Applications at Pervasive 2005* (2005).
 10. Duckham, M., & Kulik, L. “Location privacy and location-aware computing.” *Dynamic & mobile GIS: investigating change in space and time* 34–51 (2006).
 11. Koda, T., and P. Maes. “Agents with faces: The effect of personification.” Pp. 189–194 in *Robot and Human Communication, 1996.*, 5th IEEE International Workshop on (1996).
 12. de Kort, Y. A.W, IJsselsteijn, W. A., & Poels, K. “Digital games as social presence technology: Development of the Social Presence in Gaming Questionnaire (SPGQ).” Pp. 195–203 in *Proceedings of PRESENCE 2007: The 10th International Workshop on Presence* (2007).
 13. Minch, R. P. “Privacy issues in location-aware mobile devices.” P. 10 in *System Sciences, 2004. Proceedings of the 37th Annual Hawaii International Conference on* (2004).
 14. Nova, N., Girardin, F., Molinari, G., & Dillenbourg, P. “The underwhelming effects of location-awareness of others on collaboration in a pervasive game.” Pp. 224–238 in *Proceeding of the 2006 conference on Cooperative Systems Design: Seamless Integration of Artifacts and Conversations–Enhanced Concepts of Infrastructure for Communication* (2006).
 15. Nowak, K. “The influence of anthropomorphism on mental models of agents and avatars in social virtual environments.” (2000).
 16. Nowak, K. L., & Rauh, C. “The influence of the avatar on online perceptions of anthropomorphism, androgyny, credibility, homophily, and attraction.” *JOURNAL OF COMPUTER MEDIATED COMMUNICATION-ELECTRONIC EDITION-* 11:153(2005).
 17. Rashid, O., Mullins, I., Coulton, P., & Edwards, R. “Extending cyberspace: location based games using cellular phones.” *Computers in Entertainment (CIE)* 4:4–es (2006).
 18. Short, J., Williams, E., & Christie, B. *The social psychology of telecommunications*. John Wiley & Sons (1976).
 19. Tang, K. P, Lin, J., Hong, J.I., Siewiorek, D. P., & Sadeh, N. “Rethinking location sharing: exploring the implications of social-driven vs. purpose-driven location sharing.” Pp. 85–94 in *Proceedings of the 12th ACM international conference on Ubiquitous computing* (2010).
 20. Tu, C. H. “The impacts of text-based CMC on online social presence.” *The journal of interactive online learning* 1:1–24 (2002).