헬스커뮤니케이션연구, 제17권 제2호
Health Communication Research, 2018, Vol. 17, No. 2, 33-67
DOI: 10.24171/hcr.2018.17.2.33.

Co-presence in Gamified Geosocial Mobile Fitness Applications: Its Determinants and Effects on Perceived Support, Exercise Self-Efficacy, and Exercise Adherence

Soela Kim, M.A.*
Research Fellow, Institute of Health Policy & Management,
Seoul National University Medical Research Center

Jeong-Yeob Han, Ph.D.**
Associate Professor, Department of Advertising &
Public Relations,University of Georgia

Despite the popularity of gamified geosocial fitness applications, there are only a few empirical studies examining their effectiveness in promoting physical activity. This study proposes co-presence, which combines spatial and social attributes of presence experience, as a theoretical construct that captures the essence of user engagement with the gamified geosocial mobile fitness applications. Co-presence in this study is defined as a sense of being with competitors (i.e., co-presence with competitors) and/or cooperators (i.e.,

* soelakim@snu.ac.kr, corresponding author
** jeonghan@uga.edu

co-presence with cooperators) in a physically and/or electronically shared space. The current study discusses and examines (1) potential determinants of co-presence and (2) how the two types of co-presence are related to perceived social support, exercise self-efficacy, and exercise adherence. Analyses of data collected through an online survey among gamified geosocial fitness application users showed that a perceived geographical proximity to other social entities with whom users interact through mobile health applications is positively related to both types of co-presence. The results also demonstrated that co-presence with competitors is positively related to exercise self-efficacy and exercise adherence; whereas co-presence with cooperators is only positively related to perceived social support. Implications and direction for future studies are discussed.

Key words : gamified geosocial fitness applications, co-presence, perceived social support, exercise self-efficacy, exercise adherence

1. Co-presence in Gamified Geosocial Mobile Fitness Applications: Its Determinants and Effects on Perceived Support, Exercise Self-Efficacy, and Exercise Adherence

Smartphones penetrate many facets of everyday life, including physical activity. One notable trend in the mobile health application market is gamification. The term “gamification” refers to an incorporation of gaming elements (e.g., goals, rewards, achievement, competition and

collaboration) in non-game contexts to create intrinsically motivating experiences that may translate into longer-term engagement and behavioral efficacy (Deterding, Dixon, Khaled, & Nacke, 2001). The idea of gamifying physical activity is not entirely new. In fact, there exists a fairly extensive body of literature that examines the potential for promoting physical health by incorporating exercise into video games (e.g., Anderson-Hanley, Synder, Nimon, & Arciero, 2011; Rhodes et al., 2017). However, as the vast majority of existing exergame studies devoted their attention to health games that are played on stationary game consoles or desktop computers (e.g., McGloin & Embacher, 2018; Peng & Crouse, 2013; Song, Kim, Tenzek, & Lee, 2010), relatively less is known about the impact of gamified physical activity in mobile environments.

Distinct from non-mobile exergames, many gamified fitness mobile applications have a geosocial feature that combines location-based services with social or multiplayer elements (Boulos, & Yang, 2013). To illustrate this distinctive feature, in the gamified geosocial fitness applications, users' bodies become game controllers; their physical surroundings in the real world (i.e., a familiar local neighborhood) become game maps; and mobile devices carried by the users become as dashboards that support their real-world behaviors with time- and location-relevant information even on their move (Boulos, & Yang, 2013; de Souza e Silva, 2009). By additionally incorporating social or multiplayer elements, the applications create and facilitate social dynamics among users, such as locating and interacting with other users in their immediate geographic location or

artificial social entities (e.g., virtual interactional counterparts) who are electronically nearby. To sum up, gamified geosocial fitness applications often turn the users' physical activity into gameplay that involves a real and/or virtual social interaction in the real world.

Examination of effectiveness of commercial gamified geosocial fitness applications and potential drivers of the effectiveness will be informative to health practitioners who consider implementing practices of commercial mobile health applications to their mobile-based physical activity interventions. However, to our best knowledge, no empirical studies have yet investigated how individuals engage with commercial gamified geosocial fitness applications and how their engagement is related to health outcomes. Although recently an increasing number of studies have begun to investigate the effectiveness of mobile-phone-based health interventions and mobile games developed to promote health behavioral changes (e.g., Leinonen et al., 2017; Whiteley, Brown, Lally, Heck, & van den Berg, 2018), the majority utilized macro behavioral theories such as social cognitive theory and theory of planned behavior or focused on few constructs in those theories (e.g., Koh, Oh, & Mackert, 2017; Payne, Lister, West, & Bernhardt, 2015). That is, it appears that the current literature lacks in an integration of theoretical constructs that specifically address individuals' engagement with gamified geosocial mobile applications.

In an attempt to address the gap in the literature, the present study proposes co-presence, a sense of being together with others social actors in a shared space created by communication technologies (IJsselsteijn &

Riva, 2003), as a construct that best captures individuals' engagement with gamified geosocial fitness applications and therefore could explain how those applications promote users' engagement with physical activity. Based on this broad proposition, this study sets two specific goals: To explore determinants and effects of co-presence in gamified geosocial mobile applications. With these goals in mind, this paper begins with a conceptual discussion and clarification of co-presence, the focal concept of this study, in the context of gamified geosocial mobile fitness applications.

1) Co-presence in the Context of Gamified Geosocial Fitness Mobile Applications

The concept of presence is generally understood as an illusion of non-mediation (Lombard & Ditton, 1997), or a psychological state in which media users feel as if they are being in a mediated environment (Lee, 2004). Particularly, media effect studies have used presence as a lens through which to understand how media facilitate users' enjoyment, involvement, task performance, and social interaction in artificially created media environments. (See, Lombard & Ditton, 1997, for a review of the effects of presence.) Building upon this scholarship, this study views presence as a possible explanation for individuals' playful engagement with another "newer" media, gamified geosocial mobile fitness applications.

Co-presence is often identified as the intersection of two subtypes of presence: spatial presence and social presence (IJsselsteijn & Riva, 2003).

The former refers to a sense of being physically located within a mediated environment (Biocca, 1997) and the latter refers to a sense of another or being with another through medium (Biocca, Harms, & Burgoon, 2003). Co-presence could be, therefore, best defined as a sense of being together with others social actors in a shared space created by communication technologies (IJsselsteijn & Riva, 2003). The current study claims that co-presence, which combines both spatial (or physical) and social attributes of presence experience, is particularly relevant in an environment that is created by gamified geosocial mobile fitness applications. By offering digital stimuli that correspond to the users' real world activities at any moment, gamified geosocial mobile fitness applications transform familiar neighborhoods into game boards in which the users can participate with other real and/or artificial social actors (Boulos, & Yang, 2013; de Souza e Silva, 2009). Through this, it is likely that those applications can generate a sense of being co-located with other social entities in a physically and/or electronically shared space (for a similar discussion, see de Souza e Silva, 2009; Wagner et al., 2009).

The meaning of co-presence in the context of gamified geosocial mobile fitness applications could be further clarified by specifying the social entities with whom users interact through the applications. In this regard, competition and cooperation are known as two fundamental goal structures commonly implemented in multiplayer games (Peng & Crouse, 2013; Peng & Hsieh, 2012). Social entities with whom users interact through gamified geosocial fitness applications could be (a) competitors

who strive to achieve their own goals but not others' and (b) cooperators who work together to reach mutually beneficial goals. Accordingly, the definition of co-presence in the current study is refined as a sense of being co-located either with competitors (i.e., co-presence with competitors) or with cooperators (i.e., co-presence with cooperators) in a physically and/or electronically shared space. The refined definition is beneficial not only because it specifies the characteristics of social entities in the context of gamified geosocial mobile applications, but also because it will allow us to examine the differential predictors and effects of the two types of co-presence on health outcomes.

2) Determinants of Co-presence in Gamified Geosocial Mobile Fitness Applications

In early research on social presence in computer-mediated communication (CMC; e.g., Walther & Burgoon, 1992), CMC was considered to feature a relatively lower level of social presence when compared to face-to-face communication. That is mainly because, limited modalities of communication were assumed to reduce the number and quality of social context cues available to communicators in mediated communication contexts (Sproull & Kiesler, 1986). Later research on presence focused predominantly on examining technological factors in CMC that foster presence experience, such as display characteristics, multimodality, interactivity, and quality of digital stimuli afforded by media (e.g., Bente, Ruggenberg, Kramer, & Eschenburg, 2008; IJsselsteijn

& Riva, 2003; Lombard & Ditton, 1997; Nowak & Biocca, 2003). The assumption underlying this tradition could be that the real world and the mediated world actually exist separately; and all these technological factors ultimately aim to achieve one common goal which is to maximize the fidelity of an artificial environment so that it replaces the real world more completely.

However, the environment created by advanced mobile devices is likely to differ from CMC. The difference may lie in the roles of digital stimuli. As aforementioned, digital stimuli in the context of gamified geosocial mobile fitness applications closely match and therefore are highly relevant to things happening to the users in the real world. Thus, the digital stimuli are more likely to supplement or enhance, rather than to realistically reproduce or naturally replace, the users' real world experience (de Souza e Silva, 2009). Extending this further, it seems reasonable to argue that unlike CMC, gamified geosocial mobile fitness applications accentuate existing social context cues, not necessarily attenuate them.

Given the fundamental difference between the purely-mediated and the mobile-enhanced environments, instead of exploring technological determinants, the current study thus puts its focus on determinants tied to social and geographical distance from other social entities. Each factor is discussed in greater detail below.

(1) Preexisting social relationships

Many geosocial mobile fitness applications allow users electronically

interact not only with strangers or artificial social entities (e.g., virtual opponents) but also with known others. For instance, *Nike+ Running*, one popular mobile fitness application available in the market, has social features that facilitate its users to publish their post-run outputs to online social media on which they casually share their daily activities, interests, and real-life social connections with other people in their preexisting social network. The users can also solicit support and invite their friends to complete a certain running goal together or to join a friendly competition through the online social network. In such instances, a gamified physical activity can be an extension of social activity that occurs within a preexisting network of people.

Previous research provides some evidence that game players' preexisting relationship with their opponents affects the degree of presence they experience. In an experiment conducted by Gajadhar, de Kort, and IJsselsteihn (2008), game players reported more social presence when they played game with friends than with strangers. A similar pattern was also observed for spatial presence, such that game playing against a friend induced spatial presence of the highest degree, followed by playing the same game against another human, and against a computer (Ravaja et al., 2006). Based on these, the first hypothesis is generated:

H1: The more one perceives he or she is interacting with known others, the higher co-presence one experiences.

(2) Perceived geographical proximity between social entities

Geographical distance between communicators has been found to be a

key factor in CMC, according to previous studies. It has been demonstrated that physical proximity between communicators facilitates their online social interaction and improves communication in terms of its quality and frequency (Lowry, Roberts, Romano Jr., Cheney, & Hightower, 2006; Wilson, O'leary, Metiu, & Jett, 2008). Similarly, an experiment by Bradner and Mark (2002) showed that in case of both video conferencing and instant messing, individuals are more persuaded by and cooperated with someone who they believe is in the same city with them compared to someone in a distant city. Drawing upon the empirical evidence, the current study also predicts that when individuals perceive that other social entities are located in their physical vicinity, it may lead to an increase in co-presence. The experiment conducted by Gajadhar et al. (2008) provides the most direct evidence that supports this prediction. Their study showed that playing game against co-located another human induced a greater level of social presence than playing game against another human who is located in a different place. This study, along with other studies on the effects of geographical distance on communication and social interaction in CMC, leads us to believe that mobile health application users' perception of geographical distance from interactional partners could be one prominent predictor of co-presence. Thus, the second hypothesis is put forth:

H2: The more one perceives that his or her interaction counterparts are located in geographical proximity, the higher co-presence one experiences.

3) Effects of Co-presence

The second purpose of the present study is to examine differential effects of different types of co-presence on three outcomes, focusing on two psychosocial (i.e., perceived social support and exercise self-efficacy) and one behavioral (i.e., exercise adherence) outcomes.

(1) Effects on perceived social support

Perceived social support refers to an individual's belief about the availability of others who are willing to provide resources and assistance when he or she needs them (Zimet, Dahlem, Zimet, & Farley, 1988). Recent models of social support emphasize a relational and interactional quality as a potential predictor of one's subjective evaluation of supportive social environments in different health communication contexts, including face-to-face, community-based, and online (for example, see Greene & Magsamen-Conrad, 2010). Unlike competitive social interactions that facilitate individuals' actions in their own self-interest, collaborative interaction involves meaningful social interaction with cooperative others, such as sharing of knowledge and mutual contribution to accomplishing a shared task or goal (Hamalainen, 2008; Morschheuser, Riar, Hamari, & Maedche, 2017). Considering this, it seems reasonable to expect the two types of co-presence to predict perceived social support in opposite directions.

H3a: Co-presence with cooperators positively predicts perceived social support.

H3b: Co-presence with competitors negatively predicts perceived social support.

(2) Effects on exercise self-efficacy and exercise adherence

Exercise self-efficacy refers to individuals' beliefs or convictions in their capabilities to successfully plan and perform a desired physical activity while overcoming barriers (Fletcher & Banasik, 2001). Exercise self-efficacy has been considered as one important variable of interest in physical activity interventions since it can be both a consequence of one's engagement in desired physical activities as well as a predictor of the strength of an individual's commitment to performing physical activities, namely exercise adherence (e.g., McAuley & Blissmer, 2000).

Existing research on multiplayer exergames will shed some lights on how the two different types of co-presence may influence exercise self-efficacy and exercise adherence. The central premise running through the area of exergame research is that exergame fosters intrinsic motivation toward exercise such as enjoyment and positive moods during game play, which leads to increased exercise self-efficacy and exercise adherence (Monedero, Lyons, & O'Gorman, 2015; Rhodes et al., 2017; Song et al., 2010). Also, the presence of a virtual companion during an exercise is shown to enhance exercise performance and enjoyment (Murray, Neumann, Moffitt, & Thomas, 2016). However, evidence regarding the relative effectiveness of competitive and cooperative playing modes remains not only scarce, but also inconclusive. For example, the results of Peng and Crouse's (2013) experimental study indicate that

game players in a competitive exergame mode found the game more enjoyable and more motivating than those in a single player mode or those in a cooperative mode where game players collaborated with another player who was physically nearby. In physical activity interventions of Staiano, Abraham, and Calvert (2012 & 2013), by contrast, the results showed that compared with competitive exergame play, cooperative exergame play produced significantly higher intrinsic motivation to play and self-efficacy.

As the existing evidence does not lead to a clear prediction about differential effects of two types of co-presence, the current study poses the following research question.

RQ: How would the two types of co-presence differently predict exercise self-efficacy and exercise adherence?

2. Methods

1) Procedure

To test the hypotheses, a cross-sectional online-based survey was conducted. On November 2012, we compiled a list of twenty mobile applications that were 1) primarily designed to promote physical activities (e.g., running and bicycling etc.); and 2) equipped with location-based features by reviewing Health/Fitness and Lifestyle categories in Apple iTunes App Store. From February 2nd to March 10th, 2013, a recruiting

message with the link for the online survey was posted in the selected applications' Facebook pages. The same message was also directly sent to individuals who had *Liked* or had left comments on wall-posts of the selected Facebook pages and to Twitter users who were following the selected mobile applications' official Twitter accounts. Additionally, students of a major southeastern university in the U.S. who have used those mobile health applications were also recruited through in-class announcements of introductory communication classes and on-campus flyers. All participants were given an opportunity to enter a drawing for $10 gift card. The student participants from the communication classes received extra credit for their participation. As a result, 273 people completed the online survey. Out of 273 participants, 61 participants who had no experience with mobile health applications were screened through eligibility questions; 22 participants' responses were excluded because they answered all multiple-choice questions with the same answer. This procedure resulted in the final sample of 190 respondents. 73.7 % (N = 140) of respondents were female; and 78.9% (N = 150) were between the age of 18 and 24. Furthermore, about 44% of participant (n = 84) reported that they had been using more than one mobile health application.

2) Measurement

Unless noted otherwise, all items were measured on five-point Likert-type scales ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

Items measuring each of the study variables were averaged to create an index for the variable. Appendix A provides the exact wording of the finalized questionnaire items used to measure determinants of co-presence and co-presence.

(1) Preexisting relationship with other social entities

There was not a scale for measuring the type of relationship individuals have with other social entities in geosocial mobile health applications. Thus, to tap if participants interact with someone whom they already know in real-life via mobile application, this study asked participants to answer three questions such as “Most of the people that I interact with through the apps are my close friends” The authors carefully assessed face validity and content validity of the questionnaire items. Reliability of the three items was respectable. (α = .72, M = 3.18, SD = .99).

(2) Perceived geographical proximity with other social entities

Three questionnaire items were created to assess perceived geographical proximity. The authors assessed face validity and content validity of the items. A sample item included: "When using the application, I have the impression that I could have encountered other users whom I interact with through the app(s) in the real world.” (α = .80, M = 3.16. SD = 1.03).

(3) Co-presence

Due to the lack of literature on co-presence in the context of the study's interest, co-presence items were taken from studies on collaborative or competitive online environments (Curtis & Lawson, 2001; Johnson & Johnson, 2004; Lee, Jeong, Park, & Ryu, 2011) and modified based on the definition of the construct. A sample item measuring co-presence with competitors included: In the course of using the apps, "I have a sense that I was in the same place as the competitors" (α = .76, M = 3.10, SD = .84). A sample item for co-presence with cooperators included: In the course of using the apps, "I have a sense that I was in the same place as the cooperators" (α = .81, M = 3.24, SD = .75).

(4) Perceived social support

Perceived social support was measured by items adapted from the Multidimensional Scale of Perceived Social Support (Zimet, Dahlem, Zimet, & Farley, 1988). A sample items included: "When using the application, there are people who are around when I am in need" (α = .94, M = 3.68, SD = .94).

(5) Exercise self-efficacy

Seven items measuring exercise self-efficacy were adapted from the Physical Activity Self-Efficacy Scale (Bartholomew, Loukas, Jowers, & Allua, 2006). Sample statements include: "When using the application(s), I can be physically active most days" and "…I can be physically active no matter how busy my day is" (α = .77, M = 3.62, SD = .94).

(6) Exercise adherence

To assess participants' exercise adherence, they were asked to report the number of days per week they have done exercise of at least moderate intensity with mobile applications (0 = none; 7 = everyday) (M = 3.52, SD = 1.62).

(7) Control variables

To rule out alternative explanations for observed association between variables of the study's interest, we included socio-demographic variables (i.e., age, gender, education, and income levels) and health-related individual characteristics (i.e., their use of the Internet for health purpose and sedentary lifestyle tendency) as control variables. Additionally, two more control variables are used. The index for participants' use of the Internet for health purpose was created using summative scores for seven binary items asking participants if they had used the internet for several different health purposes in the last 12 months (e.g., "to buy medicine" "to participate in online social support group") (*No* = 0, *Yes* = 1; M = 3.13, SD = 1.60). Further, participants' sedentary lifestyle tendency was measured by asking "how many hours per day, on average, did you sit and watch TV or movie, surf the web, or play computer games?"(1 = *Less than a half hour*; 7 = *Four hours or more*; M = 5.04, SD = 1.60). All the items measuring control variables were adapted from the publicly available HINTS 4 (Cycle 1) survey materials (National Cancer Institute, 2011).

3. Results

First, the current study hypothesized that a preexisting social relationship (H1) and perceived geographical proximity (H2) are positively related to co-presence. Two hierarchical regression analyses were conducted with co-presence with competitors and co-presence with cooperators as outcome variables, respectively. Following control variables entered in the first block, the two proposed determinants were entered.

Table 1. *Hierarchical Regression of Co-presence with Competitor and Co-presence with Cooperator on Proposed Determinants and Control Variables*

Variable Entered	*With Competitors (N = 151)*				*With Cooperators (N = 150)*			
	B	*SE (B)*	*β*	*Δ R^2*	*B*	*SE (B)*	*β*	*Δ R^2*
Step 1				.01				.07
Age	-.03	.08	-.04		-.06	.06	-.08	
Gender	-.13	.15	-.07		.04	.12	-.03	
Edu	-.01	.13	-.01		-.12	.10	-.10	
Income	-.01	.03	-.01		-.04	.02	-.14	
Internet Use	-.01	.04	-.02		-.05	.04	-.12	
Sedentariness	.08	.04	.15		-.01	.03	.03	
Step 2				.17***				.15***
Preexisting Relationship	-.01	.08	-.01		.06	.06	.08	
Proximity	.35	.08	.43**		.23	.06	.34**	

*p <.05, **p <.01, *** p < .001 two-tailed.

None of the control variables significantly predicted the two types of co-presence. After control variables were accounted for, the second set of predictors (i.e., co-presence determinants) explained a significant amount of co-presence with competitors, R^2 change = .17, $F(2, 142) = 14.95$, $p < .001$, and co-presence with cooperators, R^2 change = .15, $F(2, 141) = 13.07$, $p < .001$. However, a preexisting social relationship did not predict both types of presence (co-presence with competitors: $\beta = -.01$, $p = .95$; co-presence with cooperators: $\beta = .08$, $p = .36$). Thus, H1 was not supported. On the other hand, perceived geographical proximity significantly predicted co-presence with competitors ($\beta = .43$, $p < .001$) and co-presence with cooperators ($\beta = .34$, $p < .001$), supporting H2.

H3a predicted a positive relationship between co-presence with cooperators and perceived social support, whereas H3b predicted a negative relationship between co-presence with competitors and perceived social support. Hierarchical regression analysis was conducted to test the two hypotheses. As shown in Table 2, co-presence with cooperators significantly and positively predicted perceived social support ($\beta = .53$, $p < .001$). Thus, H3a received support. However, the relationship between co-presence with competitors and perceived social support was not statistically significant ($\beta = -.02$, $p = .77$). H3b was not supported.

The research question regarding differential effects of the two types of co-presence on exercise self-efficacy and exercise adherence were answered through two hierarchical regression analyses. The results showed that after controlling for control variables and determinant variables,

Table 2. *Hierarchical Regression of* Health Outcomes on Control Variables, Determinants of Co-presence, Two Types of Co-presence

	Social Support (N = 148)				Exercise Efficacy (N = 149)				Exercise Adherence (N = 150)			
Variable Entered	B	SE (B)	β	Δ R2	B	SE (B)	β	Δ R2	B	SE (B)	β	ΔR^2
Step 1				.05				.08				.06
Age	.01	.08	.01		-.09	.06	-.15		-.05	.15	-.03	
Gender	-.14	.16	-.06		.03	.11	.02		.19	.29	.05	
Edu	.13	.14	.09		.05	.09	.06		.21	.24	.08	
Income	.02	.03	.05		-.01	.02	-.06		-.04	.05	-.07	
Internet Use	-.08	.05	-.13		-.07	.03	-.18*		-.22	.08	-.22**	
Sedentariness	.04	.05	.06		-07	.06	-.18*		-.05	.08	-.05	
Step 2				.03				.00				.07*
Preexisting Relationship	.02	.08	.02		.05	.06	.08		-.12	.15	-.07	
Geographical Proximity	-.02	.09	-.02		-.06	.06	-.11		-.50	.16	-32**	
Step 3				.22***				.04*				.03*
With Competitors	-.03	.09	-.02		.15	.06	.22*		.37	.16	.20*	
With Cooperators	.72	.11	.53***		-.05	.08	-.06		.09	.20	.04	

*p <.05, **p <.01, *** p < .001 two-tailed.

co-presence with competitors significantly and positively predicted exercise self-efficacy (β = .22, p = .01) and exercise adherence (β = .20, p = .02), while co-presence with cooperators did not predict either outcome.

4. Discussion

By proposing co-presence as a concept that embraces a unique user experience in a mobile-enhanced communication environment, this study explored and examined determinants and effects of the two types of co-presence.

As predicted, the data showed that a perceived geographical proximity to competitors or cooperators with whom users interact through gamified mobile health applications was significantly related to the degree of both types of co-presence. However, contrary to the study's hypothesis, a preexisting social relationship was not significantly related to co-presence experience. Overall, the results of this study indicate that physical distance, rather than social distance, is a more important predictor of co-presence in the context of geosocial mobile fitness applications. That is, having other individuals physically nearby seems more important for engagement in a mobile-enhanced context than having real-life relationships with them. This provides a basis for community-based health intervention that focuses on local population. However, still, one may raise a question, whether having a preexisting relationship with other social entities is an adequate proxy for social distance. Considering

a large body of research conducted on cognitive and behavioral consequences of psychological distance (e.g., Soderberg, Callahan, Kochersberger, Amit, & Ledgerwood, 2015), future studies may take a step further and compare the effect of psychological social distance versus geographical distance on co-presence. Doing so may also help lay a bridge between presence research and psychological distance research.

By testing how the two types of co-presence are differently related to social support perception, exercise self-efficacy, and exercise adherence, the current study also provides valuable inputs for the development and implementation of mobile-mediated health interventions for people in shared contexts (e.g., local communities). The results of data analyses showed that co-presence with cooperators was significantly related to perception of social support while co-presence with competitors was not. Furthermore, co-presence with competitors was significantly related to exercise self-efficacy and exercise adherence while co-presence with cooperators was not. These findings altogether emphasize the importance of selective incorporation of game mechanics that would better serve the purpose of mobile-based health intervention. In line with prior research demonstrating parallel competition in separate physical spaces as an optimal exergame playing mode (Lee, Kim, Park, & Peng, 2017; McGloin & Embacher, 2018; Peng & Crouse, 2013), it appears that making individuals feel a sense of rivalry with other social entities seems crucial to maximize the benefits of gamified health application in enhancing exercise self-efficacy and exercise adherence. However, such an effort would not be equally worthwhile when designing a physical

activity intervention for people with chronic illness given social support is crucial in self-management of chronic illness (Gallant, 2003).

Extant findings generally indicate that competitive exergame settings increase players' exercise self-efficacy of some individuals, not all. For example, Song et al. (2010) demonstrated that presence of competitors improved only highly competitive game players' enjoyment and mood. Similar results were observed in a study that evaluated the effect of competitive virtual exergame setting on exercise behavior (Anderson-Hanley et al., 2011). To apply the findings to the current study, it is possible that the effects of co-presence with competitors on exercise self-efficacy and adherence may also differ depending on the degree of health application users' competitiveness. Other individual difference variables may also function as moderators. For example, in an exergame where game players did a leg exercise following a virtual trainer with a fit body as the game players also see their own images on screen, their body image dissatisfaction was found to reduce the effect of the exergame. That is, in comparison with game players with high body image satisfaction, game players who were not satisfied with their body reported lower exercise self-efficacy, lower positive moods, and lower enjoyment (Song, Peng, & Lee, 2011). Furthermore, given the availability of recreational space, sport ground and parks are associated with the amount of time people spend on their physical activities (Wendel-Vos et al., 2004), external factors related to the context in which gamified geosocial applications are used may also moderate the effect of co-presence. In this regard, future research should consider examining

other factors that might make competitive exergame settings and/or co-presence with competitors more or less effective. Understanding potential moderators could help identify target individuals who would get the most out of using gamified geosocial fitness applications.

Furthermore, joint effects of the two types of co-presence would also be worthy of further investigation. Tauer and Harackiewicz (2004) showed that in comparison with pure cooperation and pure competition settings, the combination of intergroup competition and within-group cooperation led to higher levels of task enjoyment and performance in basketball shooting games. No difference was observed between the pure competition and the pure cooperation game settings in terms of task enjoyment and performance. In this respect, it would be worthwhile to examine how two types of co-presence work together to influence exercise self-efficacy and adherence. More specifically, due to co-presence with cooperators' capacity to induce a sense of social support, co-presence with cooperators may further strengthen the effects of co-presence with competitors on exercise self-efficacy. Even in a hypothetical case which co-presence with competitors makes lowly competitive individuals worried and anxious about competitors' optimal or superior performance during physical activities, co-presence with cooperators and the sense of social support that accompanies may buffer the negative effects of co-presence with competitors on de-motivation to use gamified fitness mobile applications.

The current study has several limitations. First, due to the nature of cross-sectional research design, the direction of causality among the study

variables has to be interpreted with caution. Furthermore, as the study focused on examining the proposed associations between the study variables, a question regarding whether there exists a specific type of application that particularly facilitates or hinders co-presence remains beyond the scope of this study. Although additional analyses showed that both types of co-presence did not differ by the number of mobile health applications the participants had experienced (co-presence with competitors: $F(5, 183) = .56$, $p = .73$; co-presence with cooperators: $F(5, 180) = .55$, $p = .74$), future study should consider and control for extraneous factors that may lead to different results.

Additionally, due to limited previous research in this area, self-report measures of co-presence were adopted from previous studies in different communication contexts. Future research should focus on developing more valid and reliable scales to measure co-presence in mobile-enhanced communication contexts. Likewise, since there existed no scale for measuring preexisting social relationship and geographical proximity, questionnaire items to measure the proposed determinants of co-presence were created for this study. While it was relatively straightforward to measure those variables, establishing scales for assessing them would also be of benefit to future research.

The sample for the current study comprised of 190 mobile health application users who were recruited from twenty different user communities; and the majority of survey participants were highly educated female young adults who may not be representative of entire mobile health application user population. Replication of the study with

more diverse samples in terms of socio-demographics would help further advance knowledge generated by this study.

Despite these limitations, the current study is the first scholarly effort that incorporates and explicates the concept of co-presence in the context of gamified geosocial mobile fitness applications. The results of this study may shed some light on design, development, and implementation of physical activity health interventions using gamified mobile health applications.

References

Anderson-Hanley, C., Snyder, A. L., Nimon, J. P., & Arciero, P. J. (2011). Social facilitation in virtual reality-enhanced exercise: competitiveness moderates exercise effort of older adults. *Clinical Interventions in Aging*, *6*, 275-280.

Bartholomew, J. B., Loukas, A., Jowers, E. M., & Allua, S. (2006). Validation of the physical activity self-efficacy scale: Testing measurement. *Journal of Physical Activity and Health, 3*, 70-78.

Bente, G., Rüggenberg, S., Krämer, N. C., & Eschenburg, F. (2008). Avatar mediated networking: Increasing social presence and interpersonal trust in net based collaborations. *Human Communication Research*, *34*, 287-318.

Biocca, F. (1997). The cyborg's dilemma: Progressive embodiment in virtual environments. *Journal of Computer-Mediated Communication*, *3*, 0.

Biocca, F., Harms, C., & Burgoon, J. K. (2003). Toward a more robust theory and measure of social presence: Review and suggested criteria. *Presence: Teleoperators and Virtual Environments, 12*, 456-480.

Boulos, M. N. K., & Yang, S. P. (2013). Exergames for health and fitness: the roles of GPS and geosocial apps. *International Journal of Health Geographics*, *12*, 1-7.

Bradner, E., & Mark, G. (2002, November). Why distance matters: effects on cooperation, persuasion and deception. In *Proceedings of the 2002 ACM conference on Computer supported cooperative work*(pp. 226-235). ACM.

Curtis, D. D., & Lawson, M. J. (2001). Exploring collaborative online learning. *Journal of Asynchronous Learning Networks, 5*, 21-34.

de Souza e Silva, A. (2009). Hybrid Reality and Location-Based Gaming:

Redefining Mobility and Game Spaces in Urban Environments. *Simulation & Gaming*, *40*, 404-424.

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011, September). From game design elements to gamefulness: defining gamification. *Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments*, 9-15. ACM.

Fletcher, J. S., & Banasik, J. L. (2001). Exercise self-efficacy. *Clinical Excellence for Nurse Practitioners: The International Journal of NPACE*, *5*, 134-143.

Gajadhar, B., de Kort, Y.A.W., and IJsselsteijn, W.A. (2008). Shared fun is doubled fun: player enjoyment as a function of social setting. In P. Markopoulos, B. de Ruyter, W. IJsselsteijn, & D. Rowland (Eds.), *Fun and games* (pp. 106-117). New York: Springer.

Gallant, M. P. (2003). The influence of social support on chronic illness self-management:a review and directions for research. *Health Education & Behavior, 30*, 170-195.

Greene, K., & Magsamen-Conrad, K. (2010). Disclosure decisions in existing relationships online: Exploring motivations for CMC channel choice. J. R. Park & E. C. Abels (Eds.), *Interpersonal relations and social patterns in communication technologies: discourse norms, language structures and cultural variables* (pp. 48-76). Hershey, PA: Information Science Publishing.

Hamalainen, R. (2008). Designing and evaluating collaboration in a virtual game environment for vocational learning. *Computers & Education, 50*, 98-109.

IJsselsteijn, W., & Riva, G. (2003). Being there: The experience of presence in mediated environments. In G. Riva, F. Davide, W. A. IJsselsteijn, G. Riva, F. Davide, W. A. IJsselsteijn (Eds.), *Being there: Concepts, effects and measurements of user presence in synthetic environments* (pp. 3-16).

Amsterdam, Netherlands: IOS Press.

Johnson, D. W., & Johnson, R. T. (2004). Cooperation and the use of technology. In D. H. Johanssen. (2nd ed.), *Handbook of research on educational communications and technology* (pp. 785-811). Mahwah, NJ: Lawrence Erlbaum Associates.

Koh, H. E., Oh, J., & Mackert, M. (2017). Predictors of Playing Augmented Reality Mobile Games While Walking Based on the Theory of Planned Behavior: Web-Based Survey. *JMIR mHealth and uHealth*, *5*, e191.

Lee, K. (2004). Presence, Explicated. *Communication Theory*, *14*, 27-50.

Lee, K., Jeong, E., Park, N., & Ryu, S. (2011). Effects of interactivity in educational games: A mediating role of social presence on learning outcomes. *International Journal of Human-Computer Interaction, 27*, 620-633.

Lee, S., Kim, W., Park, T., & Peng, W. (2017). The psychological effects of playing exergames: A systematic review. *Cyberpsychology, Behavior, and Social Networking, 20,* 513-532.

Leinonen, A. M., Pyky, R., Ahola, R., Kangas, M., Siirtola, P., Luoto, T., ... & Mantysaari, M. (2017). Feasibility of Gamified Mobile Service Aimed at Physical Activation in Young Men: Population-Based Randomized Controlled Study (MOPO). *JMIR mHealth and uHealth*, *5*, e146.

Lombard, M., & Ditton, T. (1997). At the heart of it all: The concept of presence. *Journal of Computer Mediated Communication*, *3,* 0-0.

Lowry, P., Roberts, T. L., Romano Jr., N. C., Cheney, P. D., & Hightower, R. T. (2006). The impact of group size and social presence on small-group communication. *Small Group Research*, *37*, 631-661.

McAuley, E., & Blissmer, B. (2000). Self-efficacy determinants and consequences of physical activity. *Exercise and Sport Sciences Reviews, 28,*

85-88.

McGloin, R., & Embacher, K. (2018). “Just Like Riding a Bike”: A Model Matching Approach to Predicting the Enjoyment of a Cycling Exergame Experience. *Media Psychology, 21,* 486-505.

Monedero, J., Lyons, E. J., & O’Gorman, D. J. (2015). Interactive video game cycling leads to higher energy expenditure and is more enjoyable than conventional exercise in adults. *PloS one, 10,* e0118470.

Morschheuser, B., Riar, M., Hamari, J., & Maedche, A. (2017). How games induce cooperation? A study on the relationship between game features and we-intentions in an augmented reality game. *Computers in Human Behavior, 77,* 169-183.

Murray, E. G., Neumann, D. L., Moffitt, R. L., & Thomas, P. R. (2016). The effects of the presence of others during a rowing exercise in a virtual reality environment. P*sychology of Sport and Exercise, 22,* 328-336.

National Cancer Institute. (2011). Health information national trend survey (HINTS) 4, cycle 1 survey materials. Retrieved from http://hints.cancer.gov/instrument.aspx.

Nowak, K. L., & Biocca, F. *(2003).* The effect of the agency and anthropomorphism on users’sense of telepresence, copresence, and social presence in virtual environments. *Presence: Teleoperators and Virtual Environments, 12,* 2-35.

Payne, H. E., Lister, C., West, J. H., & Bernhardt, J. M. (2015). Behavioral functionality of mobile apps in health interventions: a systematic review of the literature. *JMIR mHealth and uHealth*, *3,* e20.

Peng, W., & Crouse, J. (2013). Playing in parallel: The effects of multiplayer modes in active video game on motivation and physical exertion. *Cyberpsychology, Behavior, and Social Networking*, *16*, 423-427.

Peng, W., & Hsieh, G. (2012). The influence of competition, cooperation,

and player relationship in a motor performance centered computer game. *Computers in Human Behavior*, *28*, 2100-2106.

Ravaja, N., Saari, T., Turpeinen, M., Laarni, J., Slaminen, M., & Kivikangas, M. (2006). Spatial presence and emotions during video game playing: Does it matter with who you play? *Presence: Teleoperators and Virtual Environments, 15,* 381-392.

Rhodes, R. E., Blanchard, C. M., Bredin, S. S., Beauchamp, M. R., Maddison, R., & Warburton, D. E. (2017). Stationary cycling exergame use among inactive children in the family home: a randomized trial. *Journal of Behavioral Medicine, 40,* 978-988.

Soderberg, C. K., Callahan, S. P., Kochersberger, A. O., Amit, E., & Ledgerwood, A. (2015). The effects of psychological distance on abstraction: Two meta-analyses. *Psychological Bulletin, 141,* 525.

Song, H., Kim, J., Tenzek, K. E., & Lee, K. M. (2010, June). *The effects of competition on intrinsic motivation in exergames and the conditional indirect effects of presence.* Paper presented at the 60th Annual Conference of the International Communication Association, Singapore. Retrieved from http://astro.temple.edu/~tuc16417/papers/ Song_et_%20al.pdf

Song, H., Peng, W., & Lee, K. M. (2011). Promoting exercise self-efficacy with an exergame. *Journal of Health Communication*, *16*, 148-162.

Sproull, L., & Kiesler, S. (1986). Reducing social context cues: Electronic mail in organizational communication. *Management Science*, *32*, 1492-1512.

Staiano, A. E., Abraham, A. A., & Calvert, S. L. (2012). Motivating effects of cooperative exergame play for overweight and obese adolescents. *Journal of Diabetes Science and Technology*, *6*, 812-819.

Staiano, A. E., Abraham, A. A., & Calvert, S. L. (2013). Adolescent Exergame Play for Weight Loss and Psychosocial Improvement: A

Controlled Physical Activity Intervention. *Obesity (Silver Spring, Md.)*, *21*, 598-601.

Wagner, I., Broll, W., Jacucci, G., Kuutii, K., McCall, R., Morrison, A., Schmalstieg, D., & Terrin, J. (2009). On the role of presence in mixed reality. *Presence: Teleoperators and Virtual Environments*, *18*, 249-276.

Walther, J. B., & Burgoon, J. K. (1992). Relational communication in computer-mediated interaction. *Human Communication Research, 19,* 50-88.

Wendel-Vos, G. C., Schuit, A. J., De Niet, R., Boshuizen, H. C., Saris, W. H., & Kromhout, D. A. A. N. (2004). Factors of the physical environment associated with walking and bicycling. *Medicine and Science in Sports and Exercise*, *36*, 725-730.

Wilson, J., O'Leary, M., Metiu, A., & Jett, Q. (2008). Perceived proximity in virtual work: Explaining the paradox of far-but-close. *Organization Studies*, *29*, 979-1002.

Whiteley, L., Brown, L., Lally, M., Heck, N., & van den Berg, J. J. (2018). A Mobile Gaming Intervention to Increase Adherence to Antiretroviral Treatment for Youth Living With HIV: Development Guided by the Information, Motivation, and Behavioral Skills Model. *JMIR mHealth and uHealth*, *6*, e96.

Zimet, G. D., Dahlem, N. W., Zimet, S. G., & Farley, G. K. (1988). The multidimensional scale of perceived social support. *Journal of Personality Assessment*, *52*, 30-41.

최초 투고일: 2018년 11월 09일
논문 수정일: 2018년 12월 08일
게재 확정일: 2018년 12월 24일

Co-presence in Gamified Geosocial Mobile Fitness Applications:
Its Determinants and Effects on Perceived Support, Exercise Self-Efficacy, and Exercise Adherence

게임화된 위치기반 소셜 피트니스 모바일 애플리케이션에서의 공현존감: 결정요인과 지각된 사회적지지, 운동 자기효능감, 운동 지속 행동에의 영향

김설아
(서울대학교 의학연구원 의료관리학연구소 선임연구원)
한정엽
(조지아대학교 광고홍보학과 부교수)

많은 사람들이 게임화된 위치기반 소셜 피트니스 모바일 애플리케이션을 사용하고 있음에도 불구하고, 그러한 애플리케이션이 사용자들의 신체활동에 어떠한 영향을 미치는지 점검한 연구는 아직 많지 않다. 본 연구는 모바일 애플리케이션 사용자 몰입의 핵심을 잘 포착하는 개념으로 공현존감을 제안한 뒤, 게임화된 위치기반 소셜 피트니스 모바일 애플리케이션이라는 특정 맥락에서 공현존감을 사용자들이 경쟁자 혹은 협력자와 실제 혹은 가상의 공간에 함께 있다고 느끼는 상태라고 정의하였다. 공현존감의 결정요인을 알아보고, 공현존감이 지각된 사회적 지지, 운동 효능감, 그리고 운동행위의 지속성에 어떠한 이바지를 하는지 점검하기 위해 실사용자 대상 설문 조사를 실시했다. 분석 결과에 따르면, 애플리케이션을 통해 상호작용하는 사회적 존재들 (실제 다른 사용자이든 가상의 존재이든)의 물리적 근접성은 공현존감과 유의미한 양의 상관관계를 보였다. 또한, 경쟁자와 같은 공간에 함께 있다는 느낌은 운동 효능감과 운동행위의 지속성과 양의 상관관계를 보였다. 반면, 협력자와 같은 공간에 함께 있다는 느낌은 오직 지각된 사회적 지지와 양의 상관관계를 보였다. 함의와 후속연구를 위한 제안이 논의되었다.

주제어 : 게임화된 위치기반 소셜 피트니스 모바일 애플리케이션, 공현존감, 지각된 사회적 지지, 운동 효능감, 운동행위의 지속성

Appendix A

Question Wording (1 = Strongly Disagree, 5 = Strongly Agree)

Preexisting Relationships with Other Social Entities

"When using the application, I have the impression that…"

1. Most of the people that I interact with through the apps are my close friends
2. Most of the people that I interact with through the apps are my acquaintances
3. Most of the people that I interact with through the apps are strangers [Reverse Coded]

Perceived Geographical Proximity with Other Social Entities

"When using the application, I have the impression that…"

1. I could have encountered other users whom I interact with through the app(s) in the real world. (modified from Regenbrecht & Schubert, 2002)
2. Most of the people that I interact with via those apps are living in the same country with me.
3. Most of the people that I interact with via those apps are living in the same state with me.
4. Most of the people I interact with via those apps are living in the same city with me.
5. Most of the people I interact with via those apps are living in the same district (e.g., county or neighborhood) with me.

Co-presence with Competitors

1. In the course of using the apps, I have a sense that I was in the same place as the competitors.
2. When using the application, I feel inclined to compare my achievement with other users.
3. When using the application, I frequently feel a sense of rivalry with users.
4. When using the application, I am depressed when I feel everyone is doing better than me in terms of exercise.

Co-presence with Cooperators

1. In the course of using the apps, I have a sense that I was in the same place as the cooperators.
2. When using the application, I have the impression that I am needed.
3. When using the application, I have the impression that other users and I have shared responsibility.
4. When using the application, I am aware of that other users have the same goal with mine.
5. When using the application, I have the impression that other users and I monitor each other's efforts and contributions