CO-PRESENCE IN GAMIFIED MHEALTH CONTEXTS:

ITS DETERMINANTS AND EFFECTS

by

SOELA KIM

(Under the Direction of Jeong Yeob Han)

ABSTRACT

This paper presents a study of gamified mobile health applications that allow users in web and physical environments to share their real-time physical activities, to communicate over various channels, and to jointly navigate around a shared communication space. Grounded in the concept of co-presence--an individual's subjective sense of being together with others social entities (either competitors or cooperators) in a digitally or physically shared space--, the current study aims to explore 1) how mobile-mediated communication conditions affect the level of co-presence and 2) how different types and varying levels of the experienced co-presence are related to health outcomes in terms of perceived social support, exercise self-efficacy, and exercise adherence.

The study employed quantitative methods of data collection and analysis. The empirical examination focuses on users of mobile health application that are currently available in market. Online self-administered survey was distributed to a convenience sample of mobile health applications users. The collected data was analyzed through Pearson's partial correlations. The associations among variables were elucidated by partial correlation coefficients.

After controlling for socio-demographics and health-related behavior factors, the analysis of quantitative data indicated that perceived geographical proximity between social entities, pre-existing social relationships, and consistency of mobile-mediated information with the objective world were positively related to the degree to which the users experience all three types of co-presence. Furthermore, the results of partial correlation analysis showed that co-presence with cooperators was positively related to perceived social support and exercise adherence. However, none of relationship between co-presence with competitors and health outcomes was statistically significant.

The present study discusses mobile-mediated communication conditions and their psychological effect on health outcomes in the contest of the gamified mHealth context. As the first scholarly effort to explore co-presence in mobile health contexts that taking a user-centric approach, the study shows the promises of various utilization of advanced mobile technologies in increasing user values, which consequently drives users to perform active roles in their healthy behaviors in everyday life context.

INDEX WORDS: co-presence, gamification, mobile health application, mHealth, co-located cooperation, co-located competition

CO-PRESENCE IN GAMIFIED MHEALTH CONTEXTS:

ITS DETERMINANTS AND EFFECTS

by

SOELA KIM

B.A., Hanyang Univeristy, Korea, 2011

A Thesis Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment

of the Requirements for the Degree

MASTER OF ART

ATHENS, GEORGIA

2013

CO-PRESENCE IN GAMIFIED MHEALTH CONTEXTS:

ITS DETERMINANTS AND EFFECTS

by

SOELA KIM

Major Professor: Jeong Yeob Han

Committee: Sun Joo Ahn
Jeffery Springston

Electronic Version Approved:

Maureen Grasso
Dean of the Graduate School
The University of Georgia
May 2013

ACKNOWLEDGEMENTS

I am very grateful for people who have helped with this project. I am sure, without their encouragement, I should not be finishing this program. First, I would like to express my gratitude to Dr. Jeong Yeob Han who has been my academic advisor since the beginning of the master's program. Dr. Han's suggestion made my idea more sharable and guided the research in a more doable way. I should also like to thank the committee members: Dr. Sun Joo Ahn, for her precise advice with the conceptual model; and Dr. Jeff Springston, for his time and effort he put in this project. Last but not least, I would never forget what I have learned from Dr. John Soloski and Dr. Jennifer L. Monahan who validated and invalidated my thoughts so that I could push my boundaries.

Thank you friends for showing me what the term of social support really means (I *perceived* it 9 on the 5-point Likert scale). My sister, I do appreciate your silliness and everyday jokes from on the other side of the globe. Hyemin, your *presence* has altered my reality. Mom and dad, words are not enough; I am lucky to have parents who taught me how to use tools to do what I really like.

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Given an aging population and rising healthcare costs, in the domain of healthcare service, a paradigm shift is happening—from a doctor-centric curative model to patient-centric proactive model. According to the Center for Disease Control and Prevention (CDC), lack of physical activity is one of the four most modifiable health risk that are responsible for much of various chronic diseases (Levy-Storms, 2005).

In the meantime, advanced mobile technology has ushered in the post-PC era. As smart mobile devices are pervasively penetrating into our daily lives, researchers have begun exploring a practical potential of utilizing mobile technology in improving the quality of peoples' lives, such as helping people to manage personal health and to modify risky behaviors in everyday situations. The use of mobile technologies and global networks as tools and platforms for health research and healthcare delivery to improve the well-being of individuals and populations is newly termed mHealth (mobile health) by the National Institutes of Health[1]. However, to effectively leverage a unique affordance of advanced mobile technologies to any greater extent when developing and implementing to mobile phone-based health interventions has yet to been fully studied.

The use of mobile technology as an interface for game play holds much potential. With an aid of mobile devices that are equipped with location sensing technologies and the Internet connection; location-based mobile services use physical space as a game board (De Souza e Silva, 2006; 2008; 2009). Gamified mobile health applications are one of the novel forms of leveraging advanced mobile technology. By utilizing the mobile platform that are pervasively embedded in people's everyday lives, mobile health applications allows users to gamify their daily activities and to make physical activity more enjoyable and entertaining. They place individual users in the center of health intervention and promote physical activity through providing a more satisfying and engaging user experience. Although studies proved that by incorporating game mechanics, health interventions lower barriers that impede people's engagement in their physical activity, such as lower exercise self-efficacy and a lack of motivation (Anderson-Hanley, Synder, Nimon, & Arciero, 2011), there exists a lack of empirical evidence that supports the same principle applicable to mHealth contexts.

One core question in mHealth is to understand multifaceted user experience associated with context-aware mobile devices. Other pertinent questions are related to understanding all possible dimensions of values that mobile health application could propose so that it can meet users' expectations--wants and needs--, which might directly or indirectly contributes to positive health outcomes. In this vein, for the current research on mHealth, two things are required to fully realize the development promise of mHealth: 1) a user-centric approach focusing on the context-awareness of advanced smart mobile devices that adds value to mobile-based health applications, and 2) a theory-driven conceptual framework that embraces unique characteristics of communication conditions and user experience in mHealth contexts. The current study pays specific attention to the context-awareness of advanced smart mobile devices that adds value to mobile-based health applications.

In an effort to develop the conceptual framework, the study proposes a co-presence--an individual's feeling of being together with others in digitally or physically shared spaces--as a focal concept that interlocks and incorporates sensory, cognitive, and affective aspects of user experience in mobile-mediated communication contexts. Furthermore, by exploring unique patterns of social interaction in gamified mHealth contexts, the current study proposes that co-presence in the gamified mHealth contexts has two subtypes: an individual user's subjective sense of being co-located either 1) with the user's competitors, or 2) with the user's cooperators in a digitally or physically shared space.

The main purpose of the study is to explore characteristics of mobile-mediated communication conditions, and patterns of social interactions in gamified mHealth contexts. In doing so, the study examines how those unique aspects of the gamified mobile health application differently affect varying level of co-presence. Furthermore, by testing the associations between the degree of co-presence and health outcomes in terms of perceived social support, exercise self-efficacy, and exercise adherence, the current study will provide critical inputs that can be utilized in designing, developing, and implementing of mobile-mediated health interventions that effectively support and promote physical activities of people in shared contexts (e.g., local communities or online virtual communities).

The paper is structured as follows. In the chapter 2 and 3, the conceptual framework of this study is to be developed, hypothesizing associations between focal constructs in the framework. Then, the study presents a survey-based study to test the hypotheses, followed by the results of data analysis. The final part of the paper discusses the theoretical and practical implications of the current study, highlighting some of the limitations and directions for future research.

CHAPTER 2

LITERATURE REVIEW

The chapter 2 reviews literature and provides theoretical background for the study's conceptual framework to explain and predict what factors influences users' co-presence experience and how variations in experienced co-presence differently affect health outcomes in the gamified mHealth context. The section is organized as follows. It begins with a discission of the value creation potential of mHealth service relative to distinct aspects of context-aware mobile devices and user experience in mobile-mediated communication environments. Then, the theory of presence and recent effort in presence research are to be reviewed along with a discussion of user experience associated with the usage of context-aware devices. Based on the discussion, for the present study, the concept of co-presence is newly defined and explicated in terms of its major dimensions.

Context Awareness: Implications for mHealth

mHealth is located at the intersection of health communication and information and communication technology (ICT). With the advent of the synergistic convergence of various information and communication technologies—sensing components (e.g., Bluetooth, GPS, voice recognition, proximity sensors, camera), interactive multimedia that deliver rich media content, intuitive touchscreen interfaces, and mobile Internet services (e.g., 3G/4G/LTE), advanced mobile devices are now regarded as dashboards that accommodate the users' behaviors as they are integrating computing, sensing, and positioning capabilities with almost ubiquitous interconnectivity (Liu at al. 2011, p.1). Furthermore, since mobile devices are commonly available and widely used communication technology, users of the mobile devices can easily and immediately track and see their real-time physical activities reflected on their mobile devices and plan their exercises based on either an assumed or established context even while on the move.

User experience associated with context-aware mobile devices, the focus of this study, is distinct from either non-mediated or online-based experience. The context-aware mobile devices and location-based services allow users to stay connected to and interact with physical environments (social entities such as real people, landmarks of their interests, and their own physical bodies), and mediated environments (digital manifestation/illustration of social entities, surrounding, and themselves such as avatars on their mobile devices) at the same time in either sensory or non-sensory ways. This merger of virtual- and real-world is called augmented reality[2] (Grant & Meadow 2008, p. 182) where users establish their own understanding of world and their real-world activities, depending on the ever changing context-implied information on their mobile communication devices. In the augmented reality context, through their smart mobile devices, users can quickly and easily interact with and process a lot of data on the context of their activity that is pulled by advanced sensing technologies. To put it shortly, in the context of augmented reality, physical space is supplemented or enhanced by real-time virtual inputs. Users are not individuals in mediated environments anymore. Rather, individuals are mobile; the mobile individuals are mediated by environments. The unique nature of interactivity in augmented reality contexts will affect human cognition--how we perceive the world we live in--, attitude, and behavior, which should be taken into account when developing mobile mediated health intervention.

Context-aware mobile devices and location-based services suggest new opportunities for effective mobile-mediated health intervention and personal behavioral control, enabling a more satisfying and engaging user experience, even with relatively inexpensive technology. The study proposes that by innovatively incorporating unique attributes of context-awareness, mobile health application developers will be able to enhance value of their service, driving users to perform active roles in their healthy behaviors.

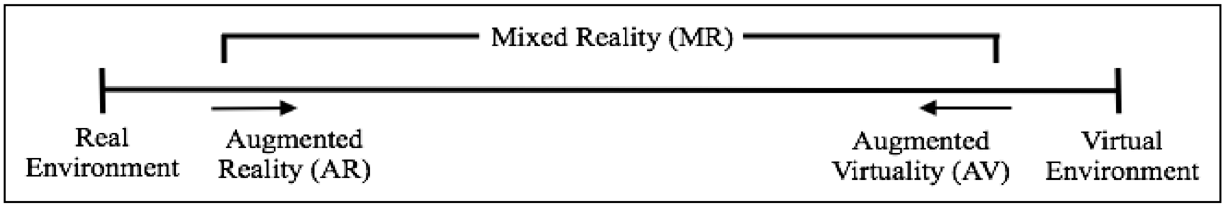


Figure 1. Reality-Virtuality (RV) Continuum (Milgram, Takemura, Utsumi, & Kishino, 1995)

Challenges in mHealth Research

Before mHealth, eHealth--the use of ICT for healthcare delivery--was widely discussed in academic community. eHealth studies suggested factors that increase effectiveness of mediated health intervention as follows: 1) to increase interactivity of system, 2) to provide personalized (tailored) information, and 3) to promote interactive communication among users and relative to social and cultural context. Although mHealth is not exactly equivalent to eHealth, the findings in the extensive eHealth research certainly have valuable implications for mHealth research which is still in its early stages.

It has been proven that interactive eHealth program leads to an improvement in user engagement and health literacy skills (Walther, Pingree, Hawkins, & Buller, 2005), greater quality of life, competence in dealing with health information, and greater social support the users experienced (Gustafson et al., 2008). However, the implementation of eHealth in peoples' daily lives have also generated skepticism due to the only marginal level of end-user engagements, utility problems (Nijland et al., 2008; Kelders, van Gemert-Pijnen, Werkman, & Seydel, 2010), and high user dropout or attrition rates (Han et al., 2009; Neve, Collins, &

Morgan, 2010). This is because most of eHealth interventions and eHealth researches have been driven by technological possibilities (e.g., interactive media technology).

The technology-driven approaches without consideration of practical implications for user experience have not always lead health interventions to success. According to Baker et al. (2011), how much benefit one takes from interactive eHealth program is dependent upon individuals' different levels of familiarity of technological tools, not absolute degree of interactivity that media platform possesses. That is, when a user perceives usage of a given online-health program requires too much complexity, the user is less likely to participate and become engaged in the program. The limitations of eHealth interventions suggest that simply leveraging context-aware features without consideration of usage situations and users' needs and wants would not always produce desired outcomes. In this regard, the current study suggests that it is the critical first step to understand unique value proposition dimensions in context-aware mobile services and to interlock them with novel aspects of user experience with mobile-health application.

Value Propositions of mHealth services

The value proposition of mobile services are relatively self-evident, which can be best summarized as ubiquity, convenience (e.g., compactness and portability), localization, socialization, personalization, accessibility, interactivity, and flexibility (Clarke, 2001; Anckar & D'Incau, 2002; Åkesson, 200; Boulos, Wheeler, Tavares, & Jones, 2011; Klasnja & Pratt, 2011). While agreeing with Åkesson (2007, p. 16) that ubiquity is a core enabler of other value value dimensions in that it allows individuals to access online on their demand, the current study suggests context-sensitivity (or context-awareness) expands the user-centric value proposition of mobile services. Although several studies proved that context-sensitivity increases perceived usefulness and usability of mobile services (Bae, Lee, Kim, & Ryu, 2006; Klemettinenm, 2007), those propositions yet do not have sufficient empirical support, nor are they closely linked to the area of mHealth.

Informative and persuasive value: advanced personalization and message tailoring

Communicators tailor messages they would like to deliver for a specifically targeted group of receivers so as to appeal to the message receivers. Research indicates that tailored messages are more likely recalled and accepted by receivers, leading to intended changes in the receivers' attitude and behavior (e.g., purchase behavior). Interactivity is a representative feature of new media technology; and emerging interactive information and communication technologies are core enablers of advanced message-tailoring. Many eHealth researchers have regarded targeting and tailoring health information as critical in promoting desired behavior changes because those strategies make the eHealth program more attractive, engaging, and more influential to the user (Akinson & Golden, 2002; Walther et al., 2005; Cassell, Jackson, & Cheuvront, 2008; Hawkins, Kreuter, Resnicow, Fishbein, & Djikstra, 2008). Hawkins et al. (2008) presented three basic tailoring strategies in health communication contexts: personalization, immediate feedback, and content matching.

The expanding sensing capabilities of mobile devices hold the critical key in distributing and dispersing personalized and targeted healthcare services. Lee and Benbasat (2004) indicate that personalization of mobile service includes spatiality, temporality, and contextuality. While eHealth programs provide generic information or tailor content to provide based on user queries or inputs provided voluntarily by the users (e.g., demographic information, profiles of usage, diagnostic test results, and personal preferences), context-aware mHealth services automatically take a specific user's context (the location, the surroundings, people in his vicinity) into consideration and immediately provide the user with the most time- and place-relevant information that are filtered through the system (Haaker, Edward, & Bouwman, 2006).

Location-based services assist users by identifying patterns of healthy or unhealthy practices and offering advice based on location (Boulos, Wheeler, Tavares, & Jones, 2011). The intervention tailored by context-aware mobile health applications have potential to help individuals with chronic health problems such as diabetes, obesity and heart diseases to better understand their health condition and to closely monitor and manage it relative to their specific context via their full-fledged computer in hand, going beyond a simple health information delivery. The University of Wisconsin's' location-aware asthma inhaler is a good example. It tracks spatiotemporal context of a user's asthma attacks and helps both healthcare providers and the user analyze specific features of asthma triggers and manage the disease more efficiently and effectively (Harvey, 2009).

Economic value: convenience, accessibility, interactivity, flexibility, and affordability

Smart mobile devices with a wide range of functions and installable software applications (apps), its faster computing power, and increased portability could serve as the most cost-efficient and effective platform for health intervention. The area of mHealth will continue to grow as it benefits most from technologically advanced "smart" mobile devices that are equipped with the synergistic convergence of various information and communication technologies. Furthermore, the user (patient)-centric mobile health-application marketplace is also growing with the increasing availability of centralized mobile application portals (e.g., iTunes App Store), where people can easily access and download affordable applications directly onto their mobile device whenever and wherever they want. As of September, 2012, Apple's iTunes Apps store featured more than 19,000 paid-apps that are designed to help people manage their health and educate themselves on health and wellness by using their Apple iOS mobile devices such as iPad and iPhone; and the list is expanding every day.

Empathetic (social, and emotional) values: social facilitation

The commercial mobile health applications are supported by two main technical capabilities of smart mobile devices: 1) the ability to derive and sense location information, 2) the ability to share the context information created by an individual user in larger online social networks. In traditional modes of communication; physical distance between communication partners cost more money, time, and effort to communicate (Goldenberg and Levy, 2009). However, ICT are important enablers of facilitating social interaction among people regardless of time and place, to minimize problems related to physical distance. In web-based communication, people are able to turn back the clock by tracking the real time activities of a stranger on the other side of the globe and interacting with one another. The Internet allows people to create the notion of 'present' as it benefits them the most.

However, Neuhauser and Kreps (2003, p.10) argue that health intervention is more effective when it is blended into people's real social-life context; and incorporating inter-personal and small-group communication attributes can improve the outcome of health communication. Their argument emphasizes two points, that health intervention should be pervasive across peoples' every day social context and that it should facilitate social interaction among people within a shared social network. Van Gemert-Pijnen et al.(2011)'s claim is also in line with Neuhauser and Kreps's claim that mHealth service should be pervasive and interactive, and also correspond with individuals' daily lives, habits, and rituals.

By leveraging the unique capabilities of smart mobile devices, mobile services are able to enrich users' social interaction in unprecedented ways. Context-aware mHealth may especially maximize communication efficacy not only between people in online communication context, but also between people in pre-existing social networks (Haarker et al., 2006). As discussed, in today's ubiquitous computing world, people are not merely the carriers of those sensing devices. Rather, they are both the source and the consumer of context-tagged information on ongoing events. Context-tagged information both manually created by users and automatically pulled by sensing technologies can archive the users' context data over time. This archived context data can be uploaded to a larger social network such as Facebook or Twitter, where users share their current activities or status under the privacy setting they set. The context-tagged information further triggers dynamics in social networking because user action--creation and consumption of context information--is not bound to any given application platform, but goes in all directions through user-driven reproduction, such as tagging, "like"ing, re-blogging, and re-tweeting.

For instance, among one of many health-related mobile applications available in the market, *Nike+ Running App for iPhone*[3], records a runner (user)'s pace, distance, elapsed time, real-time route information and stores running history. The app was primarily designed to help a user efficiently manage a work-out plan. But, with newly added social features (e.g., Cheer Me On), it allows a user to publish their runs to larger social networks--such as Facebook and Twitter--and solicit support as they run. In other words, friends in the runner's social network get to better understand their friend's real-world activity simply by browsing through context-tagged information on their timeline--patterns of mobility (location and surrounding), that of social relationships such as 'who knows whom' 'who meets whom', and that of communication 'who communicates with whom' (Hossmann, Legendre, Nomikos, & Spyropoulos, 2011). This perfectly illustrates an example of location-based mobile health applications that connect physical and online social networks. Through the enhanced social interaction and communication among users in shared communication spaces--both in web and in physical environments--users may acquire higher functional, emotional, and social values that are critical in driving stronger user adoption of new healthy behavior (Sweeney and Soutar, 2001).

The more people feel using mobile-health service is valuable, the more their intrinsic motivation for it increases (Sakamoto, Nakajima, & Alexandrova, 2012). However, if proposed value of mHealth application does not match the everyday needs and expectations of the target audience, the service would fail to be adopted. For example, De Vos, Haaker, Teerling and Kleijnen (2009) found out that when the potential added value does not outweigh the loss of privacy (e.g., sharing location information with people outside of close circle), users of context-aware mobile services show reluctance to use the context aware service. The uncertainty about the added value of context-awareness is one of the challenges in developing and implementing innovative services (Haaker, Kijl, Galli, Killström, lmmonen & De Reuver, 2006, p.13). Given that; the question is still open: How should mHealth app developers articulate the value of their applications so as to appeal to the strongest driver for users' behavioral change?

Game for Health

The "high tech-with-a-low impact" issues of previous online-based health intervention provoke further discussion on how to design health intervention more engaging, effective, and efficient so as to motivate people to enjoy their physical activities. One notable trend in the health-related mobile application market is gamification. The term "gamification" was coined to explain the phenomenon of incorporating game mechanics (e.g., interactivity, flow, competition, cooperation, achievement, rewards, narrative, character, role playing, conflict, levels of difficulty that are achievable, rules, structures, challenge/problems to be solved, or choice to make) into non-game contexts in order to improve user experience and user engagement (Deterding, Sicart, Nacke, O'Hara, & Dixon, 2011; Baranowski, Baranowski, Thompson, & Buday, 2011). This gamification phenomenon sees games as powerful motivators in various fields ranging from design of everyday products to politics (McGonigal, 2011).

Studies have proven that video games can be effective for health education and strengthening users' cognitive ability (Peng, 2009; Pempek & Calvert, 2009). Furthermore, motion-sensing games that do not require a traditional hand-held controller (e.g., Wii and Kinect) have been used to promote physical activities. Motion sensors pick up on the player's body movements and display them on the game screen, which require the player to participate physically in order to play the game. Through these game-like experiences, users may find participating in gamified health interventions more entertaining and engaging and consequently, stick with the health interventions over the long-term, not relapsing into their old sedentary lifestyle. Studies have broadly examined and empirically proven that exer-games or health games increase users' motivation, participation, and engagement in their physical activities (for example to see, Peng, 2008; Song, Peng, & Lee; 2011; Lee, Jeong, Park, & Ryu, 2011; Peng & Hsieh 2012).

Collective multi-relational social interaction in gamified mHealth contexts

As digital media opens up a more social and democratic communication domain, amongst the game mechanics discussed; competition and cooperation have been claimed as particularly critical motivational mechanisms, which can be utilized across various domains in order to increase user engagement. The users' collective actions of location-based services like *Foursquare* and its user contributed culture are good examples cooperation and competition as motivational and rewarding mechanisms (see Goodchild 2007; Shirky 2008; Olsson 2009; Liu et al., 2011). The mission of *Foursquare*: "making cities easier to use and more interesting to explore[4]" is accomplished every day by the hundreds of thousands of users participating in it. The core content available in *Foursquare* is an aggregation of content which was co-created, co-edited, co-enriched, co-managed by users within a location-based social network in a collective manner (Olsson 2009); the information on local places is constantly being created and cross-referenced, and flows in all directions, since producers and consumers are no longer distinguishable (Goodchild, 2007). The competitive aspect of *Foursquare*'s rewarding system for content creation also comes into play as users collect "points" and "badges", and strive to become a "mayor" of a particular location (Cuddy & Glassman, 2010, p. 339) and to keep that title because it can be taken away by another user anytime.

When it comes to the domain of mHealth, gamified mobile health applications allow users to synchronously or asynchronously compete or cooperate on a team, facilitating both a virtual and a real social interaction. As a preliminary focus of the study, mobile health applications on the current market were reviewed. Based on the research; this study further explicates collective social interaction in context-aware mHealth context as 1) to compete with others to achieve his or her own goal, or 2) to cooperate with others to achieve a mutual goal in the shared (either mediated and/or physical) environment.

The previous mentioned mHealth app, *Nike+ Running App for iPhone* was primarily designed to help a user efficiently manage a work-out plan. However, with newly added social features which allow users to publish their run logs and statistics to larger social networks and solicit support from friends as they run. Through the social interactions, one can perceive another to be intimate and more similar to themselves. In addition, after a user finishes running, the user is also able to update their post-run output and invite other friends to complete a certain goal (e.g., set for distance, time, etc.) together. It serves also as a motivation tool; fostering competition between friends on the social network, hence, more people can join and become engaged with physical activities.

Zombies, Run![5] is a mobile running game which is also available in the iTunes App Store. This app accomplishes gamification through a single third-person narrator who delivers stories to users' headphones directly, to motivate them to run. Furthermore, the app gives small tasks (e.g., "to run as fast as you can to a nearby tower to find shelter"). Once the tasks are completed, they get rewards in the form of survival kits, such as books, water, food, medicine, batteries, and ammo. Furthermore, as users move along, the app tracks their distance and pace so that the users can review their progress and post them online. *Zombies, Run!* users are the game players who are inseparably connected to both mediated and non-mediated spaces and interact with social entities that are both artificial and real objects (e.g., zombies and survival kits; other local *Zombies, Run!* users). These social and cognitive impacts of gamified mobile health application may provide users with additional benefits to their physical activity (Staiano, & Calvert, 2011). However, studies of the collective multi-relational social interaction and its effects on health outcomes are limited, and waiting for empirical investigation. This leads us to introduce research questions that guide the remainder of this paper:

Presence

The concept of presence can be best summarized as a psychological state in which mediated environments are experienced as natural and real (Lee, 2004). Presence is an important facet of human experience associated with media usage. For example, sometimes when encountering a beautiful piece of artwork--painting, movie, or book—we become so engaged in its narrative and end up having feelings of connection to the imaginary setting as we identify with created characters. Although advanced media technology is not a necessary condition for presence, in recent years, the concept of presence has been extended to digital contexts as well such as teleconferences and virtual reality games; explaining when users become immersed in mediated environments (e.g., virtual environments) and perceive their experience in the environment as authentic real world experiences. Media scholars have discussed presence as a key concept to be considered in any research that involves advanced media technologies and their effects human perception, cognition, attitude, and behavior (e.g., Biocca & Delaney, 1995 & 1997; Lee, 2004; Yates, Lee, & El Sawy, 2005).

Biocca (1997) indicates that the feeling of presence is a combination of physical, social and personal attributes. Given that, he categorized presence into three types: physical (or spatial)-, social-, and self-presence, defining each as 1) the sense of being physically located in mediated space and experiencing virtual physical objects as though they are actual ones (Biocca, Harms, & Burgoon, 2003, p. 456), 2) the sense of being together with others in mediated space, and 3) the sense of identifying virtual selves as the actual self. His typology is beneficial in that it differentiates various types of experience based on domains of human experience.

Lee (2004) maintains systematically analyzing multi-dimensionality of human experience is necessary in order to define the concept of presence. Then, he developed the typology of virtual experience based on three dimensions: 1) domains of human experience (physical or spatial vs. social vs. self), 2) characteristics of objects that are being experienced (in terms of whether or not the objects have real-world correlates [artificial vs. para-authentic]), and 3) ways of experiencing the objects (sensory vs. non-sensory). Based on this typology, Lee adopted a more explicit definition of presence in virtual environments, as a psychological state in which a media user experience representation of physical objects/environments, social actors connected by technology, and the user's own self is authentic and natural. Lee's work is one of the most widely agreed and frequently referred to in presence research that has revolved around virtual reality environments. The theory of presence and previous presence research provide a very useful framework in exploring how technological aspects of media and media content (e.g., a complex combination of stimulus modalities and constant high-quality sensory feedback) affect subjective user experience (e.g., degree of immersion and engagement in mediated environment) from the users' perspective.

Scholars (Yates, Lee, and El Sawy, 2005; Lee, 2010) proposed that by creating presence, mobile service could maximize user value such as rich personalization, enhanced social interaction, ubiquity, localization, convenience, and many others. Unfortunately, those claims have not been subjected to empirical examination; nor are presence and its sub-constructs yet closely connected to the area of mHealth. Furthermore, since the pre-existing approaches in presence studies have emphasized the immersive nature of virtual environments, they do not properly and sufficiently explain mobile individuals and their collective social interactions which span the digitally mediated and the physically shared environment.

For example the game *Zombies, Run!* is mainly based on scenarios involving artificial situations (game world). *Zombies, Run!* users compete with other artificial social entities (the zombies). On the other hand, however, the vast majority of mobile health apps that are currently available and popular on the market including the previously mentioned *Nike +Running*, are inspired by real life situations. The effect of role playing without fear of failure and negative consequences in real-life, like *Zombies, Run!*, may not be the same with gamified real-life social interactions (e.g., *Nike+ Running*). The screenshots of *Nike+ Running* and *Zombie Run!* (Figure 2) show the difference between two applications in terms of service features.

Co-presence in gamified mHealth context

Amongst three types of presence--physical-, social, self-presence--, social presence and its effect have been widely discussed in health communication research in that it is believed to influence users' participants and commitments in online support groups and online-based health interventions (Hawkins et al. 2010). However, as discussed, context-aware mobile technologies have created a great range of social presence situations in which various kinds of collective user interaction can occur.

Co-presence could be identified as an intersection of both physical and social presence, referring to a sense of being together in a digitally or physically shared space (Wang & Wang, 2011). Wagner et al. (2009, p.251) maintain that the concept of co-presence is the concept that is most applicable in augmented reality environments. That is because, augmented reality environments that are created by context-aware mobile devices facilitates the construction of shared spaces by presenting matching virtual and real stimuli to multiple users.

Pointing out limitations in the previous presence research in virtual reality environments, Zhao (2003 & 2004) suggests two distinct dimensions of co-presence: 1) modes of co-presence that structures physical conditions/relationships between individuals and environments, and 2) senses of co-presence that constitutes the individuals' perceptions and feelings of togetherness in a given environment. He created the taxonomy of co-presence which consists of six modes of co-presence based on two types of proximity with three types of presence conditions, explaining different types of co-presence in different modes of co-presence (Table 1). For example, in the case of the *Nike+ Running App for iPhone* while runners can be co-located in a proximal physical environment where no technological mediation is needed (corporeal co-presence; e.g., runners who live in same local area meet up and run together), they can also co-present in electronic proximity (Corporeal tele-copresence; e.g., a user views her co-worker's posts about running records in shared online social networks such as Facebook and Twitter). Many of these new interaction styles clearly exhibit the combination of the physical and the virtual. However, little research has covered mixed nature of mobile-mediated human experience.

Informed by Zhao's work, the current study proposes co-presence as a more applicable focal concept in systematically conceptualizing collective social interaction in a shared information and communication space created by context-aware mobile health applications. As discussed, in the gamified mobile-mediated interaction context, social entities whom users interact with could be either their cooperators or competitors. Considering the various kinds of collective user interaction, the definition of co-presence in the gamified mHealth context should also include characteristics of interaction counterparts along with characteristics of interaction environments. The current study defines the concept of co-presence in gamified mHealth contexts as a multimodal combination of senses that people feel they are together either with competitors or with cooperators (actual, artificial, or para-authentic) who are in physically nearby and/or in electronically shared communication spaces.

To sum up this chapter, by tapping into value propositions of mHealth services and creating co-presence, gamified mobile health applications would be able to motivate users to change their current unhealthy attitudes and become more engaged in physical activities. The study proposes co-presence as a underlying psychological mechanism that the most sufficiently explains how mobile-mediated communication conditions directly motivates users' physical activity or indirectly affects individuals' attitudes and behaviors in a healthier way by maximizing the proposed values. Figure 3 briefly visualizes this argument.

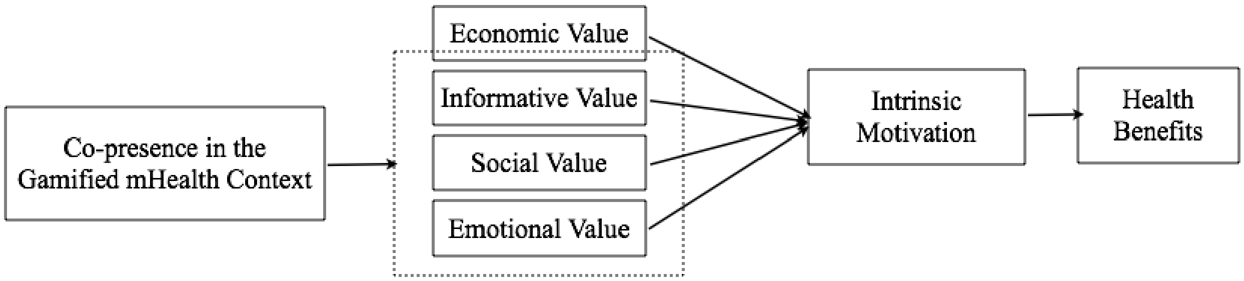


Figure 3. Co-presence, User value, Motivation, and Health Outcome

CHAPTER 3

HYPOTHESES

Essentially, presence research attempts to explain why presence occur (e.g., media conditions and other factors) and what influence it has on the user's perceptions, cognitions, attitudes, and behaviors in mediated environment (e.g., Media effect on the users' subjective experience). In chapter 3, based on the discussion, the current study proposes factors of mobile-mediated communication condition that potentially facilitate higher co-presence in mobile-mediated communication contexts, which directly or indirectly influence over health outcomes. Finally, in the later part of this section, the current study generates research hypotheses.

In everyday life, we catch plenty of clues as a means to interpret how things are around us. The same principle applies where media users perceive the mediated environments around them based on cues and stimuli provided by various media channels. From the early years, presence studies have focused more on technological enablers of presence and media conditions (e.g., tele-operating system, and virtual reality technology), emphasizing the importance of high-quality sensory feedbacks and facilitating media users' sensory experience so that the they may not notice any significant difference between the real world environments and mediated environments. The assumption underlying this approach is that the real world and the mediated world actually exist separately; and the ultimate goal of presence technology is to be in a pseudo-world that replaces the real (physical) world. One of the theories that undergird this tradition of research is media richness theory (MRT). MRT supports the idea that multimedia is a key to enable a richer and natural user experience, thereby provoking a higher presence. In other words, efficiency of a medium may depend on the quality and quantity of channels that support transmission of different nonverbal cues.

However, users of context-aware smart mobile devices become local hubs of interactive services while simultaneously interacting with digitally-mediated cues on their mobile display (location-tagged images, information, friends' comments on the place) and non-mediated cues of places, people in the shared places, and themselves. To put it shortly, in augmented reality environments, physical space is supplemented or enhanced by real-time virtual inputs. However, little is known about the role of specific aspects of augmented environment in facilitating presence experience.

Tang, Biocca and Lim (2004, p. 205) indicate that there is a difference between augmented reality and virtual reality in terms of spatial presence. Their experiment found that users in augmented reality environments are generally more confident in making body movements, than those in virtual reality environments. This is because in the augmented reality setting, users are given more real time sensory cues along with unmediated cues regarding their own body movement and spatial location.

While previous presence studies--which mostly focused on users' virtual experiences in computer-generated environments--provided valuable insights about how technological artifacts contribute to media users' subject presence experience, they do not fully address the distinct mobile-mediated media conditions. Furthermore, we still do not have a clear understanding of the scope of augmented reality environments, especially its perceptual, psychological aspects and practical implications for mobile-based health interventions. This calls for a new agenda for presence research that is more relevant to study the social and mixed--mobile, and/or situated--

nature of augmented environments that affect users' presence experience. This leads to the following research question.

RQ1. What are the factors to contribute to a sense of presence in the gamified mHealth contexts?

Communication Conditions Contributing to Co-presence in Gamified mHealth Context

It would be an important scholarly endeavor to explore how mobile-technology can enhance or improve user's co-presence experience. What aspects of mobile-mediated environment would contribute to the increase positive health outcomes in the gamified mHealth context? Motivated by this question, the current study suggests three key factors—two social presence factors and one spatial presence factor—by reviewing literature: 1) perceived geographical proximity between other social entities, 2) pre-existing relationships with other social entities (with pre-existing social relationships vs. without pre-existing social relationships), and 3) the consistency of information with the objective real world. The three factors cover unique characteristics of mobile-mediated communication conditions—characteristics of interaction counterparts and that of interaction environments—that have not been included in previous presence research. The detailed discussion is following.

Social Presence Factor 1: Perceived geographical proximity between social entities

It is often perceived that information communication technology enables people to communication with one another much easily, transcending geographical and time differences. The communication revolution intuitively suggests that physical distance does not affect—facilitate or interrupt--the way people communicate online. However, empirical evidence suggests that geographical distance is not completely irrelevant even in the IT era. Rather, some researchers argue geographical proximity has become more important for social interaction and dynamics than ever.

Studies have proven that perceived geographical proximity still matters for individual and group outcomes in computer-mediated communication contexts. People are less likely persuaded by someone they believe is in a distant city, as opposed to someone in the same city as them. Also, the degree of willingness to initially cooperate and that of engagement to group activity inversely decreases with perceived geographical distance (Wilson, Boyer O'leary, Metiu, & Jett, 2008). This is because of persisting social differences (e.g., social norms, local physical context, time zones, culture, and language) associated with geographical distances that make technologically-mediated collective activity more difficult (Bradner and Mark, 2002; Olson, and Olson, 2000, p. 2). Goldenberg and Levy (2009) examined the relationship between social interaction and physical distance and proved that physical proximity is positively related to the frequency of communication. They proved that both email and Facebook communications depend on physical distance in a very similar way. They also explained that this is because a major part of peoples' electronic communications is performed with their local counterparts.

The current study proposes that context-aware mobile devices may have even more increased importance of geographical proximity in social interaction and communication. That is mainly because when using context-aware mHealth applications, physical environment--location, surroundings--becomes one of the most important communication contexts in which user interaction happens. In this case, user interactions are less likely to cross geographical boundaries that are depicted on their mobile device than traditional computer based online communication.

According to Delomier, Bénazeth, David, and Chalon (2012), artificial communication environments implying a physical distance between social entities (e.g., Virtual reality settings, or online environments) require users' cognitive efforts in re-contextualizing information in mediated environments so that it corresponds to their real-world activities. However, context-aware mobile devices enable users to exchange location-tagged messages relative to their physical activities, surroundings, and circumstances with their local counterparts. This makes the meaning of exchanged messages richer, clearer, and more understandable, reducing the need for complex interpretation during mobile-mediated collaborative or competitive activity.

It should be noted that distance is a subjective term because people often perceive the same objective physical distance quite differently (Halford and Leonard, 2006). In this regard, the current study focuses on perceived geographical proximity that refers to an individual's perception of how close or how far another person is (Wilson, Boyer O'leary, Metiu, & Jett, 2008). Feeling geographically or physically close to others may affect how people perceive the degree of reciprocal influence, synchronicity, and responsiveness, which consequently affects perceived interactivity that is found to be a significant determinant of social presence (Nan, Tao, & Shuang, 2010; Hawkins et al. 2010). Although the concept of perceived physical or geographical proximity seems similar to the concept of co-presence; Willson et al. (2008, p. 995) maintain that the two concepts are different because perceived geographical proximity is not necessarily associated with technology-related artifacts that provoke the sensory illusion of non-mediation or being face-to-face with someone.

To restate, when people perceive that other social entities are located not only in a digitally shared space, but also in their physical vicinity; it may facilitate the development of mutual understanding of communication settings, physical environments for activities and other people in the interaction contexts, which may lead to an increase in the feeling of being in contact or co-located with other social entities. However, only limited research has considered the effects of geographical proximity between social entities (e.g., users or any other embodied agents) on co-presence experience. Based on the discussion, the first hypothesis is generated.

H1: The degree of perceived geographical proximity with other social entities is positively associated with the level of co-presence.

Social Presence Factor 2: Pre-existing relationships

Furthermore, as mentioned, context-annotated information users exchange through various channels--including social networking sites--has increased emotional and social values. Ning Shen and Khalifa (2008) demonstrated three social presence dimensions in online communities: awareness, cognitive social presence, and affective social presence. In the gamified mHealth context, the present study hypothesized perceived geographical proximity for an enabler of cognitive social presence, as more easily connecting people in shared physical spaces (H1) and continues to propose that pre-existing social relationships may affect not only cognitive, but also affective social presence--the user's emotional connection with others social entities.

Human-like features induce stronger affective social presence; and characteristics of a presumed audience and an embodied agent (e.g., an avatar) have been found to elicit varied emotional responses in people. Studies have proven that compared to a computer-operated opponent, when an embodied agent represents a human-operator, video game players experience greater engagement and threat (Timpka, Graspemo, Hassling, & Eriksson, 2005). In the health context, assessment of relational quality with a presumed audience such as intimacy, closeness, or anticipated contact influences one’s intention to participate (e.g., health diagnosis disclosure) in an online social support group (Greene & Magsamen-Conrad, 2010). Knowing who potential interaction counterparts are, in terms of similarity (e.g., demographic characteristics), trustworthiness, and intimacy (physical, intellectual, emotional, shared) may reduce relational uncertainty, therefore, users are more likely to engage and commit in social interaction. According to Walter and his colleagues (2005), users are more likely to relate to and bond with similar others; and this homophilic social interaction between users in health communication contexts leads to many psychotherapeutic benefits.

Shaw et al.'s study (2006) supports the claim that an individual's subjective assessment of a presumed audience directly affects one's disclosure behavior in online social support groups. They found that the race ratio in online support leads to a difference in overall use of CHESS among black and white HIV users--members of minority ethnic group are not active users of discussion group. They explained that African-Americans may not feel comfortable and used an online chat room slightly less when they sensed that Caucasians were present in the online chat room.

In MMORPG (massively multiplayer online role-playing game) environments, individual users have entered the game world on their own and have no pre-existing relationships with other players. Every player uses an alter identity (e.g., avatar) which does not correlate to his real-life identity. However, when using location-based mobile health applications which are connected to larger social networks; users are more likely to use their real identities and interact with people who are already in their pre-existing social networks, such as relatives, friends in peer groups, colleagues at work, or people who they have at least have heard of, rather than establishing new social relationships with complete strangers (Hofte, Mulder, & Verwijs, 2006). Communication between people who already have some degree of mutual understanding (e.g., personality and experience) and confidence in each other could be more effective and efficient, reducing the amount of time and cognitive operation required to negotiate rules, assign tasks, and build relationships around collective works (e.g., physical activities) or communications. The greater degree of familiarity and pre-existing emotional bond or trust may also help users to experience stronger levels of co-presence.

It should be highlighted that for health interventions to be effective, they should embedded into individuals' social lives; and context-aware mobile applications make the mediated world more relevant to real-life. These pre-existing relationships are likely to have strong ties that involve emotional support and accountability (White, 2010, p. 234). That means, one could differentially perceive the quality of emotional support, trust, friendships, and bonding with people they already know and that with strangers, avatars, or any other artificial social agents. Since the meaning of the content plays an important role in user's presence experience (Ijsselsteijn, de Ridder, Freeman, & Avons, 2000), it can be hypothesized that previous social interaction matters in user's co-presence experience in the gamified mHealth context.

Although several organizational communication research theories have proven that pre-existing social relationships influence an initial group task performance (Paris and Rollag, 2010), the effect of pre-existing social relationships have rarely been covered, neither in presence research nor in eHealth literature.

H2: When interacting with group of people with pre-existing relationships, the users would experience higher co-presence.

Spatial Presence Factor: Consistency of information with the objective world

Witmer (1998, p. 229) proposes the factors to contribute to a sense of presence in virtual reality environments as: 1) control factors (degree of control, immediacy of control, anticipation of events, mode of control, and physical environment modifiability), 2) sensory factors (sensory modality, environmental richness, multimodal presentation, consistency of multimodal information, degree of movement perception, and active search), 3) distraction factors (isolation, selective attention, and interface awareness), and 4) realism factors (scene realism, information consistent with objective world, meaningfulness of experience, field of view and seperation anxiety/disorientation).

Spatial presence has been discussed in terms of technological determinants and user-based determinants. Technological determinants of spatial presence are the degree of interactivity and multi-modality of mediated environment, and naturalness and realism of provided spatial information. Other user-centered determinants are an individual's attention to the mediated spatial environment, arousal level, and cognitive-spatial abilities (Hartmann, Klimmt, & Vorderer, 2010, p. 138). Presence research in virtual environments particularly emphasizes realism factors, ecological validity of the virtual environments, comparability to the reality. This tells us that, it is important to match things happening in the mediated world to the real-life phenomenon, so that media users' ideas, behaviors, and conversations span the real and the virtual more seamlessly.

Tang, Biocca and Lim's study (2004) proved that users in augmented reality environments scored higher on the ecological validity and naturalness factors than those in virtual reality environments. Individuals in the augmented reality environment receive and interact with unmediated cues (e.g., physical surrounding around the individuals) and mediated cues (e.g., sensory stimuli delivered via mobile devices) that match the physical surrounding at the same time. For example, when using the app, the users feel uphill resistance, wind movement, and many other natural physical forces as well as subtle cues such as smell, airflow, sound, mood, humidity, light that also contribute to context. In other words, by connecting and matching the real and the virtual, context-aware mobile devices would provide even more natural and seamless user experience, helping users' cognitive processes.

Furthermore, smart mobile devices which are equipped with the synergistic convergence of a camera, a location-acquisition technology (GPS), accelerometers, and proximity sensors, video chat, and Bluetooth connectivity, are able to deliver and receive a complex combination of stimulus modalities such as visual, auditory, even kinesthetics. Thanks to the context-sensing technology, mHealth app users' physical activities are reflected and synchronously updated on their mobile display in richer format. As a result, users may not experience significant differences between mediated and real environments.

Yates, Lee, & El Sawy (2005, p. 7) indicates that when mediated environments have many counterparts in the real world, users may feel more capable and confident using complex new technological tools and services. IJsselsteiijin et al. (2000, p. 521) suggest sensory-motor contingency—the match between sensor and the display—as one of the key determinants of presence. The increased sensory-motor synchronization would give users an enhanced sense of control and interactivity (e.g., sense of being able to influence the output on mobile display more intuitively), eliciting a higher sense of spatial presence in augmented reality spaces created by mHealth applications. Research indicates that when an embodied agent (e.g., avatar) is similar to a user himself in terms of appearance and behavior, the user senses a higher presence and shows a stronger willingness to perform an intended task (e.g., playing game) (Baileson, Beall, Blascovich, & Rammundo, 2001; Baileson, 2005; Ratan, Cruz, & Vorderer, 2007; Hoshi & Waterworth, 2009).

Hoshi and Waterworth (2009) emphasize the role of tangible tools in presence experience in that tangibility also allows more natural user experience, and matching between physical objects and digital representations. Our body is the most useful tool when experiencing the world around us; and the perspective from which a mediated world is presented, can govern our experience. Tangibility is closely related to first-person sensory experiences. With a context-aware mobile device, users take a first person perspective (unmediated bodily experience) along with a third person perspective (mediated experience) at the same time. As a result, users could more freely and intuitively navigate both mediated and non-mediated communication spaces.

All things considered, the current study proposes that compared to a virtual environment; in the augmented reality environment, users are more likely to experience a higher sense of spatial presence as naturally synchronizing mediated and unmediated contextual cues (Hoshi and Waterworth, 2009; Hoshi, Nyberg, & Ohberg, 2011). The higher consistency of information with the objective real world might increase the probability that mHealth application users feel as if they are physically or electronically “being there,” which consequently contributes to co-presence in the study’s context. However, there are still only a small amount of empirical studies providing conclusive support for this proposition. Based on the discussion, the current study hypothesizes that as bridging the real and the virtual, mobile-mediated communication conditions helps user to experience a greater sense of co-presence.

H3: Consistency of information with the objective world (realism and naturalness) is positively related to the level of co-presence.

To summarize, the current study predicts that the degree to which users experience co-presence in the gamified mHealth context may vary depending on relationship types (with vs. without pre-existing relationships), a perceived geographical proximity between social entities, and a degree of consistency of information with the objective world. The first set of hypotheses is visually described in the Figure 4 below.

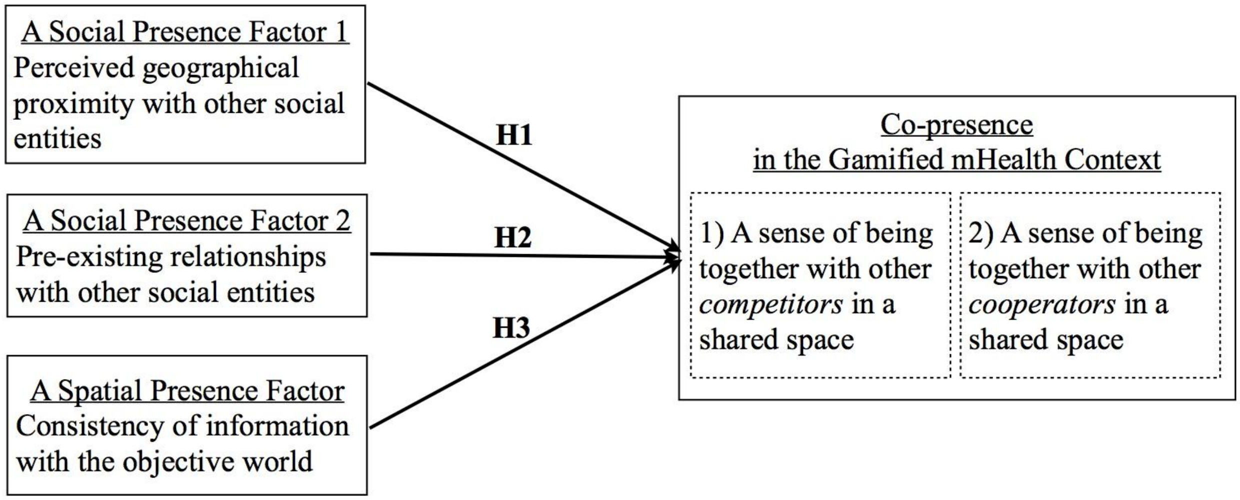


Figure 4. Hypothesized Determinants of Co-presence in the Gamified mHealth

RQ2. Do all three factors count equally toward the level of co-presence?

Effects of Co-presence on Health Outcomes in Gamified mHealth Contexts

RQ3. What effects does the experienced co-presence have on health outcomes?

In the previous section, it has been hypothesized that through the use of context-aware mobile technologies; users get a sense of being co-located and interacting with other social entities not only in a shared display, but also in a shared physical space (e.g., neighborhood). On top of that, the current study suggests that in the gamified mHealth context; the pattern of user interaction can be either competition or collaboration (or both). Based on that, we have arrived at the conclusion that co-presence in the gamified mHealth context has two aspects: a sense of being co-located and interacting with 1) competitors and 2) cooperators in either physical nearby or shared mediated spaces. Although the significance of experienced presence differs between individuals, previous studies on social presence found that social presence significantly influences users' social interaction (Short, Williams, & Christie, 1976), perceived playfulness of media content (Lee, Jeong, Park, & Ryu, 2011), and the degree to which a user trusts an online seller (Pavlou, Huigang, & Yajiong, 2005). While the effect of three different types of presence has been widely tested and empirically supported in virtual reality or online communication contexts, there is very limited evidence on the effect of co-presence in health communication or mobile-mediated communication contexts. Given that we hypothesized that, depending on different types of co-presence and varying levels of experienced co-presence, mHealth application users will get different degrees and types of health outcomes. This argument guides detailed research hypotheses which are to be discussed in the following section.

Defining health outcomes

Amongst health outcomes covered in previous research on health intervention for physical activity; the current study specifically focuses on three important health outcomes--perceived social support, exercise self-efficacy, and exercise adherence.

The definition of perceived social support is best summarized a being socially supported by others in one's digitally or physically immediate environment. According to health models on the interpersonal and community level, in developing and maintaining one's mental and physical health, the person's subjective evaluation of social bonds counts as a significant determinant. This concept is adapted to contemporary health models, emphasizing the relational quality in diverse health communication contexts including face-to-face and online (For example, see Greene, 2009), and the positive impact of social support across diverse health conditions and age groups (Fuchslocher, Emmerich, Masuch, & Krämer, 2012).

Bandura (1997, p. 3) defines self-efficacy as ‘‘beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments.'' According to Fletcher and Banasik (2001), the concept of exercise self-efficacy can best be defined as beliefs or convictions in one's capabilities to successfully plan and perform a desired physical activity, and overcoming barriers that deter the person from performing desired behaviors. Self-efficacy is one of the most widely researched concepts in health promotion, in that it can be both a determinant and a consequence of physical activity (McAuley & Blissmer, 2000). Researchers have also maintained that self-efficacy mediates the effect of health intervention on health outcomes such as the level of physical activities across various age groups (Strauss, Rodzilsky, Burack, & Colin, 2001; Lewis, Marcus, Pate, & Dunn, 2002). Song, Peng and Lee (2011) indicate that success in adopting and maintaining regular exercise habits is largely dependent upon an individual's exercise self-efficacy.

Furthermore, improvement in perceived social support and exercise self-efficacy will directly or indirectly affect exercise adherence. Ultimately, exercise adherence is the most desired outcome in health intervention on physical activities, referring to the strength of an individual's commitment to performing physical exercise. Enjoyment is one of the most important intrinsic motivations that drive people to do a given task. Each various game mechanic such as audio and visual elements, narrative, challenges, rewards, interactivity, and increased control over digital representation of players themselves, contributes to increased entertainment and enjoyable experience in a gamified context (Baranowski, Baranowski, Thompson, & Buday, 2011). Research proves that greater enjoyment associated with physical activity leads to an improvement in exercise adherence (Bartlett et al., 2011). Furthermore, presence studies demonstrated that there is a positive relationship between the level of presence and the degree of enjoyment or entertainment users feel in the course of performance. That means, a higher co-presence experience may indirectly increase exercise adherence. The detailed discussion is following.

RQ4. How different types and varying levels of co-presence are related to health outcomes--perceived social support, exercise self-efficacy, and exercise adherence.

Effect of sense of being co-located with cooperators

eHealth research indicates that person-like attributes of eHealth systems that elicit higher social presence, positively affect users' evaluation in their engagement with the systems, trustworthiness of information provided, and perceived social support (Walther et al., 2005; Hawkins et al., 2010). However, the effect of co-presence with cooperators who are also actual human is under-researched in the mHealth domain.

The needs for meaningful interpersonal relationships are one of the most inherent human needs. A lot of research has demonstrated that people who engage in meaningful social interaction experience a better psychological and physical health condition (for example, Baumeister & Leary, 1995; Cacioppo et al., 2008). This intuitively suggests that media conditions facilitating meaningful social interaction fulfill the inherent human needs to belong, and consequently fosters individuals' mental well-being and better health conditions, including being socially supported by others.

In the traditional sense, concerns over the antisocial impact of video games such as isolation, have been acknowledged (Blobel, Pharow, Sousa, & McCallum, 2012, p. 88). However, as discussed, context-aware mobile health applications offer users an opportunity to actively collaborate not only with significant others whom are linked via social networking sites, but also with complete strangers while establishing contacts with new acquaintances. Unlike simple social interaction, collaboration involves sharing ideas, contribution, discussion, interoperability, competencies, knowledge and information to accomplish a shared task or goal. Given this, a feeling of being in touch with cooperators in collaborative environments could give users a stronger sense of belonging and ownership. Through the meaningful social interaction, users may learn to develop social resources and the ability to resolve of future problems in connected spaces, which leads to an improvement in exercise self-efficacy and perceived social support. The sense of social support derived from this collaborative social interaction in shared a community can work as additional motivation for people to be more engaged in their healthy behaviors.

Meanwhile, Scott, Mandryk, and Inkpen (2003) emphasizes the important role of a shared display in increasing attention, involvement, and task outcome in the course of collaborative works within computer-mediated communication environments. This is because a shared display helps interaction partners' mutual understanding of both tasks and where their interaction partners are in relation to themselves. Although by "a shared display," Scott and his colleagues meant two students sharing one computer monitor to play cooperative game, their study provides valuable implications to understanding the importance of a physically and electronically shared space in facilitating effective and efficient cooperative works. To restate, mobile-mediated environments provide both physically and electronically shared communication space with their cooperators, so users experience increased exercise adherence. Based on this, we have arrived at the following hypotheses:

H4a: The degree of experienced co-presence (with cooperators) is positively related with the level of perceived social support.

H4b: The degree of experienced co-presence (with cooperators) is positively related with the level of exercise self-efficacy.

H4c: The degree of experienced co-presence (with cooperators) is positively related with the level of exercise adherence.

Effect of sense of being co-located with competitors

According to Lieberman (2006), people's primary motivation for playing interactive game is to have fun, followed by social interaction. Competition can invoke positively valenced feelings such as excitement, enjoyment, and challenge; and the induced positive emotions mediate improvement in performance in terms of task endurance (Cooke, Kavussanu, McIntyre, & Ring, 2011, p. 371). By employing this mechanism, health games provide competitive interaction as a powerful tool to engage and motivate users. Numerous studies have illustrated and proven that in competitive environments where virtual competitors are present, users show greater engagement, correlated with improvement in exercise self-efficacy and increased exercise effort, exercise adherence, enjoyment, and physical health (Timpka, Graspemo, Hassling, & Eriksson, 2005; Plante, Cage, Clements, & Stover, 2006; Rhodes, Warburton, & Bredin, 2009). Co-presence with virtual or actual competitors may result in a similar health outcome.

However, due to a smaller screen and other technological limitations, context-aware mobile applications are less capable of creating aurally and visually stimulating fictional environment, than computer-based serious health games are; but this weakness has turned into strength. As reviewed, mobile health applications create a stimulating competitive exercising environment among people in pre-existing social network. When a user wins against his competitors or successfully performs a challenging task, the user may get a sense of achievement (psychological rewards) and admiration for their skills as a reward (social rewards). This would possibly enhance self-efficacy for further desired behaviors in the future which, in the context of the study, is physical activity.

However, it should also be noted that since a mobile device is personal medium, most of gamified mobile health applications are played in a form that users competing as individuals rather than competing as a team. A sense of being digitally or physically co-located with competitors in the individual competition gaming environment may discourage sharing talents and exchanging support among users.

As reviewing literature, the study hypothesizes that co-presence with competitor will tap into motivational process, driving users' goal-directed behavior, aiming to improve upon previous literature that has evaluated the effects of competitive interaction on health outcomes and to extend prior research into the domain of mHealth.

H5a: The degree of experienced co-presence (with competitors) is negatively related with the level of perceived social support.

H5b: The degree of experienced co-presence (with competitors) is positively related with the level of exercise self-efficacy

H5c: The degree of experienced co-presence (with competitors) is positively related with the level of exercise adherence.

Effect of co-presence with both competitors and cooperators

The present study predicts that depending on different type of co-presence and varying level of experienced co-presence, mHealth application users will get different degree and type of health outcomes. However, this argument can be refuted because, as aforementioned, there is a possibility that a user experience two different types of presence at the same time. To illustrate, *Zombies, Run!* offers several communications tools. *Zombies, Run!* users could experience as if they are co-located with and competing against Zombies (artificial social agents) in the gaming contexts. At the same time, they also share their experience with other users (cooperators) in

Facebook page to exchange feedbacks. In this regard, the study hypothesizes the effect of overall co-presence experience on the health outcomes, too.

H6a: The degree of experienced co-presence is positively related with the level of perceived social support.

H6a: The degree of experienced co-presence is positively related with the level of exercise self-efficacy

H6c: The degree of experienced co-presence is positively related with the degree of exercise adherence.

Summary of the Conceptual Framework

The main purpose of the current study is twofold: 1) to explore important factors in mobile-mediated communication conditions that affect users' co-presence experience in the gamified mHealth context and 2) to empirically assess the effects of co-presence on perceived social support, exercise self-efficacy, and exercise engagement, focusing on the role of social facilitation. The current study hypothesizes that perceived characteristics of interaction environments--either competitive or cooperative--and that of counterparts--either competitors or cooperators--may elicit changes in health outcomes.

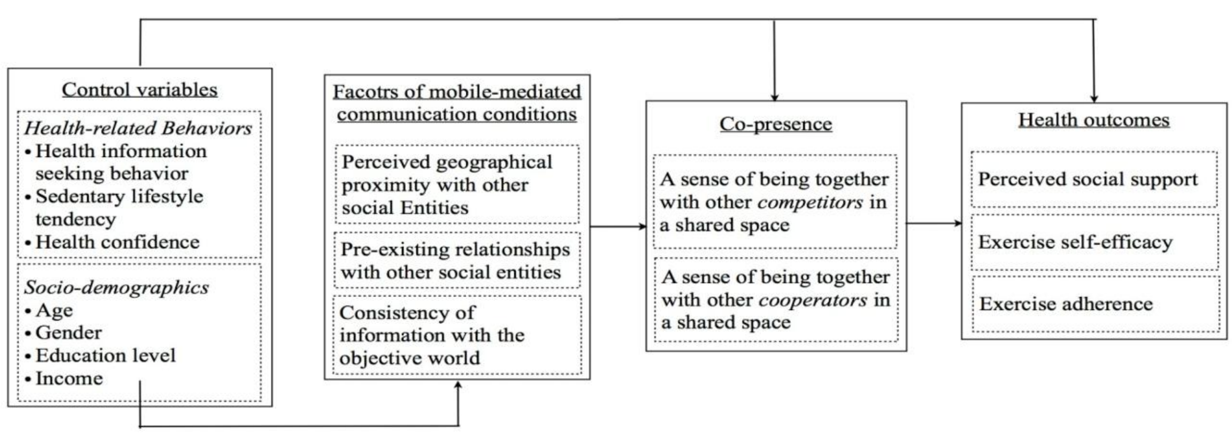


Figure 5. The Conceptual Framework of the Research

CHAPTER 4

RESEARCH METHOD

Overview of Research Design

The current study proposes that the unique technological affordance of context-aware mobile technology and the interaction paradigm in gamified mHealth context may affect user's co-presence experience. The main purpose of the current study is twofold: 1) to explore how factors like perceived geographical proximity, pre-existing relationship, and consistency of information with the objective world--affect users' presence experience in the context-aware mobile-mediated communication context, and 2) to empirically assess relationships between users' co-presence experience and health outcomes—perceived social support, exercise self-efficacy, and exercise engagement. Health-related mobile applications currently available on the mobile application market are great media artifacts to explore research questions, hence, the users of those applications were selected as the target sample of the research. A cross-sectional study is designed to look at users experience associated with the usage of the applications. In order to efficiently reach and collect data from the users, an online-based survey was administered to a convenience sample of users of mHealth applications through Qualtrics. Research hypotheses were examined by testing correlations between variables.

Data Collection and Sampling Procedure

mHealth apps selection

The empirical examination focuses on the mHealth applications and user experience associated with those applications currently available in the market. On November 2012, as a preliminery work for the study, Health/Fitness and Lifestyle categories in Apple iTunes App Store were reviewed and a list of twenty apps were: 1) primarily designed to promote daily physical activities (e.g., running, bicycling etc.) and 2) equipped with context-aware components (e.g., GPS) was compiled. Then, by using the Google search function, each app's user community (e.g., official Facebook page, Twitter account) were identified. The users of the twenty sampled mHealth apps were targeted as potential survey participants. The list of sampled apps and the web addresses (URLs) of the each app's user community are provided in Appendix D.

Participant recruitment

The online questionnaire (http://tinyurl.com/2013gamified) was distributed to targeted sample from February 2th to March 10th, 2013. The convenience sampling method was used to reach the actual users. Survey participants were recruited through online user communities of the sampled apps including official or unofficial Facebook pages and Twitter accounts. Typically, the list of people who were following official Twitter accounts were publicly available; anyone can browse and has access to people who Liked or left comments on wall-posts on online user communities.

In order to effectively reach the users, a message containing a brief summary of the study and the link for the self-administered web-based questionnaire was sent to users via communities in Facebook and Twitter by using the personal message option provided in the social-networking sites. As many as three attempts were made to contact every sampled user. The brief recruitment messages were also posted in the user communities so that unreached users could participate in the online survey.

Additionally, UGA students who have used mHealth applications were also recruited through in-class announcement of one introductory social science class and on on-campus flyers. Both the in-class announcement and on-campus flyers provided specifics on the purpose of the study, the procedures, length of the survey, the online survey address, the deadline, and the researchers' contact information.

Although there was no monetary compensation, all recruited individuals were given an opportunity to enter a drawing for $10 Starbucks gift card, regardless of whether they chose to participate. The chance of winning was 1/50 (2%). For UGA students who were recruited from the introductory class at UGA, they received extra credit as a reward for their participation in this study.

Procedure

Survey participants who followed the link were presented with a written statement of the study that specified the goals and scope of the research along with an informed consent form. Through the informed consent form, all recruited individuals were asked if they agreed or disagreed to participate in the online survey. If someone disagreed, that person was directed to the last page of the survey which had optional incentive questions, asking for his or her contact information (e-mail address) to enter the drawing or UGA student number for extra credit. Every participant was given random ID numbers upon his or her agreement or disagreement of survey participation. Personal information was recorded by different random IDs and stored in separate data sets so that the responses and personal information could not be connected or tracked back to an individual participant. If one agreed, that person was asked to proceed with the questionnaire.

The first page of the online survey clarified that the research was only intended for people who had previous experience with health-related mobile applications. Eligibility for survey participation was re-verified by the first two questions at the beginning of the online questionnaire (i.e., “Have you ever used any mobile software application (apps) that 1) helps your physical activity, AND 2) that has GPS features to track your physical activities?”, and “Please check all the mobile software application(s) that you have used before in the list provided below”). In the case of respondents who answered that they had no experience, they were directed to the optional incentive questions.

The online survey was facilitated by Qualtrics and organized into six parts. After answering eligibility verification questions, participants were provided with the first set of multiple choice questions that were designed to measure user experience with mobile health applications in terms of respondents’ perceived geographical proximity with other social entities, their real-life relationship with the social entities, and their perception toward consistency of information provided with the objective world, and also their co-presence experience. The second part of the survey included questions to assess respondents’ exercise self-efficacy and perceived social support. Then, participants were asked about their physical activity in terms of the frequency per week and duration per application usage. The third part consisted of questions asking respondents’ media usage, health information seeking behavior, sedentary lifestyle tendency, and their self-confidence in managing and dealing with personal health issues. The last part of questionnaire asked for respondents’ socio-demographics. Each questionnaire item could be skipped as participants wished. In all cases, participation took about 5-15 minutes to complete.

Participants

In total, 273 people completed the online survey; however, 61 people who had no prior experience with health-related mobile applications were screened by the participant eligibility questions. Additionally, to avoid counting dishonest answers, cases in which respondents answered all multiple choice questions with the same answer were excluded from the analysis. Overall, the final sample consisted of 190 respondents. 72.1 % of respondents were female (N = 132) and 27.9% were male (N = 51); the gender of 7 participants were not identified. The ages of the participants ranged from 18 to 64. The majority of participants (N = 141, 74.2 %) were between the age of 18 and 24. In terms of the education levels, 74.1% of respondents (N = 137) were identified as college students, followed by 15.7% of participants (N = 29) who had received a college degree. Compared to age, gender, and education levels, income levels were normally distributed. Table 2 illustrates the socio-demographic information of the survey respondents.

Measurement

The online questionnaire was designed for the users of the sampled mobile health application to measure their experience associated with the application they were currently using. Although the study tried to use item and scales wherever possible, several questions and scales had to be modified or self-developed in consideration of the context of our study.

Respondents answered online surveys consisting mostly of multiple-choice items, each of which began with “how much do you agree or disagree with the following statements?” Most of the items were anchored in a binary or a five-point Likert scale using radio buttons (e.g., "strongly disagree," "disagree," "normal," "agree," "strongly agree"). The "strongly agree" response was assigned a score of 5, the "strongly disagree" response was assigned a score of 1. Certain continuous variables such as minutes of exercise per one mobile application usage and the number of people they perceive they interact via mHealth applications was recorded using open-ended text fields. To further explain the details of measurements, the copy of online questionnaire is provided in Appendix F.

Pre-existing relationships with other social entities

To see if users interact with someone whom they already know in real-life via mobile application and to assess the type of relationships, three questions were asked: 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, and 3) Most of the people that I interact with through the apps are strangers. Each item was anchored on a 5-point Likert-type scale affixed by strongly disagree (1) and strongly agree (5). The third item was reverse-coded as necessary prior to calculating the total scale score so that high scores indicated respondents' high agreement with the concept that most people they interacted with via mobile health applications were people in their pre-existing social network. To determine the average on the 5 point scale, divide each total by 3. Overall, the mean scores of pre-existing relationships items ranged from 2.79 to 3.24 ($\alpha = .721$).

Perceived geographical proximity with other social entities

Respondents' perception toward geographical proximity between social entities was measured by employing five items: 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, 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 that I interact with via those apps are living in the same city with me, and 5) most of the people that I interact with via those apps are living in the same district (e.g., county or neighborhood) with me. Respondents were asked to indicate how strongly they agreed or disagreed with the statements. The sum of the scores for the five items was taken so that there was a single index for perceived geographical proximity between social entities. The scores of perceived geographical proximity items ranged from 2.91 to 3.84 ($\alpha = .873$).

Consistency of information with the objective world

Consistency of information with objective world refers to users' evaluation on the degree of coherence and matching between the real (e.g., physical surrounding, and real-world conditions) and the virtual (e.g., digital representation the real world). The variable is measured based on factors following factors: perceived control, realism, and distraction. To do so, the study adopted questionnaire items that Regenbrecht and Schuber (2002) initially designed to measure in augmented reality environments. The items are: "When using the application, I have the impression that the virtual objects belong to the real object (Realism)", "When using the application, I have a sense of acting in the mobile-mediated environment, rather than operating something from outside (", "When using the application, I feel that the displayed environment--the audio and video display of the environments--was part of the real world", and "When using the application, I feel that the digital objects visualized on my mobile screen actually appear to be located in the radius of my everyday life." Also, one of items that Witmer and Singer (1998) developed to measure distraction factors in virtual environments was selected and modified in order to better apply the mobile-mediated environments ("When using the application, I feel that the scenes depicted in the apps could really occur in the real world"). Additionally, an item that Slater, McCarthy, and Maringelli (1998) employed to assess realism factors affecting presence in virtual reality context was also adopted relative to the context of the current study ("When using the application, I think of the world that I experience through my mobile device as somewhere that I have visited”). Each item is assessed using a 5-point Likert-type scale. The mean scores of items for consistency of information with objective world ranged from 2.98 to 3.65 (α = .882). Table 3 illustrates details of items that are used to measure user perception toward mobile-mediated communication conditions.

Co-presence

By explicating the concept of co-presence in the gamified mHealth context as an individual’s subjective sense of being together with either competitors or cooperators in a physically or digitally shared space; the study expected two sub-dimensions of co-presence: 1) co-presence with competitors, and 1) co-presence with cooperators. Due to a limited scope of previous research on co-presence, there was no concrete measure for co-presence in the mobile-mediated environment. Given that, co-presence items were self-developed and adopted items that were used in studies on user interaction in collaborative or competitive environments (Johnson & Johnson, 1996; Curtis & Lawson, 2001; Toscos, Faber, Connelly, & Upoma, 2008; Lee, Jeong, Park, 2011;), modifying some wordings relative to the context of this study.

A sense of being co-located competitors was measured based on the level of respondents’ agreement (1 = strongly disagree, 5 = strongly agree) with the following four statements: 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, and 4) When using the application, I am depressed when I feel everyone is doing better than me in terms of exercise. The mean scores of all items ranged from 2.89 to 3.46 (α = .756).

A sense of being co-located cooperators was measured based on the level of agreement (1 = strongly disagree, 5 = strongly agree) with the following five statements: 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, and 5) In the course of using the apps, I have a sense that I was in the same place as the cooperators. The mean scores of items ranged from 2.89 to 3.64 ($\alpha = .813$). Table 4 shows co-presence items with the scores of mean and standard deviation for each item.

Perceived social support

To assess how differently respondents perceive that they are socially supported by others in the course of their mobile health application usage; this study employed the format of Zimet, Dahlem, Zimet, & Farley (1988)'s the Multidimensional Scale of Perceived Social Support (MSSPSS). Perceived social support was measured by respondent agreement to eight phrases: When using the application, 1) there are people who are around when I am in need, 2) there are whom I can share my joys and sorrows, 3) I get the emotional help and support I need from other people, 4) I have people who are a real source of comfort to me, 5) I can count on other people when things go wrong, 6) I can talk about my problem with other users, 7) there are people in my life who care about my feelings, 8) other users are willing to help me make decision. Ratings were made on a 5-point Likert-type scale with response options ranging from 1 (strongly disagree) to 5 (strongly agree). The mean scores of items ranged from 3.23 to 3.92 ($\alpha = .938$).

Exercise self-efficacy

The current study defines exercise self-efficacy as beliefs or convictions in one's capabilities to successfully plan and perform a desired physical activity. The items to measure respondents' exercise self-efficacy were adopted from the Physical Activity Self-Efficacy Scale

(PASES) conducted and validated by Bartholomew, Loukas, Jowers, & Shane Allua (2006). Since PASES was originally developed and widely utilized in studies on children's exercise self-efficacy. PASES assesses one's exercise self-efficacy based on three sub-scales: barriers to be physically active, support seeking, and positive alternatives. Some wording had to be changed so that questions could properly address the current study's target sample (e.g., deletion of expression like "after school"). In consequence, exercise self-efficacy was assessed based upon the level of agreement (1 = strongly disagree, 5 = strongly agree) with the following seven statements: When using the application, 1) I can be physically active even if I could watch TV/play video games, 2) I can be physically active even if it is very hot or cold outside, 3) I am be physically active even if I have to stay at home, 4) I can be physically active no matter how busy my day is, 5) I can be physically active most days, 6) I can ask others (e.g., family members or friends) to do physically active things with me, and 7) I have the skills I need to be physically active. The mean scores of exercise self-efficacy items ranged from 2.93 to 3.99 ($\alpha = .766$).

Exercise adherence

Exercise adherence refers to the strength of an individual's actual commitment to performing physical exercise. To assess users' exercise adherence, the open-ended question "On the days that you do any physical activity or exercise of at least moderate intensity with mobile health applications, how long are you typically doing these activities?" was asked. The duration of exercise per usage ranged from 0 to 120 minutes ($M = 55.14$, $SD = 23.74$). 33.9% of respondents ($N = 62$) answered that they usually work out 60 minutes per usage, followed by 19.1% of respondents ($N = 35$) who answered that they work out for 30 minutes, 45 minutes (16.4%, $N = 30$), and 90 minutes (12.6%, $N = 23$). Table 5 shows items for perceived social support, exercise self-efficacy, and exercise adherence with the scores of mean and standard deviation.

Control variables

The study included two types of control variables: socio-demographics and health-related pre-existing behaviors. All items are slightly modified versions of the HINTS 2012 (Cycle 1) survey materials which are publicly available[6].

Socio-demographic factors in the self-administered questionnaire included age, gender, education and income levels, and those served as control variables in the theoretical model. Educational level was classified into three categories: 8th grade or less, some high school, high school graduate, some college, college graduate, postgraduate study/law or medical school. In answers for all four questions; responses recorded as 'don't know/prefer not to answer' were recorded as missing and for gender, female was coded as 0, male was coded as 1.

Health-related behavior factors such as online health information seeking behavior, sedentary lifestyle tendency, and health confidence were also included as control variables in the theoretical framework in order to isolate other external factors that effect of pre-existing individual differences in health behaviors and to rule out alternative explanations for association between predictors and effects.

Online health information seeking behaviors were measured by multiple binary choice items adapted from HINTS 2012 (Cycle 1) survey materials. The items are: "In the last 12 months, have you used the Internet" 1) To participate in an online support group for people with a similar health or medical issue, 2) To buy medicine or vitamin online, 3) To download health-related information--including apps--to mobile device, such as mp3 players, smartphone, tablet computer (e.g., iPad), or electronic book device (e.g., Kindle), 4) To visit a social networking sites, such as Facebook or Twitter to read and share about health information, 5) To keep track of personal health information such as care received, test result, or upcoming medical appointments, 6) To look for health or medical information for someone else, and 7) To look for health or medical information for yourself. The answers were recorded as No = 0, Yes = 1. By summing up the scores for the seven items and dividing the value by 7, a single scale for online health information seeking behavior was created. Out of a total score of 7, the mean was 3.87 and the standard deviation was 1.60. Table 6 illustrates items of online health information seeking behaviors with frequency and percentage distribution; Table 7 provides frequency and percentage distribution of computed online health information seeking measures.

Sedentary lifestyle tendency were measured by two questions 1) In a typical week, how many days do you do any physical activity or exercise of at least moderate intensity, such as brisk walking, bicycling at a regular pace, and swimming at a regular pace per week? [Reverse Coded] (scale range from 0 = never to 7 = everyday; *M* = 3.52, *SD* = 1.622), and 2) Over the past 30 days, in your leisure time, how many hours per day, on average, did you sit and watch TV or movies, surf the web, or play computer games? (1 = Less than a half hour, 2 = 30 minutes to less than one hour, 3 = About an hour, 4 = More than one hour but less than two hours, 5 = Two hours to less than three hours, 6 = Three hours to less than four hours, and 7 = Four hours or more; *M* = 4.98, *SD* = 1.552). The scores of the two items were summed up and divided by 2 to generate a single scale for sedentary. Table 8 illustrates sedentary lifestyle tendency items with the scores of mean and standard deviation; Table 9 provides frequency and percentage distribution of respondents' total scores on sedentary lifestyle tendency.

Health confidence was measured via a three item self-report measure that was borrowed from the HINTS 2012 (Cycle 1) survey materials: 1) Overall, how confident are you that you could get advice or information about health or medical topics if you needed it?, 2) Overall, how confident are you about your ability to take good care of your health?, and 3) How confident are you that you have some say in who is allowed to collect, use and share your medical information? Each answer was scored on a 5-point Likert scale (1 = Not at all confident to 5 = Completely confident). The mean scores of items ranged from 3.55 to 3.93 ($\alpha = .752$). Then, the study created a composite health confidence measure by averaging the three questions. Higher scores indicated higher levels of health confidence ($M = 3.77$, $SD = .623$). Table 10 and 11 provide detailed information of the health confidence items used in this study.

Data Analysis

First, frequency and descriptive statistics were used to describe the background information of participants--in terms of age, gender, education and income level--, their online-health information seeking behaviors, sedentary lifestyle tendency, and health confidence. Then, zero-order correlation analysis was used to explore associations between all research variables. Reliability of measurement was tested through Cronbach's alpha statistic. To test hypotheses, initially, multiple regression analysis was performed. However, in the course of conducting multiple regression tests, collinearity diagnostics suggested that predictor variables were related to other predictor variables, which moderately affect the stability and variance of regression estimates. Given that, alternatively, two partial correlation analysis were conducted controlling for 1) socio-demographics and health-related behavioral factors (online health info seeking, sedentary lifestyle tendency, and health confidence, and 2) socio-demographics and health-related behavioral factors, and factors of mobile-mediated communication condition. IBM SPSS Statistics for Mac 18.0 was used to carry out all statistical analysis.

Construct Validation and Reliability Assessment

Exploratory factor analysis

Factors of mobile-mediated communication conditions

The factorability of the 14 mobile-mediated communication items was examined. Several well-recognized criteria for the factorability of a correlation were used. As a result, all items correlated at least .3, suggesting reasonable factorability. Secondly, the Kaiser-Meyer-Olkin measure of sampling adequacy was .869, above the recommended value of .6, and Bartlett's test of sphericity was significant (χ^2 (91) = 1558.009, p <.01). The diagonals of the anti-image correlation matrix were all over .6, supporting the inclusion of each item in the factor analysis. Finally, the communalities were all above .5 (see Table 12), further confirming that each item shared some common variance with other items. Given these overall indicators, factor analysis was conducted with all 16 items.

Principle components analysis was used because the primary purpose was to identify and compute scores for each variable. The initial eigen values showed that the first factor explained 45.4% of the variance, the second factor 13.5% of the variance, and a third factor 7.7% of the variance. The fourth, fifth and sixth factors had eigen values of just over one, each factor explaining less than 6%. Three, four, five and six factor solutions were examined, using both varimax rotations of the factor loading matrix. The three factor solution, which explained 66.5% of the variance, was preferred because of its previous theoretical support, the 'leveling off' of eigen values on the scree plot after three factors, and the insufficient number of primary loadings and difficulty of interpreting the fourth factor and subsequent factors.

No item was eliminated because every item contributed to a simple factor structure, and met the minimum criteria of having a primary factor loading of .04 or above, and no cross-loading of .3 or above. A principle-components factor analysis of the remaining 14 items, using Varimax rotations was conducted, with the three factors explaining 66.5% of the variance. All items had primary loadings over .5. The factor loading matrix for this final solution is presented in Table 12.

Co-presence

The factorability of the 9 co-presence items was measured. As a result, all items correlated at least .3, suggesting reasonable factorability. Secondly, the Kaiser-Meyer-Olkin measure of sampling adequacy was .761, above the recommended value of .6, and Bartlett's test of sphericity was significant (χ^2 (36) = 561,729, p <.01). The diagonals of the anti-image correlation matrix were all over .8, supporting the inclusion of each item in the factor analysis. Finally, the communalities were all above .3 (see Table 13), further confirming that each item shared some common variance with other items. Given these overall indicators, factor analysis was conducted with all 9 items.

Principle components analysis was used because the primary purpose was to identify and compute scores for each variable. The initial eigen values showed that the first factor explained 35.5% of the variance and the second factor 23.3% of the variance. The third, fourth and sixth factors had eigen values of less than one, each factor explaining less than 9%. The two factor solution, which explained 58.7% of the variance, was preferred because of its previous theoretical support, the 'leveling off' of eigen values on the scree plot after three factors, and the insufficient number of primary loadings and difficulty of interpreting the fourth factor and subsequent factors.

No item was eliminated because every item contributed to a simple factor structure, and met the minimum criteria of having a primary factor loading of .04 or above, and no cross-loading of .3 or above. A principle-components factor analysis of the remaining 9 items, using Varimax rotations was conducted, with the three factors explaining 58.7% of the variance. All items had primary loadings over .6. The factor loading matrix for this final solution is presented in Table 13.

Reliability check

To verify the internal consistency of each scale, Cronbach's alpha coefficient was computed on eight constructs: health confidence (3 items), pre-existing relationship (3 items), geographical proximity (5 items), consistency of information with the objective world (6 items), co-presence with competitors (4 items), co-presence with cooperators (5 items), perceived social support (8 items), and exercise self-efficacy (7 items). An initial assessment of each scale was conducted by calculating the internal reliability (Cronbach's α) of each scale. The range of the alpha coefficients was from .721 to .938. The generally agreed upon lower limit for Cronbach's alpha is .70 (James, Demaree, & Wolf, 1984; MacKenzie, Podsakoff, & Jarvis, 2005), the values of the current study satisfied the cutoff as follow: < = .721 (pre-existing relationship), < = .873 (perceived geographical proximity), < = .882 (consistency of information with the objective world), < = .756 (co-presence with competitors), < = .938 (co-presence with cooperators), < = .766 (exercise self-efficacy), and < = .743

CHAPTER 5

RESULT

Descriptive Statistics of Variables

Table 14 presents descriptive statistics including variable means, standard deviations, skewness, kurtosis, and alpha value. The majority of respondents were highly educated females who aged between 18 and 24. The skewness and kurtosis of control variables, except health confidence, fell outside of a tolerable range for assuming a normal distribution.

Regarding online health information seeking, the level of online health information seeking behavior (*M* = 3.87, *SD* = 1.597) was only slightly higher than the median score that is 3.50. For sedentary lifestyle tendency, the mean value of the respondents' sedentary lifestyle tendency was 4.27 (*SD* = 1.132) with a median value of 3.50.

Since the current study included the amount of time spent on media usage as one of factors in sedentary lifestyle tendency, this can be explained by the characteristics of survey participants—young adults were the most active and heavy internet users[7]. The mean value of health confidence was 3.77 (*SD* = .623).

Among three hypothesized factors affecting the level of co-presence, respondents most strongly agreed with the statement that other social entities they are interacting with via mobile application are located in their physical vicinity (*M* = 3.34. *SD* = .949), followed by that they perceive the information provided by mobile applications as consistent with the real world (*M* = 3.28, *SD* = .850), and that they have pre-existing relationships with the other users (*M* = 3.18, *SD* = .994).

The mean score for co-presence with competitors (*M* = 3.23, *SD* = .870) was only negligibly different from the mean score for co-presence with cooperators (*M* = 3.20, *SD* = .775). A paired sample t-test was conducted; and the result confirmed that there was no statistically significant difference between the two constructs. The mean score for perceived social support and exercise self-efficacy was 3.68 (*SD* = .938) and 3.62 (*SD* = .602) respectively. Lastly, the mean score and standard deviation for exercise adherence was 55.14 and 23.740 (minutes). Normality problems were not found in predictor variables and responding variables. The skewness and kurtosis values of other constructs were well within a tolerable range for assuming a normal distribution and examination of the histograms suggested that the distributions looked approximately normal (see Figure 6 and Figure 7). Descriptive statics for research variables are presented in Table 14.

Correlational Analyses

Prior to testing the hypotheses, zero-order relationships among variables were initially observed. Overall, the results of the correlational analyses presented in Table 15 show that 47 out of 120 correlations were statistically significant. Among the 47 correlations, 26 correlations fell between range from ± .20 to ± .30 (weak positive or negative relationship); 9 correlations fell between range from ± .30 to ± .40; 2 correlations fell range from ± .40 to ± .50; and 6 correlations were greater than ± .50 (strong positive or negative relationship).

First of all, as shown in Table 15, socio-demographic factors predicts differences in health-related behavior factors such as online information seeking behaviors, health confidence, perceived social support, exercise adherence. Particularly, health confidence was negatively associated with age (r =-.266, p <.01), education level (r =-.201, p <.01), sedentary lifestyle tendency (r =-.204, p <.01), and positively associated with income level (r =.298, p <.01).

There was a moderate positive association between health information seeking behaviors and co-presence with cooperators. Sedentary lifestyle tendency was negatively associated with the degree of exercise self-efficacy ($r = -.204$, $p < .01$). Health confidence was negatively associated with respondents' estimation on perceived geographical proximity ($r = -.213$, $p < .01$) and consistency of information with the objective world ($r = -.373$, $p < .01$) while being positively associated with exercise self-efficacy ($r = .307$, $p < .01$).

Pre-existing relationship was strongly and positively related to the level of perceived geographical proximity between social entities ($r = .577$, $p < .01$) and moderately and positively related to users' estimation on information consistency ($r = .387$, $p < .01$), co-presence with cooperators ($r = .313$, $p < .01$), co-presence ($r = .273$, $p < .01$), and perceived social support ($r = .226$, $p < .01$). Perceived proximity had positive association with information consistency ($r = .544$, $p < .01$), co-presence with competitors ($r = .290$, $p < .01$), co-presence with cooperators ($r = .454$, $p < .01$), co-presence ($r = .468$, $p < .01$), and perceived social support ($r = .218$, $p < .01$).

Furthermore, the more highly a respondent evaluates the information they receive via mobile health application is consistent with the objective world, the stronger their sense of co-presence with competitors ($r = .198$, $p < .01$), cooperators ($r = .357$, $p < .01$), and both ($r = .349$, $p < .01$). A weak, but positive association between co-presence with competitors and co-presence with cooperators was also founded ($r = .223$, $p < .01$), which tells us users feel as if they are co-located with competitors and cooperators at the same time.

It was also found that co-presence with competitors is positively associated with exercise self-efficacy ($r = .189$, $p < .01$). Perceived social support showed a strong positive association with co-presence with cooperators ($r = .531$, $p < .01$). Finally, perceived social support is positively associated with exercise self-efficacy ($r = .368$, $p < .01$).

Effect of Control Variables

It was assumed that socio-demographic variables (age, gender, education and income levels) and health related behavioral factors might affect the respondents' subjective evaluation on mobile-mediated communication conditions and their co-presence experience. Thus, socio-graphic variables and health-related behavioral factors were treated as control variables in this study. Table 16 and 18 show zero-order correlations and partial correlations as holding constant the values of control variables.

In Table 16, amongst socio-demographic variables, education level partially and negatively affected the degree to which users sensed they were co-located and interacted with competitors in a shared space at the significant level of .05 (r =-.157, p <.05). Also, the results showed that how actively users take advantage of the Internet as a source for health information is positively and significantly associated with the degree of experienced co-presence with cooperators (r =.231, p <.01) and the degree of experienced co-presence with both cooperators and competitors (r =.190, p <.05). Respondents health confidence showed a negative association with the level of experienced co-presence at the significant level of .01 (r =-.155, p <.01).

In Table 17, age was negatively associated with the level of perceived social support (r =-.148, p <.05). Also, men tended to show greater exercise adherence than women (r =.195, p <.01). The degree of perceived social support was negatively affected by respondents' varying education levels (r =-.172, p <.05). It has also been shown that respondents' income levels did not affect their co-presence experience and health outcomes differently.

Regarding the effect of respondents' pre-existing health-related behavioral factors on health outcomes, online health information seeking is positively associated with the degree of perceived social support (r =.171, p <.05). Sedentary lifestyle tendency especially, had a relatively strong negative effect on exercise self-efficacy (*r* =-.315, *p* <.01) and exercise adherence (*r* =-.213, *p* <.05), compared to the effects of other control variables. Finally, health confidence was negatively related to the degree to which respondents experienced co-presence (*r* =-.155, *p* <.01). Given these effects of socio-demographic factors and respondents' health-related behaviors; it can be argued that the study was able to see genuine correlations between variables of the study's interest by filtering out those factors.

As shown in Table 17, the results of additional partial correlation analysis showed the significant positive correlation coefficient of perceived geographical proximity with perceived social support (*r* = .299, *p* < .01) and exercise self-efficacy (*r* =.224, *p* < .01). That is the geographically and physically closer to other interaction counterpart, the stronger sense of social support one gets and the higher exercise self-efficacy one shows. In addition, it was also found that the positive relationship between pre-existing relationship and social support (*r* =.171, *p* < .05) and between pre-existing relationship and exercise self-efficacy were also statistically significant (*r* = .224, *p* < .05). The consistency of information with the objective was also positively associated with perceived social support (*r* =.195, *p* < .05) and with exercise self-efficacy (*r* =191, *p* < .05) while being negatively related to exercise adherence (*r* =-.221, *p* < .05). In other words, the degree to which the mobile-mediated information is analogous to users' real-time activity is positively related to the extent to which the users perceive social support, and their exercise self-efficacy. However, interestingly, the consistency of information with users' real-time activity is negatively associated with the users' exercise endurance.

Hypotheses Tests

The present study has 12 hypotheses predicting the relationships between mobile-mediated environment conditions and co-presence, and between co-presence and health outcomes within the condition of controlling socio-demographic factors and health-related individual differences that may hinder us to test the pure association between variables of the study's interest. Each hypothesis was tested by the significance of the partial correlation coefficients. The criterion for the test of the hypotheses was fixed at the significance level of .05.

Table 16 represents partial correlation between communication conditions (media conditions) and the level of two types of co-presence and overall co-presence experience (co-presence with both competitors and cooperators), after controlling for socio-demographic and health-related behavioral factors. Hypothesis 1 predicted that the degree of perceived geographical proximity with other social entities is positively associated with the level of co-presence. The results showed that the degree of perceived geographical proximity with other social entities was significantly and positively related to the level of three types of co-presence, supporting hypothesis 1 (co-presence with competitors r =.366, p <.01; co-presence with cooperators: r =.477, p <.01; co-presence with both: r =.508, p <.01). This indicates that in the gamified mHealth context, the more users perceive other interaction counterparts are located physically nearby, the greater co-presence they experience. Perception toward geographical proximity was a positive predictor of the level of co-presence.

Hypothesis 2 predicted that the effect of pre-existing relationships between users on the level of co-presence. As Table 16 shows, the level of respondents' agreement on the statement if they have pre-existing relationships with social entities they interact with via mobile health application is positively related to the degree of experienced co-presence with competitors (r =.181, p <.05), with cooperators (r =.280, p <.01), and with both (r =.288, p <.01). This means that when users perceive their interaction counterparts as people they already know, they experience a stronger sense of being co-located in a physical or electronically shared space. Hypothesis 2 was also supported.

Hypothesis 3 predicted the positive effect of the consistency of information with the objective or real world on the level of co-presence. As shown in Table 16, partial correlation coefficients between the degree of information consistency and three different types of co-presence were statistically significant: co-presence with competitors r =.200, p <.05; co-presence with cooperators: r =.326, p <.01; co-presence with both: r =.327, p <.01. This supports hypothesis 3 that predicts the extent to which users perceive mobile-mediated experience as consistent with the objective world is positively related to the level of co-presence.

Overall, although variables of mobile-mediated communication conditions were more strongly related to co-presence with cooperators (or both) than co-presence with competitors, from the results, it can be inferred that all hypothesized factors are positively contributed to the degree of three types of co-presence that users experience via mobile health application.

Controlling for the values of socio-demographics and health-related behavior, and communication condition factors, partial correlation analysis was conducted in order to see the genuine association between three types of co-presence and health outcomes, independent of the effect of communication condition on health outcomes. The lowest three rows in Table 17 show the partial correlations between the levels of different types of co-presence and health outcomes, holding constant the values of socio-demographic, health-related behavioral, and communication condition (media condition) factors.

The partial correlation coefficients between the degree of co-presence with cooperators and the level of perceived social support was statistically significant (r =.501, p <.01), supporting H4a. That is, when users feel as if they are co-located and collaboratively interact with other people; they experience a stronger sense of being socially supported by others. Furthermore, the relationship between co-presence with cooperators and exercise adherence was found to be significant (r =.200, $p < .01$); therefore H4c was also supported. However, the results demonstrated that the correlation coefficients between co-presence with cooperators and exercise self-efficacy (r = -.106, p = .228) was not significant; H4b was not supported.

However, none of correlation coefficients between co-presence with competitors and three health outcomes was statistically significant. That being said, a sense of being together with competitors in a shared space was not inversely nor positively related to users' perception toward social support, their exercise self-efficacy, and exercise adherence. Therefore, H5a, b, and c were not supported.

The study also hypothesized that regardless of its type, co-presence would contribute to increases the level of perceived social support (H6a), the level of exercise self-efficacy (H6b), and exercise adherence (H6c). The results suggested there is only positive association between the degree of experienced co-presence and the extent to which users sensed social support (r =.355, p <.01), supporting H6a. Interestingly, however, the correlations efficient between co-presence with both types of interaction counterparts and the level of exercise self-efficacy (r = -.004, p = .961) and that of exercise adherence (r =.091, p = .299) tended to be lower and not significant.

To summarize the results, in general, when users feel like they are co-located and collaboratively interact with other peoples in a digitally or physically shared space; they tended to experience stronger sense of social support, and become more strongly committed to and engaged in physical activity. However, co-presence with competitors are not meaningfully related to the health outcomes.

Meanwhile, as the difference of partial correlation coefficients between co-presence with cooperators and co-presence with both cooperators and competitors suggests, the strength of association between the level of co-presence and social support decreased when users perceived that competitors were also present in the shared space.

CHAPTER 6

DISCUSSION

The main purpose of the current study is 1) to explore how unique mobile-mediated communication conditions affect the degree to which users of mobile health application feel as if they are together with interaction counterparts--either competitors or cooperators--in a digitally or physically shared space and 2) to test how different types and varying levels of experienced co-presence are related to health outcomes in terms of perceived social support, exercise self-efficacy, and exercise adherence. Data collected from mobile health application users through online self-administered survey was analyzed by employing Pearson's correlations; research hypotheses were tested by the significance of the partial correlation coefficients. In total, 6 out of 12 hypotheses were supported.

Mobile-mediated Communication Conditions: Their Effects on Co-presence

As presented in Table 17, the findings of the current study suggest that all three factors of mobile-mediated conditions--preexisting relationship, perceived geographical proximity, and consistency of mobile mediated information with the real world—were positively associated with the degree of perceived social support and exercise self-efficacy. Overall, among three mobile-mediated communication condition factors, perceived geographical proximity is the most significant predictor of users' co-presence experience.

Effect of perceived geographical proximity

Hypothesis 1 predicted that a positive association between the degree of perceived geographical proximity with other social entities and the level of co-presence. The association was statistically significant, supporting Hypothesis 1. That is, in the gamified mHealth context, the more users perceive their interaction counterparts as being located or residing in geographically proximate location, the more strongly they sense they are together in physically or electronically shared space. These results are consistent with previous research that discovered that face-to-face interaction with computer-mediated communication support result in higher levels of communication quality between interaction partners compared to virtual and computer-mediated communication (Lowry, Roberts, Romano Jr., Cheney, & Hightower, 2006); this also expands the finding to mobile-mediated communication contexts. That is, compared to traditional computer technology, context-aware mobile technology enables and supports users to synchronously interact with their local counterparts in a shared mediated or physical space through the use of small handheld computers. This novel interaction paradigm and users' perception that they are sharing not only their online space, but also their physical surroundings with other people possibly contributes to the increased co-presence in a mobile-mediated context.

Effect of pre-existing relationships

The supported hypothesis 2 revealed that a pre-existing social relationship is also a positive predictor on the strength of the co-presence that users experience. That means the degree to which mobile-mediated social interactions are based on pre-existing relationships (for example, classmates who use the same mobile health application) also contributes to higher co-presence. The result demonstrates that users sense the presence of people they already know in real life more strongly than that of strangers. White (2010, p. 233) provides valuable insights that can explain this result. According to him, when potential or perceived counterparts are people whom we already know, gamified interaction environments become another location where pre-existing social relationships are expanded and play out, leading to new social dynamics within a pre-existing social network. Meaningfulness of experience is one of the important factors in one's presence experience (Witmer, 1998). Gamified interactions with significant others or acquaintances would be more meaningful than with strangers; and the meaningful social interaction possibly contributes to increased co-presence. Interacting with people in their pre-existing social network in richer formats via mobile health applications would give users higher sense of being together in a shared communication space.

Effect of consistency of information with the objective world

Hypothesis 3 predicted that the level of experienced co-presence is positively related with the extent to which information on their mobile devices is consistent and parallel with their real world activity. The results of the partial correlation analysis supported the prediction.

To explain this; context-aware mobile devices automatically capture users' movement and immediately send back multi-sensory tailored information corresponding to the users' real-time situations in flexible manner. Through tailored information that closely matches with users' real-world experience, mobile health application users may experience higher sense of being in control and higher degree of interactivity. Furthermore, since the users receives both mediated cues (physical environments) and unmediated cues (information on the mobile phone) at the same time, mHealth applications enable more advanced and natural multi-sensory user experience. Lastly, users may perceive the tailored spatial information more easy to understand and engaging because it is highly consistent to their physical surroundings. These all possibly contribute to a higher spatial presence.

Co-presence and Health Outcomes

The results suggested that the effect of co-presence on health outcomes are different depending on the type and the level of co-presence that people experience in the course of using mobile health applications. The detailed discussion is following.

Co-presence and social support

The results showed that the more users perceive they are co-located with their cooperators in a shared communication environment, the stronger sense of social support they get in the course of using mobile health applications. From this result, it would be reasonable to infer that co-presence with cooperators affect the extent to which users perceive they are being supported by others. It has been discussed that cooperative works evoke a strong sense of belonging and ownership through various patterns of meaningful interactions such as sharing ideas and mutual contribution to a shared goal or task. Given this, when users are aware of their cooperators' presence in a shared space, they may experience they are supporting and being supported by the cooperators not only socially, but also relative to their physical activities.

One interesting part of the results is that co-presence with both cooperators and competitors also showed a statistically significant association with perceived social support while co-presence with competitors did not. To explain this, there can be a case that one senses as if he or she is co-located with both competitors and cooperators at the same time. For example, in some gamified multi-user interaction settings, users are designed to cooperate or collaborate with his other social entities in order to compete against other groups of competitors. In this case, users may get a sense of social support from their cooperators even while they feel as if they are also co-located with competitors. The difference in two correlation coefficient values supports this claim. And amongst three types of co-presence, co-presence with collaborators is the strongest contributor to the level of perceived social support.

Co-presence and exercise self-efficacy

As mentioned in the literature review section; exercise self-efficacy can be both primary determinants and consequences of physical activity. One's initial physical activity can result in a feedback loop where performance accomplishments lead to increased exercise self-efficacy, which, in turn, improves the person's performance, further strengthening exercise self-efficacy. However, the results also showed that none of three type of co-presence showed statistically significant associations with exercise self-efficacy, not supporting three research hypotheses (H4c, H5c, and H6c). More interestingly, while the study observed positive effects of co-presence with cooperators on perceived social support and exercise adherence regardless of the effect of mobile-mediated communication conditions, its effect on exercise self-efficacy was not found. Part of the reason behind this result could be 1) exercise self-efficacy is a less modifiable factors than other health outcomes, and 2) in a practical sense, the current gamified mobile health applications are not yet sufficiently affecting improvement in users' exercise self-efficacy.

Otherwise, the non-association between co-presence and exercise-self efficacy can be explained by cognitive effects of co-presence. As discussed, Ning Shen and Khalifa (2008) propose three social presence dimensions in online environments: awareness, cognitive social presence, and affective social presence. According to them, cognitive social presence involves constructing and confirming the meaning of a user's relationship with others. In this line of reasoning, the study argues that once a person notices others' presence in a shared space, the cognizance of the others' presence could possibly make the person to carry out a given task more consciously in relation to the others, rather than by instinct or motivation. In the gamified mHealth context; exercise is an extension of social activity, not personal or private activity. The increased socialization could affect individuals in different ways. For someone who prefers his exercise to be personal and private; co-presence with other social entities may negatively affect one's intrinsic motivation for exercise, task value, and self-efficacy. According to educational researchers (Garcia & Pintrich, 1996; Pajares & Schunk, 2001); individual autonomy fosters continuing intrinsic goal orientation, both directly and indirectly influencing one's self-efficacy. Based on this, the current study concluded that the cognitive aspect of co-presence would have negatively affected users' exercise self-efficacy.

Co-presence and exercise adherence

As reported, the degree of co-presence with cooperators was the only one that showed a significant positive association with exercise adherence. However, contrary to the study's prediction, it has been shown that the other two types of co-presence did not have any association with the level of users' exercise adherence. Another interesting part is that the positive association between co-presence with cooperators and exercise adherence was observed only when communication condition variables were controlled for.

Another possible explanation is that the non-association between co-presence and exercise self-efficacy would directly or indirectly have a knock-on effect on exercise adherence. According to McAuley and Blissmer (2000), exercise self-efficacy is one of the most significant determinants of exercise adherence. That means, improvement in exercise self-efficacy might have increased exercise adherence, too. No statistically significant association was found between three types of co-presence and exercise self-efficacy. Accordingly, it would be reasonable to infer that the non-association between co-presence and exercise self-efficacy resulted in this finding.

Co-presence with Competitors and Health Outcomes

Contrary to the study's expectations, a sense of being co-located and interacting with competitors did not meaningfully affect any of the hypothesized health outcomes, which conflicts with previous studies. There are several possible explanations for this.

In Zanbaka and his colleagues' experimental study (2007), they found that the presence of virtual humans detrimentally influences a participant's performance in complex tasks, such as mathematical calculation. The reason underlying this interesting result is that even when an animated human character is presented on video screen; participants get anxious as if they were under supervision of teachers. The increased anxiety leads to worse scores on math test than when they are alone. This provides valuable implications that when leveraging social presence, strategic planning with consideration of usage situation is necessary in order to achieve desired results.

A plausible explanation for the result is that users tend to avoid facing strong emotions like competition. Social comparison and evaluation are the concepts that undergird psychological effects of a competitive environment (Martens, 1975). Cooke and his colleagues (2011) explored psychological and physiological mechanisms underlying the competition-performance relationship. Their experimental study proved that the effect of competition is a mixed bag with improved exercise adherence, enjoyment, and anxiety the aversive emotional state. That means, in the exercise environments where competitors--threat-related distracting stimuli—are present, the users also feel worried and anxious about high-pressure associated with optimal or superior performance. The increased anxiety resulted in decreased levels of intrinsic motivation to perform a given task (Frederick-Recascino & Schuster-Smith, 2003; Eysenck et al., 2007; Kerr et al., 2007).

However, the results did not prove there is a negative association between co-presence with competitors and health outcomes, neither. This can be explained by individual differences. The same competitive environment can differently affect users. To illustrate, for a competitive person; competitive interaction setting and the presence of competitors would serve as a strong motivator while the same competitive environment could make a person who has low competitive behavioral tendency further anxious, negatively influencing his or her intrinsic motivation for physical activities.

The experimental study conducted by Song, Kim, Tenzek & Lee (2010) empirically supports this explanation. The results of their study demonstrated that although there is no observed difference between highly competitive individuals and lowly competitive ones in terms of performance outcomes; competitive interaction environments harmfully affects non-competitive people: their mood, intrinsic motivation, and exercise self-efficacy. Likewise, for users who are non or less competitive, competitive interaction environments where their competitor presents provoke negative emotions and decrease intrinsic motivation, counterbalancing the positive effect of co-presence with competitors (e.g., enjoyment, reward, social support, a sense of achievement, and self-efficacy).

Given that, it can be argued that the effect of co-presence with competitors on perceived social support, exercise self-efficacy, and exercise adherence varies depending on individual differences in competitive tendency. Unfortunately, the current study's conceptual framework did not include individual differences in personality traits (competitive vs. non-competitive) and social value orientations (pro-social vs. individualistic) that are closely associated with individuals intrinsic and extrinsic motivation related to exercise. Future study should include individual personality orientation as one of critical factors to consider.

Theoretical Implications

Randolph and Viswanath (2004) emphasize the importance of theory-based health intervention in that theories provide health professionals a strategic guideline to identify a set of determinants of target group of peoples' attitude, intention, and actual health behavior. However, unfortunately, since mHealth is new area, there has been relatively limited academic work which provides foundation for designing theory-informed mobile health interventions. In this regard, the current study has several theoretical implications.

First and foremost, the current study opens a new academic discussion in the domain of mHealth by developing a conceptual framework to explore multifaceted user experience associated with their mobile media usage. The theoretical framework included social and hybrid nature of mobile-mediated communication conditions where the real meets the virtual along with various patterns of social interaction among users in the gamified mHealth context.

In developing a theoretical framework, the study takes co-presence as a focal concept that explains the psychological effects of mobile-mediated communication conditions. By hypothesizing factors that affect users' co-presence experience and testing its effects on health outcomes, the current study addresses the sensory, cognitive, and affective aspects of mobile health application.

The current study is the first scholarly effort taking the concept of presence or co-presence into the domain of mobile-mediated health communication contexts. Extrapolating previous presence research demonstrating effect of media conditions on various communication outcomes in computer-mediated communication context, it is hypothesized that there are two primary ways in which unique mobile-mediated communication conditions influence health outcome. First, they can have a direct effect on health outcome independent of co-presence experience. Second, they can have an indirect effect on health outcome, provoking a sense of being together and interacting with other social entities in digitally and physically shared spaces in users' mind. By determining mobile-mediated communication conditions factors affecting varying level of co-presence, and to test how the experienced co-presence consequently and ultimately affect beneficial health outcomes in terms of perceived social support, exercise self-efficacy, and exercise engagement, the study provides crucial implication for mobile health researchers. By providing empirical evidence, the study empirically supports the effectiveness of leveraging presence in the design of mobile services, which has been proposed by media researchers.

Finally, the results of study highlighted location-based cooperative social interactions in that significantly contribute to improvement of users' mental well-being. Given this, another theoretical contribution of the current study is support for researchers claim that for health intervention to be effective and successful, it should penetrate into people's everyday life and blend into their social and life context.

Practical Implications

Context-aware mobile device and location-based mobile health services have a lot of potential to maximize end-user values by directly providing personalized service and facilitating various forms of social interaction at a low price. Gamified mobile health application is one of the novel forms of health intervention that utilizing the advanced functionality of mobile devices.

Lewis (2007) indicates when developing gamified mobile health intervention, developers must consider both content (e.g., narratives, flow, characters of game players) and game aspects of application (goals, rewards, competition, cooperation, collaboration). However, all game mechanics might not be equally effective in promoting desired health outcomes. Unfortunately, there has been little research exploring which game mechanic works better and why it does.

The current study proposed three types of co-presence--1) co-presence with cooperators, 2) co-presence with competitors, and 3) co-presence with both--, investigating how three different types of co-presence in the gamified mHealth context yield health outcomes differently. The result of data analysis showed a very counterintuitive finding. That is, while co-presence with cooperators was positively related to exercise adherence and perceived social support, co-presence with competitor did not positively affect the extent to which users are committed to and engaged in their physical activity, nor negatively affect the degree of perceived social support. The findings imply that adding competition mechanism into mobile health applications may not be always beneficial, emphasizing selective incorporation of game components. Given that, it is imperative that academic researchers empirically test and find the optimum level of competitiveness of gamified mobile health application.

Furthermore, by assessing the positive relationship between co-presence with cooperators and perceived social support and between co-presence and exercise adherence, the study provides empirical evidence for the effectiveness of mobile health application with collaborative or cooperative storytelling that creates the feeling of being physically or digitally co-located with cooperators in users' mind. This will help mobile application developers who aim to strategically design their application, thereby bringing innovative life-enhancing solutions to who want to maintain healthy lifestyles.

Lastly, another unique contribution of this research is that it provides valuable implication for community-based health intervention that focuses on local population. While previous presence research examined technological enablers that contribute to higher presence experience, very limited research has explored the potential effects of users' perception of relationship types and geographical distance with their interaction partners. By examining the effect of those factors on higher co-presence and health benefits, and by empirically supporting the claim, the study suggests a lot of potential to increase effectiveness of community-based health intervention by facilitating social interaction among people in pre-existing physical social network and creating their genuine engagement in unprecedented ways. Mobile health application developers and scholars should pay special attention for local community-based health interventions that can be further facilitated by utilization of advanced mobile devices.

Limitations and Future Study

The current study also has limitations. First and foremost, due to the nature of cross-sectional research design, the direction of causality among the study variables implied in the theoretical framework cannot be drawn. Therefore, the interpretation of relationships among research variables has to be done with caution. Although the current study may not enough to draw causal inference and "impact" of various factors on co-presence experience and that of co-presence on health outcome, the results of the study may guide future study as preliminary evidence. Future research should consider testing the proposed model by using path analysis techniques like SEM (structural equation modeling) that hypothesizes causal relationships among variables or utilizing longitudinal data, which would help in validating the proposed model.

Second, the study used online-based survey instruments to collect data and was given the corresponding drawbacks. Since only self-report measures were used, certain variables such as geographical proximity were not objective measures. However, the current study focused on users' subjective experience with mobile health application and its psychological effect on health outcomes, the employment of survey instrument was necessary and unavoidable.

Due to limited previous research in this area, survey items had to be integrated from previous studies in different communication contexts (e.g., online, virtual reality contexts, and physical competitive/collaborative environments), modified corresponding to the current research's context, or self-developed. Although the instrument employed in the current study showed both reliability and validity, future works should focus on developing more valid and reliable scales to measure co-presence in mobile-mediated communication contexts, which is necessary to go one step further for the theoretical development.

There also are limitations to the generalizability of the results. First of all, 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. Furthermore, although the current study controlled for individual difference in socio-demographics and health status in order to minimize the influence of external variables known to affect the relationships between research variables, other potential determinants of physical activities were not entirely covered in the current study. G.C. Wanda (2004) showed factors of physical environment such as green and recreational space (e.g., recreational facility, sport ground and parks) are associated with time people spend on their physical activities. Replication of the study with more diverse samples in terms of socio-demographic factors including a place of residence would help to generalize the findings of the current study. Additionally, considering the continuously growing number of mobile health applications and users, the sample size is relatively small. In this regard, research with much a larger sample would be also required to increase generalizability of the study's findings.

Another weakness associated with the sampling procedure is that survey participants were recruited from twenty different online user communities. Because of this, the study was not able to rule out differences in other service features that possibly affect user experience. Experimental study which explicitly manipulates communication conditions (online vs. off-line vs. both; presence of competitors vs. presence of cooperators vs. both vs. neither) and gives different conditions to different groups of people could solve the issues. Empirically investigating how each condition would yield different results will give us valuable insights which help us to firmly determine how mobile-mediated communication conditions directly and indirectly contribute to higher co-presence and positive health outcomes.

Last but not least, as mentioned earlier, there may be other underlying psychological mechanisms that may moderate the association found in this study but were not part of the study design. Future research could measure individual differences of personality traits (competitive vs. non-competitive) and social value orientations (pro-social vs. individualistic) to see if those factors influenced the current study's result.

However, despite the limitations, as the first scholarly effort to explore co-presence in mobile health contexts, the current study shows scholars and mobile application developers that there are points--strengths and challenges ahead--to further look, serving as a base for upcoming research.

REFERENCES

Akinson, N.L., & Gold, R.S. (2002). The Promise and Challenge of eHealth Interventions. American Journal of Health Behavior, 26(6) (2002): 494–503.

Åkesson, M. (2007). Value proposition in m-commerce: exploring service provider and user perceptions. Presented at LA Global Mobility Round Table, Los Angeles, May 31-June 2.

Anckar, B. and D'Incau, D. (2002). Value-Added Services in Mobile Commerce: An Analytical Framework and Empirical Findings from a National Consumer Survey, Proceedings of the 35th Hawaii International Conference on System Sciences.

Anderson-Hanley, C., Synder, A., Nimon, J., & Arciero, P. (2011). social facilitation in virtual reality-enhanced exercise: competitiveness moderates exercise effort of older adults. Clinical Interventions in Aging , 6(1), 275-280. Retrieved from http://www.dovepress.com/social-facilitation-in-virtual-reality-enhanced-exercise-competitivene-peer-reviewed-article-CIA

Apple's app store downloads top 25 billion. (2012, March 5). Retrieved from: http://www.apple.com/pr/library/2012/03/05Apples-App-Store-Downloads-Top-25-Billion.html

Bailenson, J.N., Beall, A.C., Blascovich, J., & Raimmundo, R. Intelligent Agent Who Wears Your Face: Users' Reactions to the Virtual Self. Intelligent Virtual Agent, 86-99, Springer, 2001

Bailenson, J. (2005). The Independent and Interactive Effects of Embodied-Agent Appearance and Behavior on Self-Report, Cognitive, and Behavioral Markers of Copresence in

Immersive Virtual Environments. Presence: Teleoperators & Virtual Environments,14(4), 379-393.

Bandura, A. (1997). Self-efficacy: The exercise of control. Worth Publishers.

Baranowski, T., Baranowski, J., Thompson, D., & Buday, R. (2011). Behavioral science in video games for children's diet and physical activity change: key research needs. Journal Of Diabetes Science And Technology, 5(2), 229-233.

Bartlett, J. D., Close, G. L., MacLaren, D. P., Gregson, W., Drust, B., & Morton, J. P. (2011). High-intensity interval running is perceived to be more enjoyable than moderate-intensity continuous exercise: implications for exercise adherence. Journal of sports sciences, 29(6), 547-553.

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: desire for interpersonal attachments as a fundamental human motivation. Psychological bulletin, 117(3), 497.

Biocca, F., & Delaney, B. (1995). Immersive virtual reality technology. In F. Biocca, M. R. Levy (Eds.) , Communication in the age of virtual reality (pp. 57-124). Hillsdale, NJ England: Lawrence Erlbaum Associates, Inc.

Blobel, B., Pharow, P., Sousa, F., & McCallum, S. (2012). Gamification and Serious Games for Personalized Health. Studies In Health Technology & Informatics, 177: 85-96.

Boulos, M., Wheeler, S., Tavares, C., & Jones, R. (2011). How smartphones are changing the face of mobile and participatory healthcare: an overview, with example from eCAALYX. Biomedical Engineering Online, 10(1), 24-37.

Bradner, E. E., & Mark, G. G. (2002). Why Distance Matters: Effects on Cooperation, Persuasion and Deception. Cscw -Conference-, 226-235.

Cacioppo, J. T., Hawkley, L. C., Kalil, A., Hughes, M. E., Waite, L., & Thisted, R. A. (2008). Happiness and the invisible threads of social connection. The science of subjective well-being, 195-219.

Cassell, M.M., Jackson, C., & Cheuvront, B. (1998). Health communication on the internet: An effective channel for health behavior change? Journal of Health Communication, 3, 71-79.

Center for Disease Control and Prevention. Chronic diseases and health promotion. Retrieved from: http://www.cdc.gov/chronicdisease/overview/index.htm

Cooke, A., Kavussanu, M., McIntyre, D., & Ring, C. (2011). Effects of competition on endurance performance and the underlying psychological and physiological mechanisms. Biological Psychology, 86(3), 370-378.

Cuddy, C., & Glassman, N. (2010). Location-Based Services: Foursquare and Gowalla, Should Libraries Play?. Journal Of Electronic Resources In Medical Libraries, 7(4), 336-343.

Delomier, F., Bénazeth, C., David, B., & Chalon, R. (2012) Collocated and Situated Learning Game Design. In 6th European Conference on Games Based Learning (p. 139). Academic Conferences Limited.

Deterding, S., Sicart, M., Nacke, L., O'Hara, K., & Dixon, D. (2011). Gamification. using game-design elements in non-gaming contexts. Proceedings Of The 2011 Annual Conference Extended Abstracts: Human Factors In Computing Systems, 2425.

De Souza e Silva, A., & Delacruz, G. C. (2006). Hybrid Reality Games Reframed: Potential Uses in Educational Contexts. Games And Culture: A Journal Of Interactive Media, 1(3), 231-251.

De Souza e Silva, A., & Sutko, D. M. (2008). Playing Life and Living Play: How Hybrid Reality Games Reframe Space, Play, and the Ordinary. Critical Studies In Media Communication, 25(5), 447-465.

De Souza e Silva, A. (2009). Hybrid Reality and Location-Based Gaming: Redefining Mobility and Game Spaces in Urban Environments. Simulation & Gaming, 40(3), 404-424.

De Vos, H., Haaker, T., Teerling, M., & Kleijnen, M. (2009). Consumer Value of Context Aware and Location Based Mobile Services. *International Journal Of E-Services & Mobile Applications*, *1*(4), 36. doi:10.4018/jesma.2009070803

Eysenck, M.W., Derakshan, N., Santos, R., & Calvo, M.G. (2007). Anxiety and cognitive performance: Attentional control theory. Emotion (Washington, D.C.), 7, 336–353.

Fletcher, J. S., & Banasik, J. L. (2001). Exercise self-efficacy. Clinical excellence for nurse practitioners: the international journal of NPACE, 5(3), 134.

Frederick-Recascino, C. M., & Schuster-Smith, H. (2003). Competition and intrinsic motivation in physical activity: A comparison of tw... Journal of Sport Behavior, 26, 3.

Fuchslocher, A., Emmerich, K., Masuch, M., & Krämer, N. (2012) Social Health Games for Wellbeing: A Methodological Approach.

Garcia, T., & Pintrich, P. R. (1996). The Effects of Autonomy on Motivation and Performance in the College Classroom. Contemporary Educational Psychology, 21(4), 477-486.

G.C. Wanda, W. (2004). Factors of the Physical Environment Associated with Walking and Bicycling. Medicine & Science In Sports & Exercise, 36(4), 725-730.

Goldenberg, J., & Levy, M. (2009). Distance Is Not Dead: Social Interaction and Geographical Distance in the Internet Era. Retrieved from: http://arxiv.org/ftp/arxiv/papers/0906/0906.3202.pdf

Goodchild, M. F. (2007). Citizens as sensors: the world of volunteered geography. Geojournal, (4), 211.

Grant, A. E., & Meadows, J. J. (2008). Communications technology update and fundamentals. 11th ed.

Greene, K. (2009). An integrated model of health disclosure decision-making. In T. Afifi & W. Afifi (Eds.) Uncertainty and information regulation in interpersonal contexts: Theories and applications (pp. 226-253). NY: Routledge.

Greene, K., & Magsamen-Conrad, K. (2010). Disclosure Decisions in Existing Relationships Online: Exploring Motivations for CMC Channel Choice. Interpersonal relations and social patterns in communication technologies: Discourse norms, language structures and cultural variables (pp. 48–76). Hershey, PA: Information Science Publishing.

Han, J.Y., Hawkins, R.P., Shaw, B., Pingree, S., McTavish, F. & Gustafson, D. (2009). Unraveling Uses and Effects of an Interactive Health Communication System. Journal of Broadcasting & Electronic Media, 53(1), 112 - 133.

Haaker, T., Edward, F., & Bouwman, H. (2006). Balancing customer and network value in business models for mobile services. International Journal Of Mobile Communications, 4(6), 2.

Haaker, T., Kijl, B., Galli, L., Killström, U., Immonen, O., & De Reuver, M. (2006, November). Challenges in designing viable business models for context-aware mobile services. In *3rd International CICT Conference, Copenhagen, Denmark.*

Halford, S., & Leonard, P. (2006). Place, Space and Time: Contextualizing Workplace Subjectivities. Organization Studies (01708406), 27(5), 657-676.

Hartmann, T., Klimmt, C., & Vorderer, P. (2010). Telepresence and media entertainment. *Immersed in media: Telepresence in everyday life*, 87-109.

Harvey, B. (2009, June 22). Uw-madison researcher's 'smart' inhaler pinpoints where and when attacks occur. JSOnline. Retrieved from: www.jsonline.com/features/health/48785912.html

Hawkins, R. P., & Buller, D. B. (2005). Attributes of interactive online health information systems. Journal of Medical Internet Research, 7(3), 1-10.

Hawkins, R., Kreuter, M., Resnicow, K., Fishbein, M., & Djikstra, A. (2008). Understanding tailoring in communicating about health. Health Education Research, 23(3), 454-466.

Hawkins, R. P., Han, J., Pingree, S., Shaw, B. R., Baker, T. B., & Roberts, L. J. (2010). Interactivity and presence of three eHealth interventions. Computers In Human Behavior, 26(5), 1081-1088.

Hawkins, R. P., & Buller, D. B. (2005). Attributes of interactive online health information systems. Journal of Medical Internet Research, 7(3), 1-10.

Hofte, G., Mulder, I., & Verwijs, C. (2006). Close encounters of the virtual kind: a study on place-based presence. AI & Society, 20(2), 151-168.

Hossmann, T., Legendre, F., Nomikos, G., & Spyropoulos, T. (2011, June). Stumbl: Using facebook to collect rich datasets for opportunistic networking research. In *World of Wireless, Mobile and Multimedia Networks (WoWMoM), 2011 IEEE International Symposium on a* (pp. 1-6). IEEE.

Hoshi, K., Nyberg, A. & Öhberg, F. (2011). Bridging the contextual reality gap in blended reality space: the case of AGNES. In: Include 2011 Proceedings: the role of inclusive design in making social innovation happen. Paper presented at The 6th International conference on Inclusive Design.

Hoshi, K., & Waterworth, J. A. (2009). Tangible Presence in Blended Reality Space, PRESENCE 2009. Proceedings of the 12th Annual International Workshop on Presence. Los Angeles, CA, USA.

Igroup presence questionnaire item. Retrieved from http://www.igroup.org/pq/ipq/download.php

Ijsselsteijn, W. A., de Ridder, H. H., Freeman, J. J., & Avons, S. E. (2000). Presence: concept, determinants, and measurement. Proceedings- Spie The International Society For Optical Engineering, (3959), 520-529.

Kelders, S., van Gemert-Pijnen, J., Werkman, A., & Seydel, E. (2010). Evaluation of a web-based lifestyle coach designed to maintain a healthy bodyweight. Journal Of Telemedicine And Telecare, 16(1), 3-7.

Kerr, N., Messé, L., Seok, D., Sambolec, E., Lount, R., & Park, E. (2007). Psychological mechanisms underlying the Köhler motivation gain. Personality & Social Psychology Bulletin, 33(6), 828-841.

Klasnja, P., & Pratt, W. (2001). Healthcare in the pocket: Mapping the space of mobile-phone health interventions. Journal Of Biomedical Informatics, 45(1), 184-198.

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(6), 631-661.

Lee, Y. E., & Benbasat, I. I. (2004). Interface design for mobile commerce. *Communications Of The ACM*, (12), 48. doi:10.1145/953460.953487

Lee, K. (2004). Presence, Explicated. Communication Theory, 14(1), 27-50.

Lee, K. (2010). Value Creation of Mobile Services Through Presence: Designing Mobile Information and Entertainment Applications with Presence in Mind. Presence: Teleoperators & Virtual Environments, 19(3), 265-279.

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(7), 620-633.

Levy-Storms, L. (2005). Strategies for diffusing public health innovations through older adults' health communication networks. Generations, 29(2), 70-75.

Lieberman, D. A. (2006). What Can We Learn From Games? Playing Interactive. *Playing video games: Motives, responses, and consequences*, 447.

Liu, Yefeng, Vili Lehdonvirta, Todorka Alexandrova, Ming Liu, and Nakajima Tatsuo. 2011 "Engaging Social Media: Case Mobile Crowdsourcing." Paper presented at SoME 2011: International Workshop on Social Media Engagement, Hyderabad, India, 2011, http://vili.lehdonvirta.com/files/prxb1914/liu-2011-social-media-crowdsourcing.pdf.

Martens, R. (1975). Social Psychology and Physical Activity. New York: Harper and Row.

McAuley, E., & Blissmer, B. (2000). Self-efficacy determinants and consequences of physical activity. Exercise and sport sciences reviews, 28(2), 85-88.

McGonigal, J. (2011). Reality is broken: Why games make us better and how they can change the world. New York, NY US: Penguin Press.

MacKenzie, S. B., Podsakoff, P. M., & Jarvis, C. B. (2005). The problem of measurement model misspecification in behavioral and organizational research and some recommended solutions. Journal of Applied Psychology, 90(4), 710-729.

Milgram, P., Takemura, H., Utsumi, A., & Kishino, F. (1995). Augmented reality: a class of displays on the reality-virtuality continuum. Proceedings Of SPIE, (1), 282.

Nan, C., Tao,W., & Shuang, X. (2010). THE INFLUENCE OF SOCIAL PRESENCE ON CONSUMERS' PERCEPTIONS OF THE INTERACTIVITY OF WEB SITES. Journal Of Interactive Advertising, 11(1), 36.

Neve, M., Collins, C., & Morgan, P. (2010). Dropout, nonusage attrition, and pretreatment predictors of nonusage attrition in a commercial Web-based weight loss program. Journal Of Medical Internet Research, 12(4), e69.

Nijland, N., van Gemert-Pijnen, J., Boer, H., Steehouder, M., & Seydel, E. (2008). Evaluation of internet-based technology for supporting self-care: problems encountered by patients and caregivers when using self-care applications. Journal Of Medical Internet Research, 10(2), e13.

Olson, G. M., & Olson, J. S. (2000). Distance matters. Human-computer interaction, 15(2), 139-178.

Olsson, T. T. (2009). Understanding collective content: Purposes, characteristics and collaborative practices. 21-30.

Pajares, F., & Schunk, D. (2001). The development of academic self-efficacy.), Development of achievement motivation. United States.

Pavlou, P., Huigang, L., & Yajiong, X. (2005). Understanding and mitigating uncertainty in online environments: A longitudinal analysis of the role of trust and social presence. Academy Of Management Annual Meeting Proceedings, H1-H6.

Pempek, T.A. & Calvert, S.L. (2009). Tipping the Balance: Use of Advergames to Promote Consumption of Nutritious Foods and Beverages by Low-Income African American Children. Archives of Pediatric Adolescent Medicine, 163(7), 633-637.

Peng, W. (2009). Design and evaluation of a computer game to promote a healthy diet for young adults. Health Communication, 24, 115-127.

Peng, W. (2008). The mediational role of identification in the relationship between experience mode and self-efficacy: Enactive role-playing versus passive observation. CyberPsychology, Behavior, and Social Networking, 11, 649-652.

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(6), 2100-2106.

Plante, T. G., Cage, C., Clements, S., & Stover, A. (2006). Psychological benefits of exercise paired with virtual reality: Outdoor exercise energizes whereas indoor virtual exercise relaxes. International Journal Of Stress Management, 13(1), 108-117.

Randolph, W., & Viswanath, K. (2004). Lessons Learned from Public Health Mass Media Campaigns: Marketing Health in a Crowded Media World*. Annu. Rev. Public Health, 25, 419-437.

Ratan, R., Santa Cruz, M., & Vorderer, P. (2007). Multitasking, presence, and self-presence on the Wii. *Proceedings of Presence, Barcelona, Spain*.

Regenbrecht, H., & Schubert, T. (2002, October). Measuring presence in augmented reality environments: design and a first test of a questionnaire. In Proceedings of the Fifth Annual International Workshop Presence 2002.

Rhodes, R. E., Warburton, D. R., & Bredin, S. D. (2009). Predicting the effect of interactive video bikes on exercise adherence: An efficacy trial. Psychology, Health & Medicine, 14(6), 631-640.

Sakamoto, M., Nakajima, T., & Alexandrova, T. (2012). Value-Based design for gamifying daily activities. In Entertainment Computing-ICEC 2012 (pp. 421-424). Springer Berlin Heidelberg.

Scott, S. D., Mandryk, R. L., & Inkpen, K. M. (2003). Understanding children's collaborative interactions in shared environments. Journal Of Computer Assisted Learning, 19(2), 220-228.

Ning Shen, K., & Khalifa, M. (2008). Exploring multidimensional conceptualization of social presence in the context of online communities. *Intl. Journal of Human–Computer Interaction*, *24*(7), 722-748.

Shirky, C. (2008). Here comes everybody : the power of organizing without organizations / Clay Shirky. New York : Penguin Press, 2008.

Short, J., Williams, E., & Christie, B. (1976). The social psychology of telecommunications / John Short, Ederyn Williams, Bruce Christie. London ; New York : Wiley, c1976.

Slater, M., McCarthy, J., & Maringelli, F. (1998). The influence of body movement on subjective presence in virtual environments. Human Factors: The Journal of the Human Factors and Ergonomics Society, 40(3), 469-477.

Song, H., Peng, W., & Lee, K. (2011). Promoting Exercise Self-Efficacy With an Exergame.Journal Of Health Communication, 16(2), 148-162.

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. In annual conference of the International Communication Association, Singapore.

Staiano, A. E., & Calvert, S. L. (2011). Exergames for physical education courses: Physical, social, and cognitive benefits. *Child development perspectives*, *5*(2), 93-98.

Sweeney, J. C., & Soutar, G. N. (2001). Article: Consumer perceived value: The development of a multiple item scale. *Journal Of Retailing*, 77203-220.

Tang, A., Biocca, F., and Lim, L. (2004). Comparing differences in presence during social interaction in augmented reality versus virtual reality environments: an exploratory study. In Proceedings of PRESENCE 2004, Seventh Annual International Workshop on Presence, pp. 204 – 207, October 13 – 15, 2004, Valencia, Spain.

Timpka, T. T., Graspemo, G. G., Hassling, L. L., Nordfeldt, S. S., & Eriksson, H. H. (2005). Towards Integration of Computer Games in Interactive Health Education Environments: understanding gameplay challenge, narrative and spectacle. *Studies In Health Technology And Informatics,* 107, 941-945.

Toscos, T., Faber, A., Connelly, K., & Upoma, A. M. (2008, January). Encouraging physical activity in teens Can technology help reduce barriers to physical activity in adolescent girls?. In Pervasive Computing Technologies for Healthcare, 2008. PervasiveHealth 2008. Second International Conference on (pp. 218-221). IEEE.

Van Gemert-Pijnen, J., Nijland, N., van Limburg, M., Ossebaard, H., Kelders, S., Eysenbach, G., & Seydel, E. (2011). A holistic framework to improve the uptake and impact of eHealth technologies. Journal Of Medical Internet Research, 13(4), e111.

Wagner, I., W. Broll, G. Jacucci, K. Kuutii, R. McCall, A. Morrison, D. Schmalstieg, and J.-J. Terrin. 2009. "On the Role of Presence in Mixed Reality." Presence -Cambridge Massachusetts- 18, no. 4: 249-276.Walther, J. B., Pingree, S.,

Wang, X., and R. Wang. 2011. "Co-presence in Mixed Reality-Mediated Collaborative Design Space." International Series On Intelligent Systems Control And Automation.Science And Engineering 48, 51-66. British Library Document Supply Centre Inside Serials & Conference Proceedings

White, D. (2010) Residency, relationships, and responsibility. In Panayiotis, Z. and Ang, C. S. (Eds.) Social Computing and Virtual Communities (Chapter 10.; pp. 223-242) London, Chapman & Hall/CRC Press, c2010.

Wilson, J. M., Boyer O'leary, M., Metiu, A., & Jett, Q. R. (2008). Perceived Proximity in Virtual Work: Explaining the Paradox of Far-but-Close. Organization Studies (01708406), 29(7), 979-1002.

Witmer, B. J., & Singer, M. J. (1998). Measuring Presence in Virtual Environments: A Presence Questionnaire. Presence: Teleoperators & Virtual Environments, 7(3), 225-240.

Yates, D., Lee K.M., El Sawy O. (2005), “Leveraging Presence in the Design of Mobile Services: Challenges, Opportunities, and Value Creation”, CTM Research Paper, USC Marshall School of Business. Retrieved from: http://classic.marshall.usc.edu/assets/002/5138.pdf

Zanbaka, C. C., Ulinski, A. A., Goolkasian, P. P., & Hodges, L. F. (2007). Social Responses to Virtual Humans: Implications for Future Interface Design. Chi -Conference-, 21561-1570.

Zhao, Shanyang. 2003. "Toward a Taxonomy of Copresence." Presence: Teleoperators & Virtual Environments 12, no. 5: 445-455.References

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(1), 30-41.

APPENDICES

APPENDIX A. TABLES

Table 1. Taxonomy of Co-presence (Zhao, 2003, pp. 447-449)

Corporeal Presence on	Distance Between Two Sides			
	Physical Proximity		Electronic Proximity	
Both sides	Corporeal copresence	A form of human colocation in which both individuals are present in person at their sites as well as in each other's physical proximity.	Corporeal telepresence	A form of human colocation in which both individuals are present in person at their local sites, but they are located in each other's electronic proximity rather than physical proximity.
One side	Virtual copresence	A form of human colocation in which both individuals are in each other's physical proximity, but one is present in person at the site and the other is present through a physical representation.	Virtual telepresence	A form of human colocation in which both individuals are in each other's electronic proximity, but one is present in person at the site and the other is present through a digital representation.
Neither sides	Hypervirtual copresence	A form of human colocation in which individuals on both sides are virtually present at the site through physical representations that are positioned in each other's physical proximity.	Hypervirtual telepresence	A form of human colocation in which individuals on both sides are virtually present at the site through digital representations that are located in each other's electronic proximity.

Table 2.Socio-Demographic Information of the Respondents

	Socio-demographics	Frequency (N)	Percent (%)
Gender	Male	51	21.9
	Female	132	72.1
Total		183 (missing: 7)	100
Age	18 – 24 years old	141	74.2
	25 – 29 years old	21	11.1
	30 – 34 years old	13	6.8
	35 – 39 years old	6	3.2
	40 – 44 years old	2	1.1
	45 – 54 years old	2	1.1
Total		185 (missing: 5)	100
Education Level	High school graduate	8	4.3
	Some college	137	74.1
	College graduate	29	15.7
	Postgraduate study/law or medical school	11	5.9
Total		185 (missing: 5)	100
Income	Less than $9,999	24	14.9
	$10,000 to just under $14,999	15	9.3
	$15,000 to just under $19,999	5	3.1
	$20,000 to just under $34,999	9	5.6
	$35,000 to just under $49,999	16	9.9
	$50,000 to just under $74,999	21	13.0
	$75,000 to just under $99,999	20	12.4
	$100,000 to just under $199,999	31	
	$200,000 or more	20	
Total		161 (missing: 29)	100

Table 3. Items for Determinants of Co-presence in Mobile-mediated Environments

	Items (source)	Mean	*SD*
Pre-existing Relationships With Other Social Entities	Most of the people that I interact with through the apps are my close friends	3.24	1.302
	Most of the people that I interact with through the apps are my acquaintances	3.08	1.142
	Most of the people that I interact with through the apps are strangers [Reverse Coded]	2.79	1.272
Perceived Geographical Proximity With Other Social Entities	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 (modified from Regenbrecht & Schubert, 2002)	3.44	1.138
	When using the application, I have the impression that most of the people that I interact with via those apps are living in the same country with me.	3.84	.962
	When using the application, I have the impression that most of the people that I interact with via those apps are living in the same state with me.	3.38	1.196
	When using the application, I have the impression that most of the people that I interact with via those apps are living in the same city with me.	3.13	1.262
	When using the application, I have the impression that most of the people that I interact with via those apps are living in the same district (e.g., county or neighborhood) with me.	2.91	1.238
Consistency of Information With the Objective World	When using the application, I have the impression that the virtual objects belong to the real object (modified from Regenbrecht & Schubert, 2002) Realism	2.98	1.201
	When using the application, I think of the world that I experience through my mobile device as somewhere that I have visited (modified from Slater, McCarthy, and Maringelli, 1998)	3.05	1.145
	When using the application, I have a sense of acting in the mobile-mediated environment, rather than operating something from outside (modified from Igroup presence questionnaire item)	3.65	.965
	When using the application, I feel that the displayed environment--the audio and video display of the environments--was part of the real world (modified from Regenbrecht & Schubert, 2002)	3.09	1.114

	When using the application, I feel that the scenes depicted in the apps could really occur in the real world (modified from Witmer & Singer, 1998)	3.50	.988
	When using the application, I feel that the digital objects visualized on my mobile screen actually appear to be located in the radius of my everyday life (Regenbrecht & Schubert, 2002)	3.39	.998

Scale range: 1-strongly disagree to 5-strongly agree

Table 4. Co-presence Items

	Items	Mean	*SD*
Co-presence (with competitors) (α = .756).	In the course of using the apps, I have a sense that I was in the same place as the competitors	3.01	.995
	When using the application, I feel inclined to compare my achievement with other users	3.46	1.096
	When using the application, I frequently feel a sense of rivalry with users.	3.23	1.059
	When using the application, I am depressed when I feel everyone is doing better than me in terms of exercise.	2.89	1.091
Co-presence (with cooperators) (α = .813).	In the course of using the apps, I have a sense that I was in the same place as the cooperators	3.08	.999
	When using the application, I have the impression that I am needed.	2.89	1.106
	When using the application, I have the impression that other users and I have shared responsibility.	3.11	1.012
	When using the application, I am aware of that other users have the same goal with mine	3.64	.974
	In the course of using the apps, I have a sense that I was in the same place as the cooperators	3.29	1.042

Scale range: 1-strongly disagree to 5-strongly agree

Table 5. Items for Health Outcomes

	Items	Mean	*SD*
Perceived Social Support (α = .938)	When using the application, there are people who are around when I am in need	3.73	1.052
	When using the application, there are whom I can share my joys and sorrows	3.77	1.115
	When using the application, I get the emotional help and support I need from other people	3.74	1.126
	When using the application, I have people who are a real source of comfort to me	3.84	1.108
	When using the application, I can count on other people when things go wrong	3.78	1.099
	When using the application, I can talk about my problem with other users	3.23	1.168
	When using the application, there are people in my life who cares about my feelings	3.92	1.128
	When using the application, other users are willing to help me make decision	3.38	1.157
	Scale range: 1-strongly disagree to 5-strongly agree		
Exercise Self-efficacy (α = .766)	When using the application, I can be physically active even if I could watch TV/play video games	3.56	.922
	When using the application, I can be physically active even if it is very hot or cold outside	3.57	1.026
	When using the application, I am be physically active even if I have to stay at home	3.64	.942
	When using the application, I can be physically active no matter how busy my day is	2.93	1.127
	When using the application, I can be physically active most days	3.88	.786
	When using the application, I can ask others (e.g., family members or friends) to do physically active thing with me	3.81	8.27
	When using the application, I have the skills I need to be physically active	3.99	.848
	Scale range: 1-strongly disagree to 5-strongly agree		
Exercise Adherence	On the days that you do any physical activity or exercise of with mobile health applications at least moderate intensity, how long do you typically do these activities? (Specify numerically in text box below. If you never do exercise you may enter "0"; if you exercise for one and half hours, you may enter "90")	55.14	23.740

Table 6. Respondents' Online Health Information Seeking Behaviors

In the past 12 months, have you used the Internet for any of the following reasons?		Frequency (*N*)	Percent (%)
To participate in an online support group for people with a similar health or medical issue	Yes	147	79.5
	No	38	20.5
	Total	185	100
To buy medicine or vitamin online	Yes	130	69.9
	No	56	30.1
	Total	186	100
To download health-related information--including apps--to mobile device, such as mp3 players, smartphone, tablet computer (e.g., iPad), or electronic book device (e.g., Kindle)	Yes	56	30.1
	No	130	69.9
	Total	186	100
To visit a social networking sites, such as Facebook or Twitter to read and share about health information	Yes	39	21.0
	No	147	79.0
	Total	186	100
To keep track of personal health information such as care received, test result, or upcoming medical appointments	Yes	95	51.4
	No	90	48.6
	Total	185	100
To look for health or medical information for someone else	Yes	81	43.8
	No	104	56.2
	Total	185	100
To look for health or medical information for yourself	Yes	31	16.7
	NO	155	83.3
	Total	186	100

Table 7. Frequency and Percentage Distribution of Health information Seeking Score

Total Score (out of 7)	Frequency (*N*)	Percent (%)
0	7	3.8
1	7	3.8
2	20	10.9
3	33	18.0
4	49	26.8
5	43	23.5
6	16	8.7
7	8	4.4
Total	183	100
Mean	3.87	
SD	1.597	

Table 8. Sedentary Lifestyle Tendency Items

	Items	Mean	*SD*
Sedentary Lifestyle Tendency	In a typical week, how many days do you do any physical activity or exercise of at least moderate intensity, such as brisk walking, bicycling at a regular pace, and swimming at a regular pace per week? [Reverse Coded][a]	3.52	1.622
	Over the past 30 days, in your leisure time, how many hours per day, on average, did you sit and watch TV or movies, surf the web, or play computer games? Do not include active gaming such as Wii[b]	4.98	1.552

[a] Scale range: 0 – never to 7 – everyday

[b] Scale: 1 - Less than a half hour, 2 - 30 minutes to less than one hour, 3 - About an hour, 4 - More than one hour but less than two hours, 5 - Two hours to less than three hours, 6 - Three hours to less than four hours, and 7 - Four hours or more

Table 9. Frequency and Percentage Distribution of Sedentary Lifestyle Tendency

Total Score (out of 7)	Frequency (*N*)	Percent (%)
.50	2	1.1
1.00	1	.5
1.50	1	.5
2.00	3	1.6
2.50	9	4.9
3.00	18	9.9
3.50	25	13.7
4.00	25	13.7
4.50	38	20.9
5.00	24	13.2
5.50	22	12.1
6.00	11	6.0
6.50	3	1.6
Total	182	100
Mean	4.24	
SD	1.132	

Table 10. Health Confidence Items

Items	Mean	*SD*
Overall, how confident are you that you could get advice or information about health or medical topics if you needed it?	3.93	.780
Overall, how confident are you about your ability to take good care of your health?	3.82	.751
How confident are you that you have some say in who is allowed to collect, use and share your medical information?	3.55	.930

Scale range: 1 - Not at all confident to 5 - Completely confident.

Table 11. Frequency and Percentage Distribution of Health Confidence Score

Total Score (out of 5)	Frequency (*N*)	Percent (%)
2.33	2	1.1
2.67	6	3.3
3.00	31	16.8
3.33	23	12.5
3.67	32	17.4
4.00	51	27.7
4.33	17	9.2
4.67	7	3.8
5.00	15	8.2
Total	184	100.0
Mean	3.77	
SD	.623	

Table 12. Factor Loadings and Communalities based on a Principle Components Analysis with Orthogonal Rotation for 16 Items from Mobile-mediated Communication Conditions (N = 185)

Items	Factors			Communality	α
	Consistency	Proximity	Pre-existing Relationship		
When using the application, I feel that the digital objects visualized on my mobile screen actually appear to be located in the radius of my everyday life	**.814**	.270	.166	.764	.882
When using the application, I feel that the displayed environment--the audio and video display of the environments--was part of the real world	**.806**	.198	.053	.692	
When using the application, I have the impression that the virtual objects belong to the real object	**.774**	.263	-.112	.680	
When using the application, I feel that the scenes depicted in the apps could really occur in the real world	**.728**	.163	.239	.614	
When using the application, I have a sense of acting in the mobile-mediated environment, rather than operating something from outside.	**.726**	.002	.229	.579	
I think of the world that I experience through my mobile device as somewhere that I have visited	**.714**	.375	-.014	.651	
When using the application, I have the impression that most of the people that I interact with via those apps are living in the same state with me.	.165	**.865**	.241	.834	.873
When using the application, I have the impression that most of the people that I interact with via those apps are living in the same city with me.	.303	**.829**	.080	.786	
When using the application, I have the impression that most of the people that I interact with via those apps are living in the same district (e.g., county or neighborhood) with me.	.354	**.804**	.081	.778	

When using the application, I have the impression that most of the people that I interact with via those apps are living in the same country with me.	.062	**.710**	.162	.534	
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	.243	**.533**	.313	.441	
Most of the people that I interact with through the apps are strangers [Reverse Coded]	-.001	.089	.818	**.677**	
Most of the people that I interact with through the apps are my close friends	.198	.501	.695	**.773**	.721
Most of the people that I interact with through the apps are my acquaintances	.315	.404	.502	**.515**	

Table 13. Factor Loadings and Communalities based on a Principle Components Analysis with Orthogonal Rotation for 9 Co-presence Items (*N* = 187)

Items	Factors		Communality	α
	Cooperators	Competitors		
When using the application, I have the impression that other users and I have shared responsibility.	**.837**	.077	.706	.813
In the course of using the apps, I have a sense that I was in the same place as the cooperators	**.806**	.099	.659	
When using the application, I have the impression that I am needed.	**.771**	.016	.594	
When using the application, I am aware of that other users have the same goal with mine	**.728**	.061	.533	
In the course of using the apps, I have a sense that I was in the same place as the cooperators	**.614**	.022	.378	
When using the application, I frequently feel a sense of rivalry with users.	.140	**.865**	.768	.756
When using the application, I feel inclined to compare my achievement with other users	.228	**.791**	.677	
In the course of using the apps, I have a sense that I was in the same place as the competitors	.047	**.714**	.512	
When using the application, I am depressed when I feel everyone is doing better than me in terms of exercise.	-.138	**.664**	.460	

Table 14. Descriptive Statistics for Research Variables (Valid *N* = 169)

Variables	*N*	Range	*M*	*SD*	Skewness	Kurtosis	Alpha
Age	185	6	1.46	1.021	2.911	10.005	
Gender (0 = female, 1 = male)	183	1	.28	.450	.995	-1.020	
Education	185	3	4.23	.621	1.310	2.089	
Income	161	8	5.46	2.755	-.418	-1.207	
Online Health Information Seeking	183	7.00 (5.00)	3.87 (2.77)	1.597 (1.414)	-.365	-.011	
Sedentary Lifestyle Tendency	182	6.00 (4.29)	4.27 (3.03)	1.132 (.808)	-.511	.470	
Health Confidence	184	2.67	3.77	.623	.167	-.422	
Pre-existing Relationship	190	4.00	3.18	.994	-.273	-.509	.721
Geographical Proximity	187	4.00	3.34	.949	.039	-.324	.873
Consistence of Information	186	3.50	3.28	.850	.416	-.476	.882
Co-presence (with competitors)	188	3.67	3.23	.870	-.059	-.414	.756
Co-presence (with cooperators)	187	4.00	3.20	.775	.009	.396	.813
Co-presence (with both)	187	3.27	3.21	.645	-.564	.015	.766
Perceived Social Support	182	4.00	3.68	.938	-.861	.595	.938
Exercise Self-efficacy	187	4.00	3.62	.602	-.323	.392	
Exercise Adherence (Minutes)	183	120	55.14	23.740	.704	.528	

Table 15. Zero-order Correlations among Research Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Age	1															
2. Gender (female=0, male=1)	.072	1														
3. Education	.576**	.035	1													
4. Income	-.193*	-.110	-.272*	1												
5. Online health info seeking	.246**	.100	.177*	-.021	1											
6. Sedentary tendency	-.017	-.026	.000	-.135	-.086	1										
7. Health confidence	-.266**	.041	-.201**	.298**	.003	-.204**	1									
8. Pre-existing	.101	.049	.041	-.170*	.124	.012	-.073	1								
9. Proximity	.101	.003	.057	-.233**	.116	.044	-.213**	.577**	1							
10. Consistency	.220**	-.066	.144	-.236**	-.023	-.016	-.373**	.387**	544**	1						
11. Co-presence w/ competitors	-.031	.070	-.157*	-.107	.078	-.003	-.115	.127	.290**	.198**	1					
12. Co-presence w/ cooperators	.104	-.023	.052	-.065	.231**	-.002	-.128	.313**	.454**	.357**	.223**	1				
13. Co-presence	0.42	.035	-.074	-.113	.190*	-.002	-.155*	.273**	.468**	.349**	.810**	.752**	1			
14. Social support	-.148*	.082	-.172*	.116	.171*	-.077	.144	.226**	.218**	.061	.116	.531**	.396**	1		
15. Self-efficacy	-.083	.135	-.084	.081	.149*	-.346**	.307**	.121	.079	.013	.189**	.048	.156*	.368**	1	
16. Exercise Adherence	.127	.195**	.145	.048	.036	-.213**	-.010	-.141	-.057	-.135	-.012	.052	.023	.035	.072	1

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

Table 16. Bivariate and Partial Correlations between Factors of Communication Conditions and Three Types of Co-presence (*N* = 142)

	Co-presence		
	Co-presence with Competitors	Co-presence with Cooperators	Co-presence
	Bivariate correlations		
Age	.104	-.031	.042
Gender (female=0, male=1)	-.023	.070	.035
Education Level	.052	-.157*	-.074
Income Level	-.065	-.107	-.113
Online Health Information Seeking	.231**	.078	.190*
Sedentary Lifestyle	-.002	-.003	-.002
Health Confidence	-.128	-.115	-.155**
	Partial correlations controlling for socio-demographic and health-related behavioral factors		
Pre-existing relationship	.181*	.280**	.288**
Geographical Proximity	.366**	.477**	.508**
Information Consistency	.200*	.326**	.327**

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

Table 17. Bivariate and Partial Correlations among Research Variables (*N* = 142)

	Health Outcomes		
	Perceived Social Support	Exercise Self-efficacy	Exercise Adherence
	Bivariate correlations		
Age	-.148*	-.062	.172
Gender (female=0, male=1)	.082	.100	.195**
Education Level	-.172*	-.108	.145
Income Level	.116	.145	.048
Online Health Information Seeking	.171*	.072	.036
Sedentary Lifestyle	-.077	-.315**	-.213**
Health Confidence	.114	.232**	-.010
	Partial correlations controlling for socio-demographic and health-related behavioral factors		
Pre-existing Relationship	.171*	.204*	-.148
Geographical Proximity	.299**	.224**	-.118
Information Consistency	.195*	.191*	-.221**
	Partial correlations controlling for socio-demographic, health-related behavioral, and communication condition factors (pre-existing relationship, perceived geographical proximity, and Information Consistency)		
Co-presence (with competitors)	.070	.080	-.040
Co-presence (with cooperators)	.501**	-.106	.200*
Co-presence	.355**	-.004	.091

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

APPENDIX B. FIGURES

Figure 2. Screenshots of 5K Runner (Above) and Zombie Run! (Below)

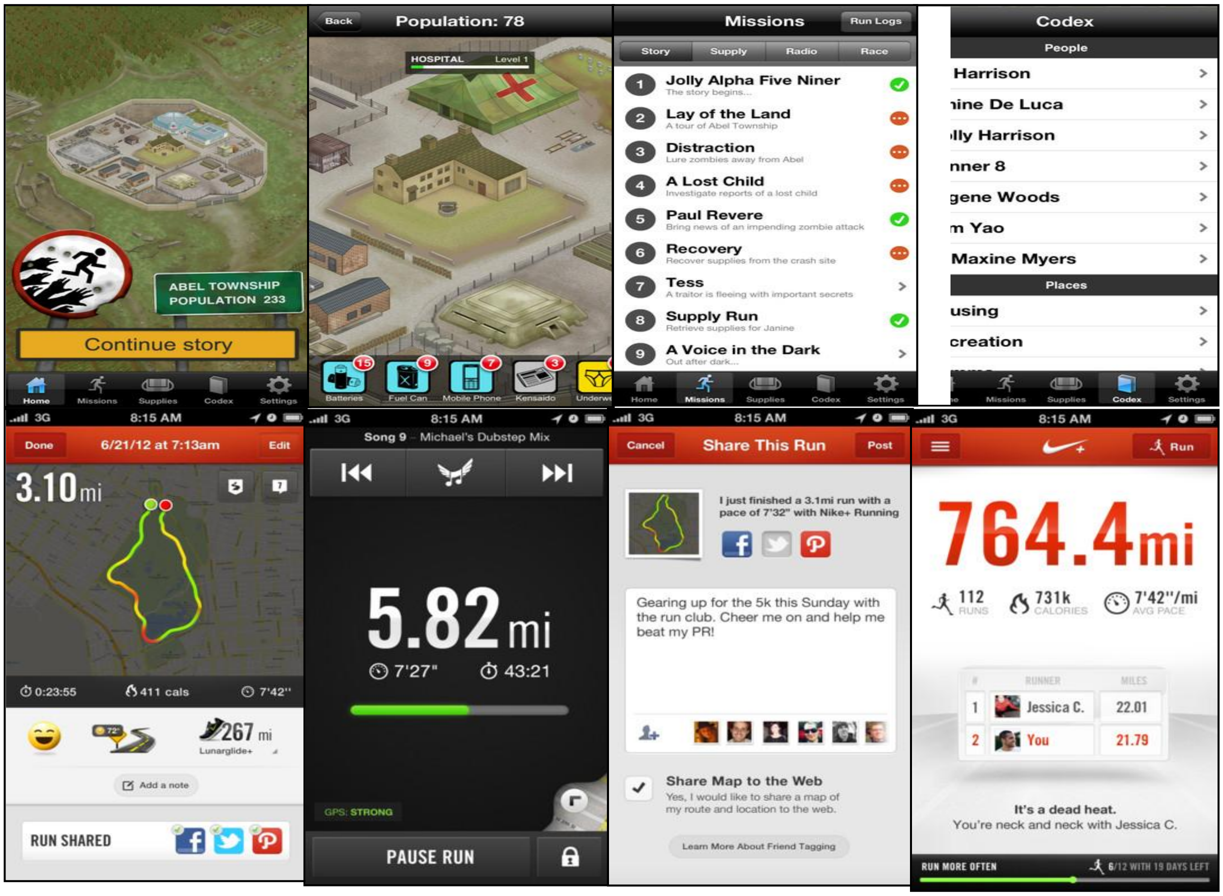
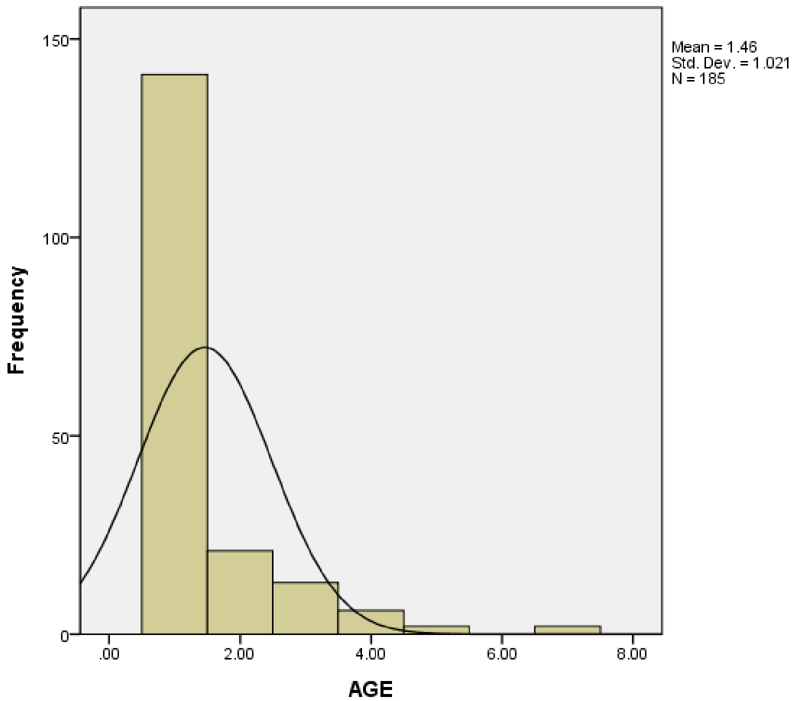
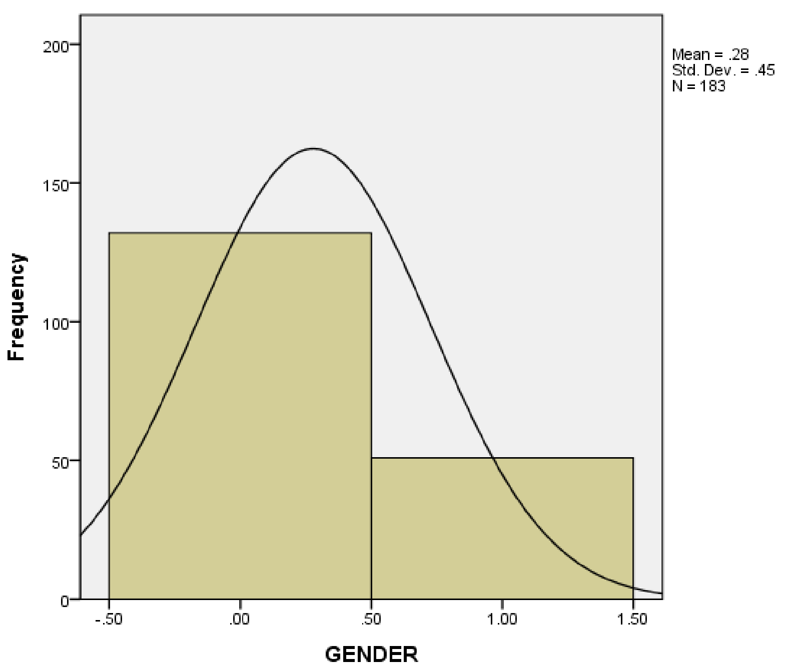
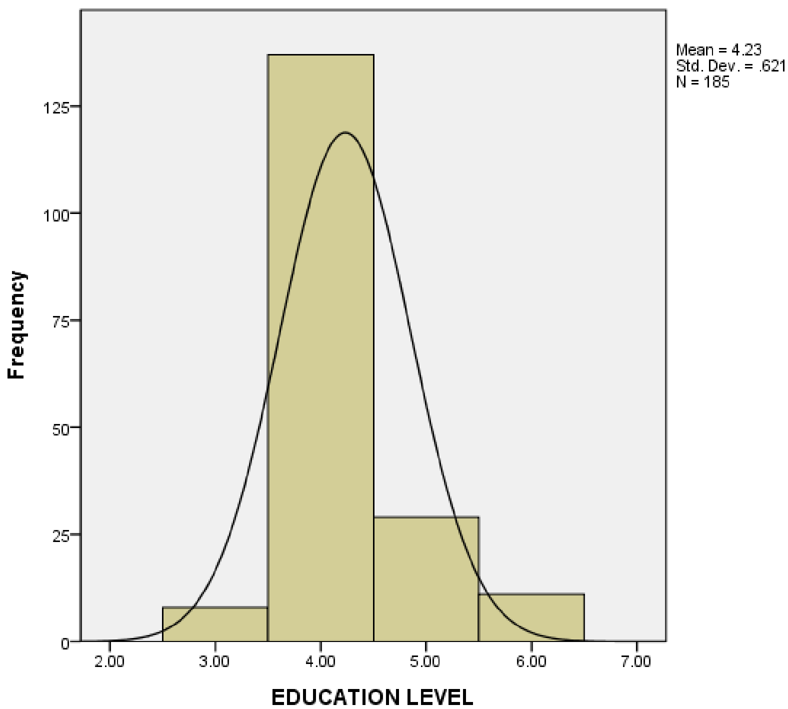
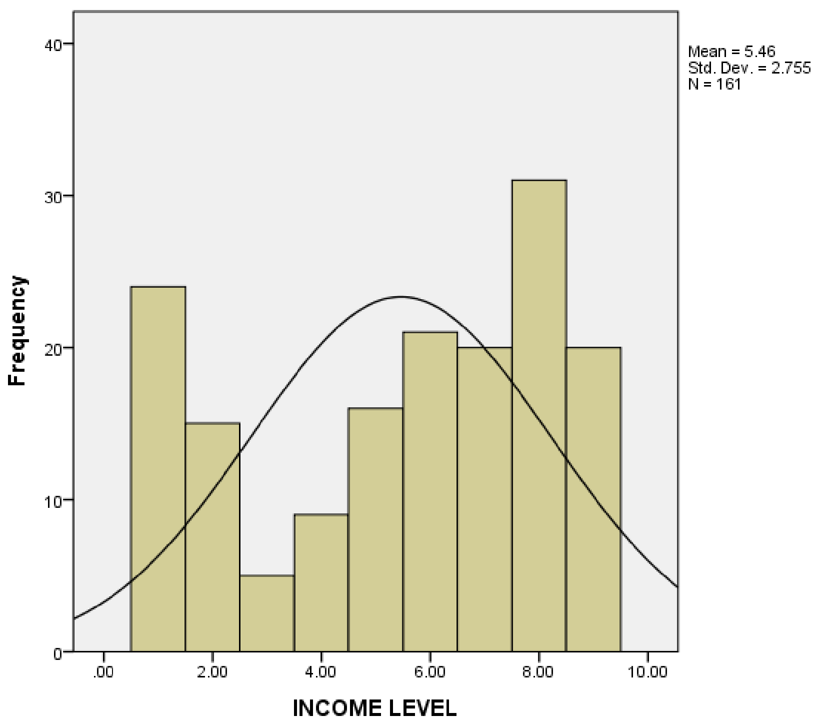


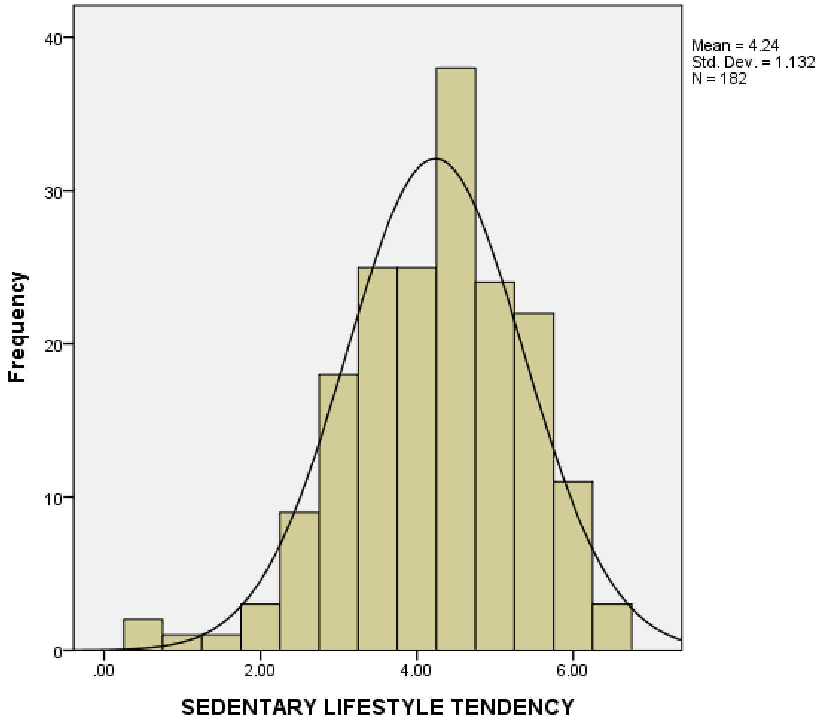
Figure 6. Frequency Distribution of Control Variable

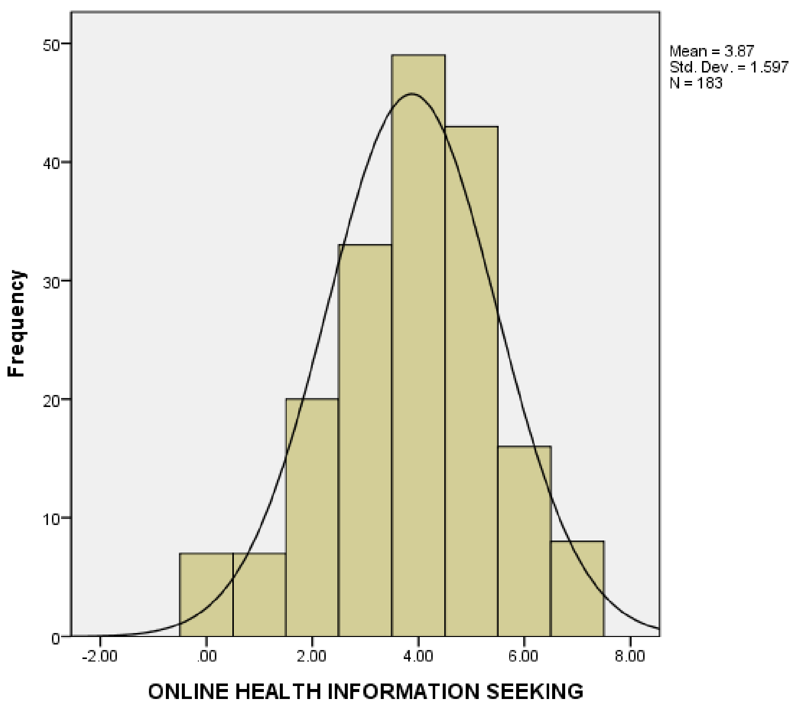


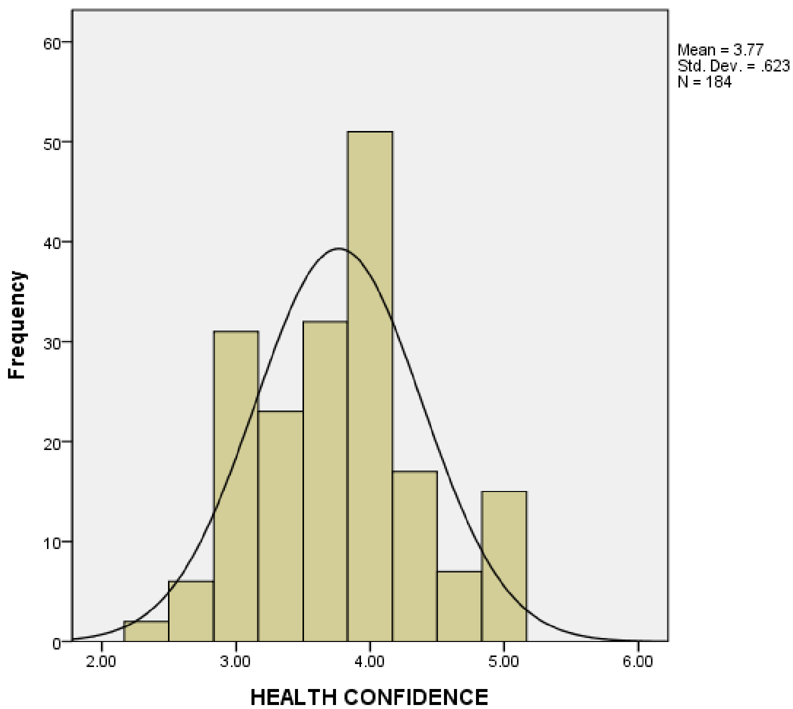



Mean = 4.23
Std. Dev. = .621
N = 185
Frequency
125
100
75
50
25
0
2.00
3.00
4.00
5.00
6.00
7.00
EDUCATION LEVEL


Mean = 5.46
Std. Dev. = 2.755
N = 161
Frequency
40
30
20
10
0
.00
2.00
4.00
6.00
8.00
10.00
INCOME LEVEL

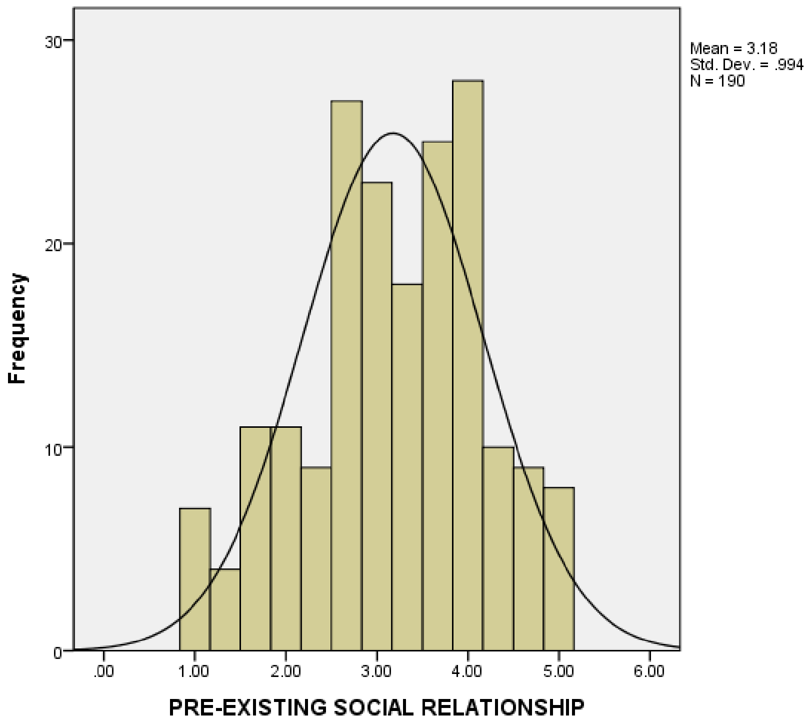

Mean = 4.24
Std. Dev. = 1.132
N = 182
Frequency
40
30
20
10
0
.00
2.00
4.00
6.00
SEDENTARY LIFESTYLE TENDENCY

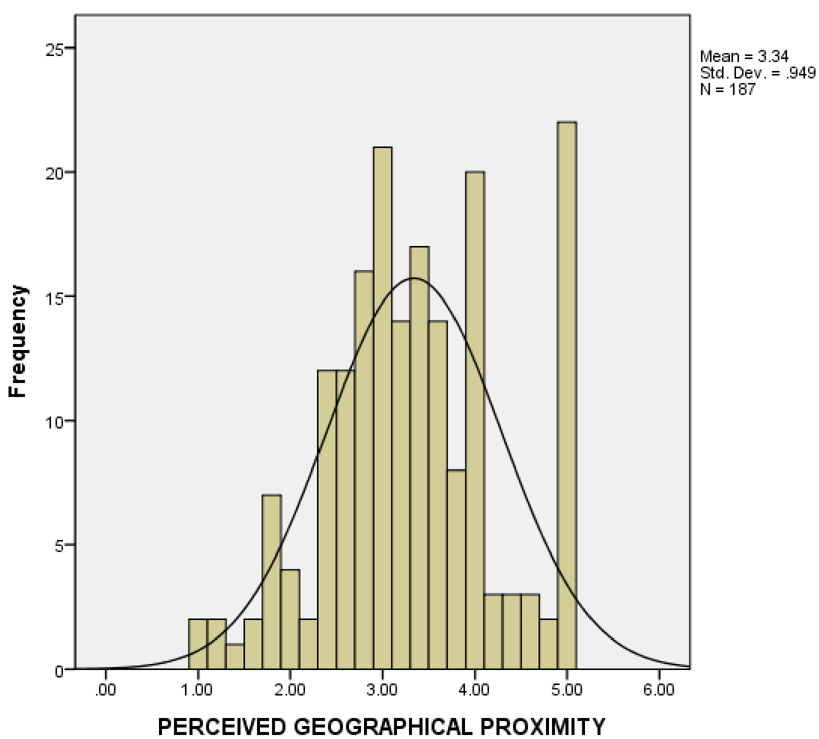

Mean = 3.87
Std. Dev. = 1.597
N = 183
Frequency
50
40
30
20
10
0
-2.00
.00
2.00
4.00
6.00
8.00
ONLINE HEALTH INFORMATION SEEKING

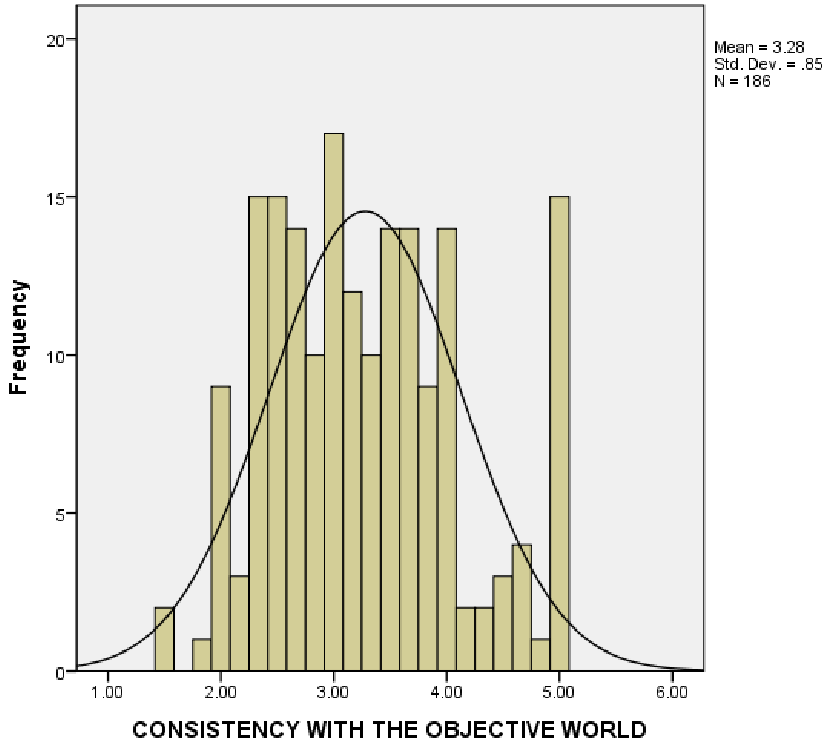


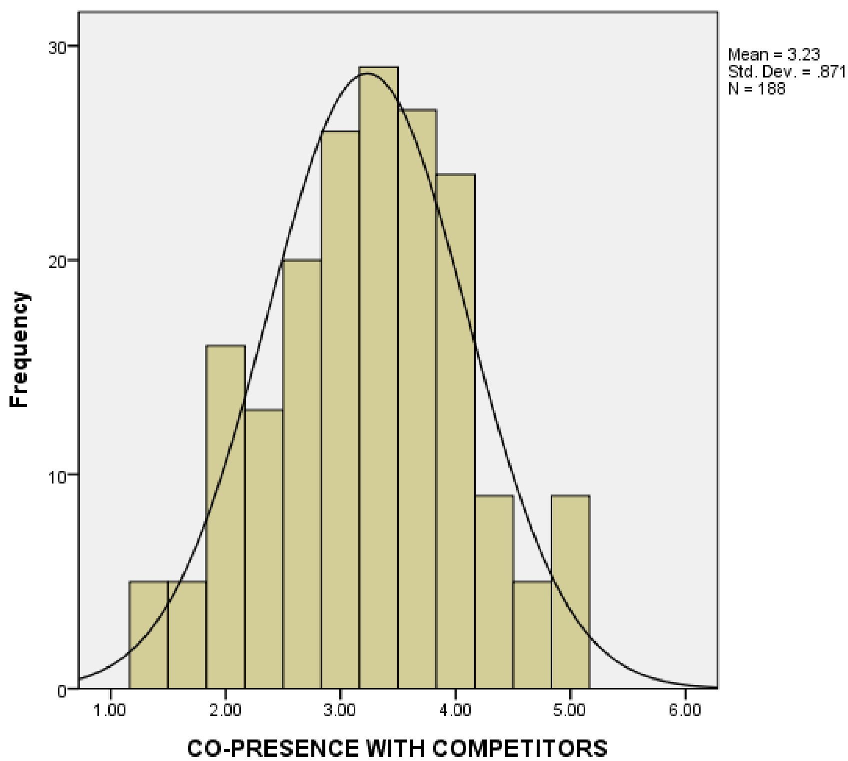
Mean = 3.77
Std. Dev. = .623
N = 184
Frequency
0
10
20
30
40
50
60
2.00
3.00
4.00
5.00
6.00
HEALTH CONFIDENCE

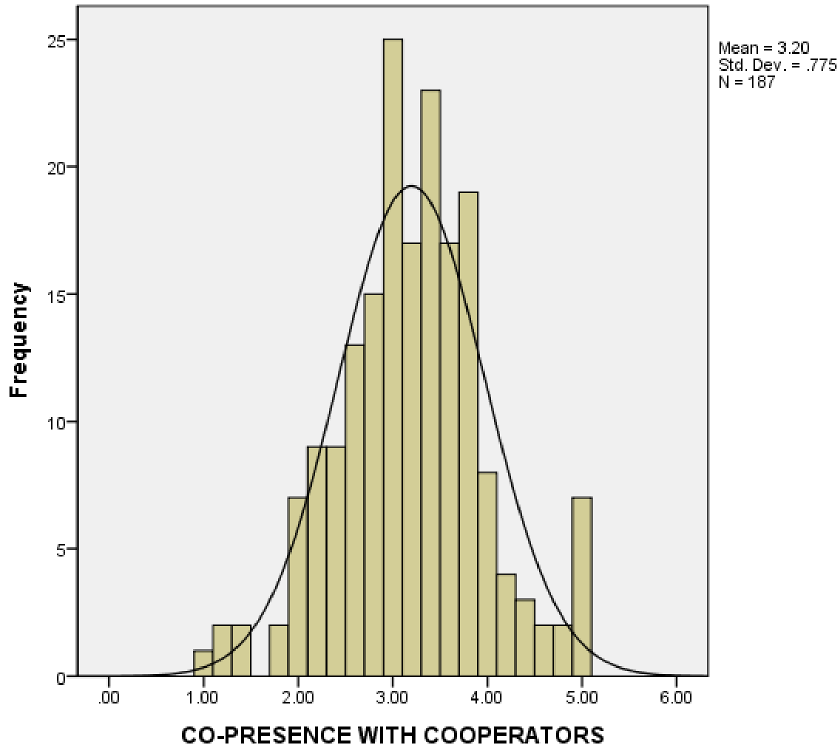
Figure 7. Frequency Distribution of Research Variable

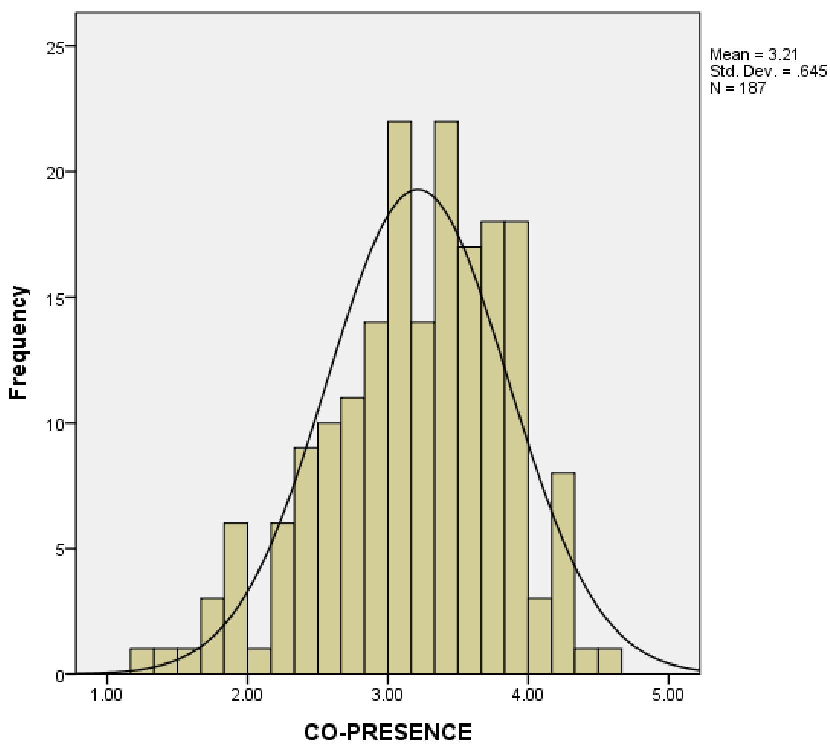


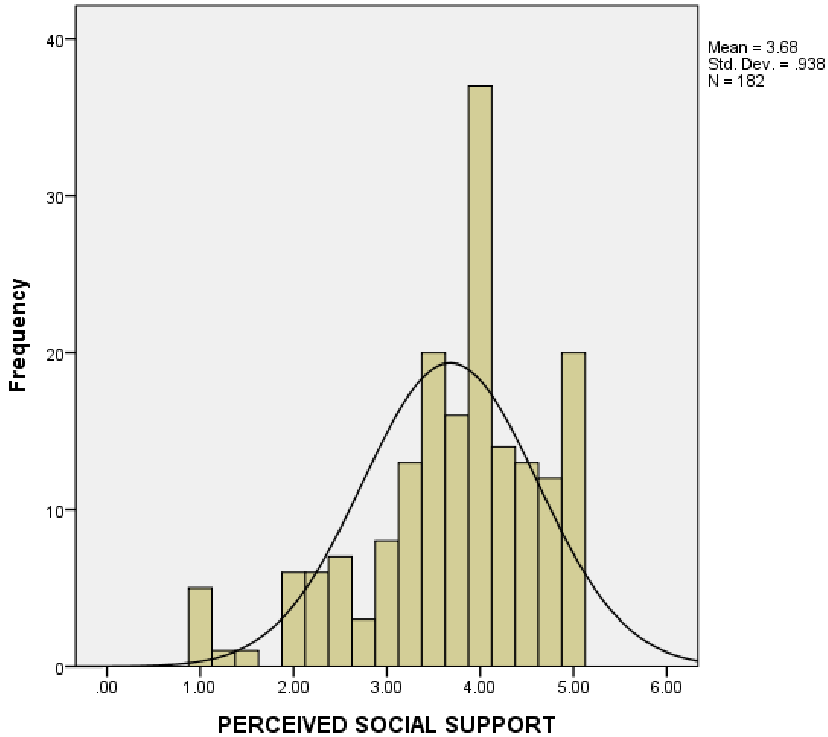


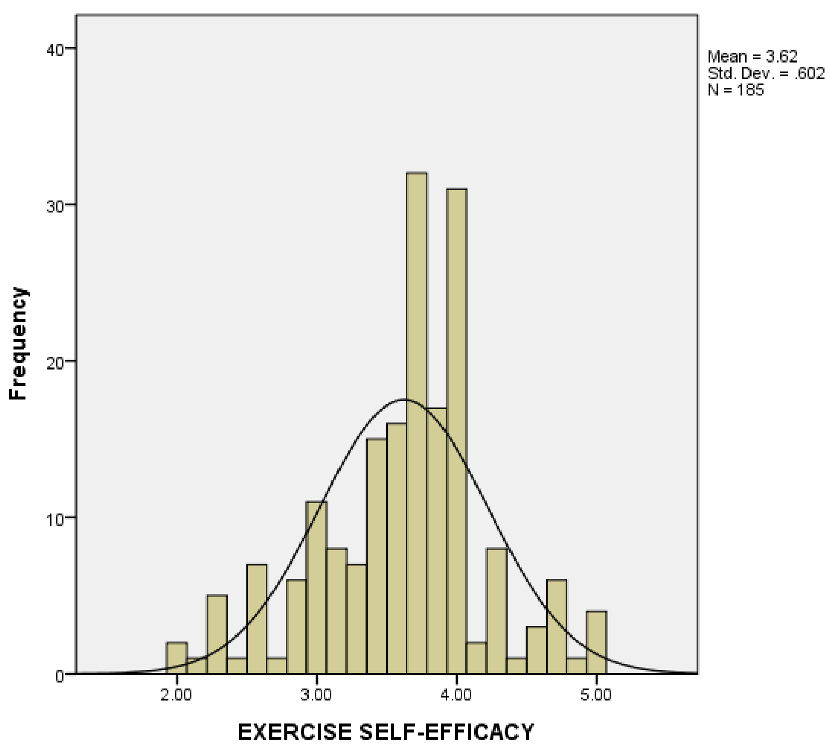

Mean = 3.28
Std. Dev. = .85
N = 186
Frequency
CONSISTENCY WITH THE OBJECTIVE WORLD

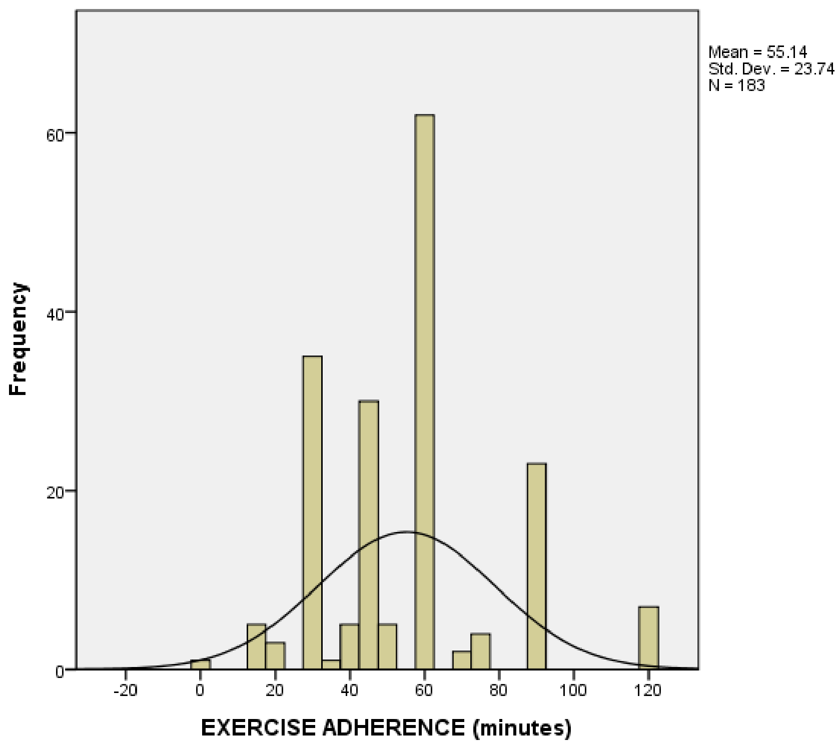

Mean = 3.23
Std. Dev. = .871
N = 188
Frequency
CO-PRESENCE WITH COMPETITORS


Mean = 3.20
Std. Dev. = .775
N = 187
Frequency
0
5
10
15
20
25
.00
1.00
2.00
3.00
4.00
5.00
6.00
CO-PRESENCE WITH COOPERATORS


Mean = 3.21
Std. Dev. = .645
N = 187
Frequency
0
5
10
15
20
25
1.00
2.00
3.00
4.00
5.00
CO-PRESENCE


Mean = 3.68
Std. Dev. = .938
N = 182
Frequency
40
30
20
10
0
.00
1.00
2.00
3.00
4.00
5.00
6.00
PERCEIVED SOCIAL SUPPORT


Mean = 3.62
Std. Dev. = .602
N = 185
Frequency
40
30
20
10
0
2.00
3.00
4.00
5.00
EXERCISE SELF-EFFICACY


Mean = 55.14
Std. Dev. = 23.74
N = 183
Frequency
0
20
40
60
-20
0
20
40
60
80
100
120
EXERCISE ADHERENCE (minutes)

APPENDIX C.

Presence and Their Manifestation in Mobile Services (Based on Lee 2004; Yates et al. 2006)

Types of Presence	Characteristics of Virtuality	Explication	Operationalization (system properties)
Physical	Para-Authentic	Experiencing virtual physical objects and environments which have authentic connection with the corresponding actual physical objects and environments.	▪ Providing health information in multi-media format (e.g., apps with videos, sounds, and photos instruction on yoga stretching) ▪ Offering tailored information relative to a user's current location. ▪ Providing virtual imagery on top of real location (augmented reality setting, e.g., apps that geo-locate places for a user's physical activity)
	Artificial	Experiencing virtual physical objects and environments artificially created or simulated by technology.	▪ Enabling users to explore virtual environment (fictional setting)

Social	Para-Authentic	Experiencing social interaction with others connected by context-aware mobile technology	▪ The ability to be aware of, contact, and interact with real people (phone conversation, SMS, email) ▪ Proximity alert (suggest who's near to a user) ▪ Being connected to larger social networks so that a user is able to get social responses from his peers (e.g., apps with automatic upload to Facebook) ▪ Promote collective/collaborative activity or competition with other users in a user's vicinity (including people in a user's pre-existing social network.
	Artificial	Experiencing social interaction with artificial objects	▪ Social interaction with artificial agents which have personality and express emotion (e.g., encouragement from artificial trainers/coaches) ▪ Promote collective/collaborative activity or competition with artificial agents.
Self	Para-Authentic	Experiencing the representation of one's own genuine self--either physically manifested or psychologically assumed--inside a virtual environment	▪ Experiencing the representation of one's own genuine self (identity, personality, self-representation) ▪ Automatically monitoring and recording a user's health-condition (e.g., heart rate, weight, calorie counter etc.) through mobile devices. ▪ Exploring environment which reacts sensitive to user inputs (e.g., an app that provided automated feedback about user's reports of his/her physical activity)

	Artificial	Experiencing an alter self, constructed--either physically or psychologically--inside a virtual environment	▪ Experiencing an artificial constructed alter-self (e.g., gender swapped avatars)

APPENDIX D.

List of the Sampled Mobile Health Applications and URL for User Communities

Application(s)	iTunes Preview	User communities
5K Runner: 0 to 5K run training	https://itunes.apple.com/us/app/5k-runner-0-to-5k-run-training/id439852091?mt=8	http://www.facebook.com/5K.Runner.Community
Runtastic Pro	https://itunes.apple.com/us/app/runtastic-pro/id366626332?mt=8	http://www.facebook.com/runtastic
Get running (Couch to 5K)	https://itunes.apple.com/us/app/get-running-couch-to-5k/id319043985?mt=8	https://twitter.com/getrunningapp
Garmin Fit	https://itunes.apple.com/us/app/garmin-fit/id446196700?mt=8	http://www.facebook.com/Garmin/
Cyclemeter GPS Cycling Computer	https://itunes.apple.com/us/app/cyclemeter-gps-cycling-computer/id330595774?mt=8	http://www.facebook.com/cyclemeter
Zombies, Run! 5k Training	https://itunes.apple.com/us/app/zombies-run!-5k-training/id566596422?mt=8	https://twitter.com/ZombiesRunGame?tw_i=242799645351350272&tw_p=tweetembed http://www.facebook.com/zombiesrungame
Nike+ Running,	https://itunes.apple.com/us/app/nike+-running/id387771637?mt=8	http://www.facebook.com/nikerunapp http://www.facebook.com/nikerunning https://twitter.com/NikeRunning
Nike Training Club	https://itunes.apple.com/us/app/nike-training-club/id301521403?mt=8	http://www.facebook.com/NikeTrainingClubUK?fref=ts
Nike+ FuelBand	https://itunes.apple.com/us/app/nike+-fuelband/id493325070?mt=8	http://www.facebook.com/nikefuel?fref=ts
MapMyRun GPS Running	https://itunes.apple.com/us/app/mapmyrun-gps-running/id291890420?mt=8	http://www.facebook.com/mapmyrun https://twitter.com/mapmyrun

Application(s)	iTunes Preview	User communities
MapMyRide GPS Cycling	https://itunes.apple.com/us/app/mapmyride-gps-cycling/id292223170?mt=8	http://www.facebook.com/mapmyride https://twitter.com/mapmyride
RunKeeper	https://itunes.apple.com/us/app/runkeeper-gps-track-running/id300235330?mt=8	http://www.facebook.com/RunKeeper https://twitter.com/RunKeeper
Strava Run	https://itunes.apple.com/us/app/strava-run/id488914018?mt=8	http://www.facebook.com/StravaRun https://twitter.com/strava
Strava Cycling	https://itunes.apple.com/us/app/strava-cycling/id426826309?mt=8	http://www.facebook.com/Strava https://twitter.com/strava
iRunner I Running, Jogging, Walking GPS Tracking & Heart Rate Monitor Training	https://itunes.apple.com/us/app/irunner-running-jogging-walking/id304074554?mt=8	http://www.facebook.com/digifit
Sport Tracker	https://itunes.apple.com/us/app/sports-tracker/id426684873?mt=8	http://www.facebook.com/sportstracking https://twitter.com/sportstracking
C25K® - 5K Trainer	https://itunes.apple.com/us/app/c25k-5k-trainer-pro/id497401338?mt=8	http://www.facebook.com/c25kfree

APPENDIX E.

On-campus Flyer

Gamify Your Exercise?

Have you ever used any mobile application (app)*1) that helps your physical activities (e.g., running, bike riding, squat, and many others), AND 2) that is equipped with location-sensing features (e.g., GPS) tracking your real-life physical activities?* If yes, please participate in this study.

This survey can be completed from your home, taking about 5 mins to be completed). If you are interested, please go to this web site ***http://tinyurl.com/2013gamified*** or scan the QR code on the above, and check further information of the study. Everyone will be given an opportunity to enter a drawing for **$10 STARBUCKS GIFT CARD,** regardless of whether you agree to participate.

For more information, please contact:
Soela Kim, Master student at the Grady College
(mobile: 706-461-6489, e-mail: soelakim@uga.edu)
or, Dr. Jeong-Yeob Han (jeonghan@uga.edu), the Principal Investigator.

Appendix F

Online Survey Questionnaire

Q1 INFORMED CONSENT FORM

Hello, my name is Soela Kim, and I am a graduate student in the Grady College of Journalism and Mass Communication at the University of Georgia. I am working on research about game-like mobile software applications which are designed to help your physical activities, which is being conducted under the direction of Dr. Jeong-Yeob Han.

The purpose of this research project is to see how the various utilization of mobile technologies, specifically context sensing technologies (E.g. GPS), affects peoples' physical activity in their everyday lives.

In this survey, you will be asked about 1) your experience with smart phone applications which are designed to help your physical activities, 2) your media usage (in general) to look for health information, and 3) your daily physical activities. I think you will find the questions interesting and easy to answer.

It should take about less than 10 minutes to complete this questionnaire. Your participation is voluntary. You can refuse to participate without penalty or loss of benefits to which you are otherwise entitled. If you do not feel comfortable with a question, skip it and go on to the next question. Closing the survey window will erase your answers without submitting them. You will be given a choice of submitting or discarding your responses at the end of the survey.

The findings from this project may offer practical implications in the development of user-centric high-value mHealth services—utilization of mobile technologies to deliver health care services--which ultimately improve public health and well-being. Through participation, you will observe the protocol of social science research. The results of this study will be given to participants who request it.

All data obtained from participants will be kept confidential and will only be reported in an aggregate format (by reporting only combined results and never reporting individual ones). All questionnaires will be concealed, and no one other than the researchers will have access to them. The data collected will be stored in the electronic research folder by Qualtrics-secure database. While all precautions have been taken to protect the security of your responses, the Internet does not allow for total security. The IP address of your computer, however, will not be a part of the data file used to analyze survey responses.

This on-line survey will give all recruited individuals an opportunity to enter a drawing for $10 Starbucks gift cards in which everyone has an equal chance (2%) of receiving the incentive whether or not they have completed the survey. For UGA students who are recruited from in-class announcement at the Grady College of Journalism and Mass Communication, your participation may earn you extra credit for the course in which you sign up for the study, at the discretion of the instructor. No risks or discomforts are anticipated.

If you have any questions about this research project, please feel free to contact me at 706 462 6489 or send an e-mail to soelakim@uga.edu. Questions or concerns about your rights as a research participant should be directed to The Chairperson, University of Georgia Institutional Review Board, 629 Boyd GSRC, Athens, Georgia 30602; telephone (706) 542-3199; email address irb@uga.edu.

I have read and understand the statement above and agree to take part in this research project.

- I AGREE, CONTINUE (1)
- NO, I DO NOT AGREE (2)

If NO, I DO NOT AGREE Is Selected, Then Skip To End of Survey

Q2 SECTION A. SURVEY ELIGIBILITY VERIFICATION

1. Have you ever used any mobile software application (apps) that 1) helps your physical activity, and 2) has GPS features to track your physical activities?

- o YES (1)
- o NO (2)

If NO Is Selected, Then Skip To SECTION C. HEALTH INFORMATION SEEKING...

Q3 Please check all the mobile software application(s) that you have used before in the list provided below:

- o 5K Runner: 0 to 5K run training (or) 10K Runner: 0 to 5K to 10 K run training (1)
- o runtastic Pro (2)
- o Pedometor Pro GPS + (3)
- o Get running (Couch to 5K) (4)
- o Garmin Fit (5)
- o Cyclemeter GPS Cycling Computer (6)
- o Zombies, Run! 5k Training (7)
- o Nike+ Running (8)
- o Nike Training Club (9)
- o Nike+ FuelBand (10)
- o MapMyRun GPS Running (11)
- o RunKeeper (12)
- o MapMyRide GPS Cycling (13)
- o Strava Cycling (14)
- o iRunner I Running, Jogging, Walking GPS Tracking & Heart Rate Monitor Training (15)
- o Sport Tracker (16)
- o Strava Run (17)
- o Pedal Brain (18)
- o C25K® - 5K Trainer (19)
- o Others; if you remember the name of the apps please specify in the blank below: (20) ____________________

SECTION B. EXPERIENCE WITH THE APP(S)

Now we are going to ask you some questions regarding your experience with the apps you specified above. Now, thinking about the people you interact with in the course of using the apps (e.g., the other users of the application you use). By people, we mean actual human beings, digital representations of them such as picture, graphic, sound, or video clips (e.g., avatars). Anything you think it has human characteristics can be "people" in this context. We are curious about your subjective experience. There's no correct answer. For example, if you think a dot on the Google map indicates a human standing on the physical location, it can be considered as a person.

Q4 How much do you agree with the following statements?"

When using the application(s)..."	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
Most of the people that I interact with through the apps are my close friends (1)	❍	❍	❍	❍	❍
Most of the people that I interact with through the apps are my acquaintances (2)	❍	❍	❍	❍	❍
Most of the people that I interact with through the apps are strangers (3)	❍	❍	❍	❍	❍

Q5 How much do you agree with the following statements?

When using the application(s)..."	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
In the course of using the apps, I have a sense that I was in the same place as the competitors (1)	❍	❍	❍	❍	❍
I frequently feel a sense of rivalry with users (2)	❍	❍	❍	❍	❍
I feel inclined to compare my achievement with other users (3)	❍	❍	❍	❍	❍
I am depressed when I feel everyone is doing better than me in terms of exercise. (4)	❍	❍	❍	❍	❍
In the course of using the apps, I have a sense that I was in the same place as the cooperators (5)	❍	❍	❍	❍	❍
I have the impression that I am needed. (6)	❍	❍	❍	❍	❍
I have the impression that other users and I have shared responsibility. (7)	❍	❍	❍	❍	❍
I am aware of that other users have the same goal with mine (8)	❍	❍	❍	❍	❍
I have the impression that other users and I monitor each other’s efforts and contributions (9)	❍	❍	❍	❍	❍

Q6 How much do you agree with the following statements?

When using the application	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
B25. I have the impression that I could have encountered other users whom I interact with through the app(s) in the real world (1)	❍	❍	❍	❍	❍
B26. I have the impression that most of the people that I interact with via those apps are living in the same country with me. (2)	❍	❍	❍	❍	❍
B27. I have the impression that most of the people that I interact with via those apps are living in the same state with me. (3)	❍	❍	❍	❍	❍
B28. I have the impression that most of the people that I interact with via those apps are living in the same city with me. (4)	❍	❍	❍	❍	❍
B29. I have the impression that most of the people that I interact with via those apps are living in the same district (e.g., county or neighborhood) with me. (5)	❍	❍	❍	❍	❍

Q7 Now we are going to ask you some questions about THE WORLD you experienced through the app(s) How much do you agree with the following statements?

When using the application	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I have the impression that the virtual objects belong to the real object (1)	❍	❍	❍	❍	❍
I think of the world that I experience through my mobile device as somewhere that I have visited (2)	❍	❍	❍	❍	❍
I have a sense of acting in the mobile-mediated environment, rather than operating something from outside (3)	❍	❍	❍	❍	❍
I feel that the displayed environment--the audio and video display of the environments--was part of the real world (4)	❍	❍	❍	❍	❍
I feel that the scenes depicted in the apps could really occur in the real world (5)	❍	❍	❍	❍	❍
I feel that the digital objects visualized on my mobile screen actually appear to be located in the radius of my everyday life (6)	❍	❍	❍	❍	❍

Q8 Now we are going to ask some questions about in what way and how does the usage of the app(s) help your exercise. How much do you agree with the following statements?

When using the application(s)...	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
I can be physically active most days (1)	❍	❍	❍	❍	❍
I can ask others (e.g., family members or friends) to do physically active thing with me. (2)	❍	❍	❍	❍	❍
I can be physically active even if I could watch TV/play video games (3)	❍	❍	❍	❍	❍
I can be physically active even if it is very hot or cold outside (4)	❍	❍	❍	❍	❍
I am be physically active even if I have to stay at home (5)	❍	❍	❍	❍	❍
I have the skills I need to be physically active (6)	❍	❍	❍	❍	❍
I can be physically active no matter how busy my day is (7)	❍	❍	❍	❍	❍
There are people who are around when I am in need (8)	❍	❍	❍	❍	❍
There are whom I can share my joys and sorrows (9)	❍	❍	❍	❍	❍
I get the emotional help and support I need from other people (10)	❍	❍	❍	❍	❍
I have people who are a real source of comfort to me (11)	❍	❍	❍	❍	❍
I can count on other people when things go wrong (12)	❍	❍	❍	❍	❍
I can talk about my problem with other users (13)	❍	❍	❍	❍	❍
There are people in my life who cares about my feelings (14)	❍	❍	❍	❍	❍
Other users are willing to help me make decision (15)	❍	❍	❍	❍	❍

Q9. In the past 12 months, have you used the Internet for any of the following reasons?

	Yes (1)	No (2)
To participate in an online support group for people with a similar health or medical issue (1)	❍	❍
To buy medicine or vitamin online (2)	❍	❍
To download health-related information--including apps--to mobile device, such as mp3 players, smartphone, tablet computer (e.g., iPad), or electronic book device (e.g., Kindle) (3)	❍	❍
To visit a social networking sites, such as Facebook or Twitter to read and share about health information (4)	❍	❍
To keep track of personal health information such as care received, test result, or upcoming medical appointments (5)	❍	❍
To look for health or medical information for someone else (6)	❍	❍
To look for health or medical information for yourself (7)	❍	❍

Q10. Please answer the following questions

	Not at all confident (1)	Little confident (2)	Somewhat confident (3)	Very confident (4)	Completely confident (5)
A. Overall, how confident are you that you could get advice or information about health or medical topics if you needed it? (1)	❍	❍	❍	❍	❍
Overall, how confident are you about your ability to take good care of your health? (2)	❍	❍	❍	❍	❍
How confident are you that you have some say in who is allowed to collect, use and share your medical information? (3)	❍	❍	❍	❍	❍

SECTION C. PHYSICAL ACTIVITY

In this section, we are going to ask your physical activities in typical days.

Q11a. In a typical week, how many days do you do any physical activity or exercise of at least moderate intensity, such as brisk walking, bicycling at a regular pace, and swimming at a regular pace?

- 1 days per week (1)
- 2 days per week (2)
- 3 days per week (3)
- 4 days per week (4)
- 5 days per week (5)
- 6 days per week (6)
- Every day, 7 days per week (7)
- None (8)

Q11b. On the days that you do any physical activity or exercise of at least moderate intensity with mobile health applications, how long are you typically doing these activities? (Specify numerically in text box below. If you never do exercise you may enter "0"; if you exercise for one and half hours, you may enter "90")

minute(s)

Q11c. Over the past 30 days, in your leisure time, how many hours per day, on average, did you sit and watch TV or movies, surf the web, or play computer games? Do not include active gaming such as Wii.

- Less than a half hour (1)
- 30 minutes to less than one hour (2)
- About an hour (3)
- More than one hour but less than two hours (4)
- Two hours to less than three hours (5)
- Three hours to less than four hours (6)
- Four hours or more (7)
- Don’t know/Prefer not to answer (8)

SECTION D.

Now, just a few questions to help us classify your responses...

Q12. What is your age?

- 18-24 (1)
- 25-29 (2)
- 30-34 (3)
- 35-39 (4)
- 40–44 (5)
- 45-54 (6)
- 55-64 (7)
- 65 or older (8)
- Don’t know/Prefer not to answer (9)

Q13 What is your gender?

- Male (1)
- Female (2)

Q14 What is the last grade or class that you completed in school?

- 8th grade or less (1)
- Some high school (2)
- High school graduate (3)
- Some college (4)
- College graduate (5)
- Postgraduate study/law or medical school (6)
- Don’t know/Prefer not to answer (7)

Q15 Finally, just for classification purposes, was your total family income before tax last year was: (best estimate is fine)

- Less than $9,999 (1)
- $10,000 to just under $14,999 (2)
- $15,000 to just under $19,999 (3)
- $20,000 to just under $34,999 (4)
- $35,000 to just under $49,999 (5)
- $50,000 to just under $74,999 (6)
- $75,000 to just under $99,999 (7)
- $100,000 to just under $199,999 (8)
- $200,000 or more (9)
- Don’t know/Prefer not to answer (10)

SECTION E. INCENTIVE QUESTION (OPTIONAL)

THE CONTACT INFORMATION AND STUDENT INFORMATION (if you are a UGA student) WILL BE SEPARATED FROM YOUR RESPONSES AND WILL NOT BE USED FOR ANY OTHER PURPOSE. YOU MAY NOT ANSWER THE QUESTION.

E1. Please specify from where you heard about this research

E1. Please specify from where you heard about this research

- UGA on-campus flyer (1)
- UGA Grady College in-class announcement (2)
- Email (or any other social media message) from the researchers (3)
- Others (4)

E2. Now that you have completed the survey, you are eligible for extra credit in one course. To take advantage of this offer, indicate the course you want the extra credit applied towards. Note: You may select one course. Course Number (e.g., ADPR 3100

- o Course Number (e.g., ADPR 3100) ____________________ (1)
- o UGA student ID (810 number identification, e.g.,810XXXXXX) ____________________ (2)
- o The full name of the course instructor ____________________(3)

E3. If you would like to be entered into a random drawing for a ten dollar Starbucks gift card, please provide your email address.

- o No, I would not like to be entered into the drawing (1)
- o Yes, I would like to be entered into the drawing (please, provide your email address below) (2) ____________________