

Examining the impacts of Pokémon Go on the Physical Health and Social Interaction among
College students

BY

Adedotun Ojelabi

A Thesis submitted in partial fulfillment of the requirements for the degree of Master of Science
in Computer and Information Science.

January 17th, 2018


University of Michigan – Flint

Flint, MI

Approved by:



Thesis Advisor



Second Reader

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Charlotte **Tang** Ph.D

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ABSTRACT

Pokémon Go arguably depicts the most popular adoption of augmented reality (AR) technology on any platform and particularly mobile games during the conduct of this research. The mobile location-based game was launched in July 2016, to the delight of millions of people globally. Pokémon Go requires people to physically navigate the real world in the course of playing the game; this was a relatively new experience for many especially as a mobile game.

The need to physically navigate the real world in Pokémon Go prompted the quest to examine what impacts Pokémon Go has on college students. Specifically, we focus on the impact on their social interaction and physical activity as there were studies that have shown that traditional mobile games and video games have made people become anti-social, adopt sedentary lifestyles resulting in various issues in social and health aspects.

This research aims to acquire a better understanding of how AR games like Pokémon Go impacts social interaction and physical activity, and to recommend guidelines for developing similar augmented reality games to promote social interaction and physical activity. Semi-structured interviews were conducted with twenty participants attending a college in the mid-western region of the United States of America. Our findings revealed that Pokémon Go encouraged increased social interaction among family, friends and strangers. Participants also enjoyed some health and educational benefits as a result of playing Pokémon Go. We also identified some challenges and concerns of playing Pokémon Go which borders on personal safety and security, circumvention of game design as well as privacy. Our findings led us to propose recommendation for augmented reality game design that will promote social interaction and physical activity. These include incorporating social game components to enhance players' overall gaming experience, addressing

game design circumvention by developing algorithms that will intelligently permit cheating or out rightly prevent cheating. We also recommended a more transparent and flexible permission requests to address privacy concerns.

DEDICATION

To my mother, Oluremi Johnson-Ojelabi, who has had my back since day one. You are the best and I LOVE YOU.

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TABLE OF CONTENTS

ABSTRACT.....	2
DEDICATION.....	4
ACKNOWLEDGEMENTS	5
LIST OF FIGURES.....	8
CHAPTER 1: INTRODUCTION.....	9
CHAPTER 2: RELATED WORK	13
2.1 Obesity/Overweight and Physical Activity	13
2.2 Physical Activity and Technology.....	14
2.3 Technology and Social Interaction	15
2.4 Brief History of Augmented Reality and gaming.....	16
2.5 Interaction in Augmented Reality	18
CHAPTER 3: METHODOLOGY.....	21
3.1 Method	21
3.2 Participants.....	21
CHAPTER 4: FINDINGS	23
4.1 Information sources for Pokémon Go.....	23
4.1.1 Multimedia Promotion of Pokémon Go before Launch	23
4.1.2 Learning primarily through Social media	23
4.2 Motivation to Play Pokémon Go.....	24
4.3 Adoption of the game, Frequency, and duration of play and attitude towards physical activity in the game	26
4.4 Benefits of Playing Pokémon Go.....	29
4.4.1 Health Benefits.	29
4.4.2 Increased social interaction.....	30
4.4.3 Educational Benefits.	34
4.4.4 Attaining business benefit.	35
4.5 Challenges and concerns of Playing Pokémon Go	35
4.5.1 Safety.....	35
4.5.2 Privacy Issues.	37
4.5.3 Circumventing game design.....	37
4.5.4 Application based Challenges.	38
4.6 Summary.....	39

CHAPTER 5: DISCUSSIONS	40
5.1 Social Game	40
5.2 Implications for technology design	41
5.2.1 Personal and communal safety	41
5.2.2 Addressing circumventing game design	42
5.2.3 Provision transparent privacy options	44
5.3 AR gaming challenges the notion that technology is making humans less sociable	45
5.4 Potential health benefits of increased physical activity using AR games	47
5.5 Limitations	48
5.6 Summary	48
Chapter: Conclusion	50
6.1 Research Problem	50
6.2 Contributions	51
6.3 Future Works	52
References	54
Appendix	61
A. Appendix- Interview questions	61
B. Appendix- Game concepts	65
C. Appendix- Minimum Game specification	68
D. Appendix – Recruitment Material	68

LIST OF FIGURES

Figure 1: Physical Activity level & reported impact of walking on Physical Activity time
(Complemented or substituted Physical Activity time)

Figure 2: Participants' perception of Walking as requirement of playing Pokémon Go

Figure 3a: First permission request on Android phones

Figure 3b: Current permission request on Android phones

CHAPTER 1: INTRODUCTION

With the advent of the television, computers, and video games, people's lifestyle has become increasingly sedentary, which unfortunately is linked to many diseases and ailments such as diabetes, heart disease, and obesity. Overweight and obese college students in America increased from 27.4 percent in 2006 to 29.2 percent in 2011 (Andersen, 2012). Whereas 36.5% of adults in the U.S. were found to be obese between 2011 and 2014 (Ogden, Carroll, Fryar, & Flegal, 2015), this is a worrisome phenomenon that needs to be addressed urgently.

Reduced physical activity is one of the leading causes of many diseases and ailments, in particular, obesity, as reported by Bach (2014). While examining national health survey results from 1988 through 2010, researchers found considerable increases in both obesity and inactivity, but not in the overall number of calories consumed per person. In an attempt to help promote a healthy lifestyle, exercise games (a.k.a. exergames) such as Wii and Kinect, have been developed to encourage people to engage in physical activities via technology. Most of them were designed for indoors.

Advances in technology have made the world a connected village, where communication among people in disparate locations is often just one click away. The Internet has dramatically made communication more comfortable but to the detriment of other forms of communication like face-to-face communication (Drussell 2012). Rather than meeting in person to socialize, the Internet provided alternate means of communicating with electronic devices via texting, voice or video calls. People have thus become more reliant on talking with friends and family through technology, rather than engaging personally, even in the presence of others (Drago 2015).

In summer 2016, Pokémon Go was launched on smartphones and became the top mobile game with over 10 million downloads in the first week (Sears 2016). Pokémon Go exceeded Twitter in daily average number of users and had a higher average time spent per user than Facebook, Instagram, Snapchat and WhatsApp (Sears 2016). Pokémon Go is an augmented reality game that places digital Pokémon creatures in real-world locations, where players can catch them. To do so, players have to navigate and move around in streets and cities, resulting in increased physical activities (Catch Pokémon Go, 2017).

Pokémon Go is a free, location-based augmented reality game that was developed by Niantic for iOS and Android devices. It was released in the summer of 2016 in different parts of the world as follows: Australia and North America on July 6, Europe on July 13, and Japan on July 22.

In Pokémon Go, players use the GPS capability of a mobile device to locate, capture, battle, and train virtual creatures called Pokémon. These creatures appear on the screen as if they were in the same real-world location as the player (Pokémon Go, n.d.). Players may also make in-app purchases of Pokécoins, which is the in-game currency of Pokémon GO, to exchange for power-ups, extra items, and other enhancements during gameplay.

One of the advantages of playing games in the real world is that players can navigate the environment and communicate with players in natural ways (Mulloni, Wagner, & Schmalstieg, 2008). Pokémon Go can be played individually or in a team, thus making it a social tool as well. The intuitive interfacing with the real world makes Augmented Reality (AR) games makes it ideal for players of any age, gender, and

technical expertise since they can be involved socially and physically using the same mechanics they regularly use in everyday contexts (Mulloni, Wagner, & Schmalstieg, 2008).

Thus, AR has laid the foundation to transition from indoor gaming activities to the outdoors readily. Given the potential for AR games like Pokémon Go to promote a healthy lifestyle while maintaining a similar level of gaming satisfaction as other indoor games, we aimed to examine the social and physical impacts of this game in promoting active living. We also focused on a particular population of college students who are prone to inactivity due to their attachment to indoor entertainments like TV and video games nowadays. We conducted semi-structured interviews with 20 college students who played or have played Pokémon Go to acquire a better understanding of their gaming experience and their perceived barriers and benefits of their engagement in the game. We believe that the results from this study will help us design similar games to promote physical activities and social interactions in the future.

Our findings reveal new information on the impacts of Pokémon Go on social interaction and physical activity among college students, and we have made recommendations based on participants' reported experience that will help design AR games that will promote social interaction and physical activity in addition to the pleasure derived from playing Pokémon Go. Our recommendation includes incorporation of Social game components to help increase interaction, social skills, maintain and sustain players' interest in the game. We also made recommendations on how to avoid pitfalls that are present in Pokémon Go regarding safety and game design circumvention.

In the remainder of this thesis, Chapter 2 provides a literature review on Obesity/Overweight and Physical Activity, Physical Activity and Technology, technology and social interaction, a brief history of AR and AR games and lastly, interaction in AR games. In Chapter 3, I presented research methodology by describing the method of data collection, analysis and participants' recruitment procedure and demographics. In Chapter 4, I presented the findings from our semi-structured interviews of the 20 participants. In Chapter 5, I discussed the Social game and other technological implications as a result of our findings. Finally, Chapter 6 concluded this research by highlighting my contributions and future work.

CHAPTER 2: RELATED WORK

In this section, we first presented the related work on obesity/overweight and physical activity, its prevalence and how technology-mediated activities can help increase physical activity to mitigate/reduce the risk of being obese/overweight through gamification and exergaming. We further presented forms of interaction in gaming, and how these interactions are influenced by technology especially as it pertains to social interaction. Finally, we provided a brief history of AR, the technology used to deploy Pokémon Go and AR games, their successes and failures as regarding social interaction and physical activity.

2.1 Obesity/Overweight and Physical Activity

One of the leading causes of obesity is the lack of physical activities and exercise, which likely led to global obesity epidemic (Reilly, 2005). There are many factors that influence how many calories people burn each day, and the most variable and the most easily modified factor is the number of physical activity people undertake (Obesity Prevention Source).

Obesity can lead to a variety of adverse health consequences including an increased risk of premature death, non-fatal but debilitating effect on quality of life, and many non-communicable diseases (World Health Organization, 2000). Previous research has established that obesity and level of physical activity (PA) are negatively correlated (Telford, 2007). So, any attempt to demonstrate obesity or level of PA as an independent cause of chronic diseases, such as type 2 diabetes (T2D), requires control of the other. Also, obesity in childhood has been found to cause hypertension, dyslipidemia, chronic inflammation, increased blood clotting tendency, endothelial

dysfunction, and hyperinsulinemia (Ebbeling et al., 2002). This further shows the importance of promoting active living from a young age.

2.2 Physical Activity and Technology

While technological advances have contributed to secular decline in physical activity (Nigg, 2003) due to “increased use of automobiles, automated household appliances (dishwashers and washing machines), elevators and escalators rather than stairs, television and computers for entertainment and leisure activities”, technology can also be designed to help promote physical activities, such as through exergames.

Exergames are often designed with gamification, which is used to motivate behavior change, skills development, or innovation, to engage and motivate people to exercise. Exergames, derived from two words EXERcise and Games, are technology-driven physical activities, such as video game play, that require participants to be physically active to play the game (Witherspoon, 2013). Exergames may not only need physical activities via movement of hands, fingers or neck but may also entail full body

movements to participate in virtual sports, group fitness exercise, or other interactive physical activities, as opposed to video games which are played on a television, computer monitor, smartphone, or tablet and have been identified with side effects such as obesity, and reduced physical activity. In fact, exergames have the potential to offer benefits such as fun, good physiological health, and social interaction. However, exergames still fell short in mobility such that many exergames were too large and expensive to put into a living room or bedroom (Witherspoon, 2013). Although advances in computing technology have made exergames like Wii, Kinect available in

portable form, AR games are designed for use on handheld and wearable devices so that the players can physically explore the environment while navigating game locations (Mulloni, Wagner, & Schmalstieg, 2008). Therefore, AR games offer great potential to get people out to the outdoors to engage in physical activities. In the meantime, a variety of mobile and wearable devices such as pedometers are also available to help promote physical activity. For example, pedometer-based walking has been found to increase physical activity (Williams et al. 2006 cited in Heyward, 2014), as much as 27% increase over baseline levels (Bravata et al. 2007).

2.3 Technology and Social Interaction

Technology has made it possible for people to socialize and interact in a different dimension than the traditional physical face-to-face interaction. For example, video games, personal computers, mobile phones and the Internet are some of the new media technologies that have the capability of “enhancing different patterns of social interaction, access to information, and allocation of time” (Venkatesh and Vitalari 1985).

The use of smartphones, personal computers, and the Internet has made the boundary that exists between work and family more permeable than ever (Mesch, 2006). Consequently, individuals can afford to spend more time communicating in person when working from home.

Technology has enabled us to strengthen relationships by keeping in contact with old friends, colleagues, and co-workers as well as providing opportunities for students all over the world to receive an education online (Walker 2014). On the flip side, there is a school of thought that believes technology is detrimental to social interaction. Walker

(2014) explains that dependence on technology has only conditioned people to become less social, interactive, and outgoing, citing the high rate of people using tablets, smartphones or laptops at social gatherings instead of engaging in interpersonal communication and interactions. Also, technology is having a significant impact on family communication, and social interaction as "Children and young people are becoming more individualized and socially excluded, and as a result, they are spending less time with their family members" (McGrath 2012).

2.4 Brief History of Augmented Reality and gaming

The launch of Pokémon Go in summer of 2016 has arguably brought the most attention to the use of Augmented Reality on portable devices. Before the launch of Pokémon Go, there have been a number of attempts at deploying AR games on mobile devices with varying levels of success, failure, and lessons.

Prior to the release of Pokémon Go, some AR games existed that did not garner a lot of buzz and attention like Pokémon Go. AR Quake was released in 1996 for Microsoft DOS. BotFighters, developed by *It's Alive!* was also released in 2001. BotFighters was around till 2005 and played by tens of thousands of people, mainly in its home country of Sweden as well as Russia, China and other parts of Europe (Klopper 2011).

Can You See Me Now? (CYSMN), a collaboration between Blast Theory and the Mixed Reality Lab, University of Nottingham, was launched in 2001. CYSMN was one of the first location-based games. CYSMN is played online and on the streets. Players are dropped at random locations into a virtual map. Tracked by satellites, Blast Theory's runners appear online next to your player. These runners are situated in the

real city with handheld computers showing the position of online players to guide the runners in tracking players down. CYSMN is the closest to Pokémon Go in terms of promoting increased physical activities and interaction among its players as runners physically navigate the street.

As computers increase in power and decrease in size, new mobile, wearable, and pervasive computing applications are rapidly becoming feasible to provide people ubiquitous access to online resources. As such, AR devices have become smaller over the years. In 1957, Morton Heilig created the gigantic Sensorama machine – a machine made to have an effect all the senses including touch and smell (Heilig 1992). In 1968, Ivan Sutherland created the first Head Mounted Display (HMD) named "The sword of Damocles" (Earnshaw et al., 1993). AR applications appeared on Smartphones and portable devices in 2008, and five years later, Google created a head-mounted optical display called "Google Glass" (Burch 2016). The price of the device was a significant barrier to many people who wanted to try out a Google Glass, which was believed to be the reason for its failure in the market. Contrary to public perception, the end device for AR is not a pair of smart glasses but the ubiquitous smartphone or tablet (Heng, 2015).

Augmented reality may be new technology and term to some, but the term has been around since the 1990s (Augmented Reality Games 2016). There are evidence that AR technology may have been around from as early as 1968. The first AR technology was developed in 1968 at Harvard when computer scientist Ivan Sutherland (named the "father of computer graphics") created an AR head-mounted display system (Javornik, 2016). However, the first modern and commercial AR application did not appear until

2008. It was an application developed for advertising purposes by German agencies in Munich. They designed a printed magazine advertisement of a model BMW Mini, which, when held in front of a computer's camera, also appeared on the screen (Javornik, 2016)

2.5 Interaction in Augmented Reality

Social interaction is a strong motive for engaging in online multiplayer games as it is a catalyst for forming lasting social relationships with other gamers (University of Jyvaeskylae 2007). The barrier of physical or face-to-face interaction still exists in online gaming, and physical mobility/interaction is almost non-existent.

People's regular social and physical relationship mechanics are the same as they use in non-gaming contexts (Mulloni, Wagner, & Schmalstieg, 2008), when combined with the advantage of computer games, allowing sophisticated, animated content, which is sometimes fantastic or even impossible in the real world, gives a natural strength to AR games- mixture of real-world interaction and computer controlled content. Mulloni et al. 2008 identified social interaction as one of the core element of AR games. "Social mechanics of real-world games can be preserved, e.g., face-to-face communication and pointing at objects" as players are all physically in the same environment equipped only with an unobtrusive handheld device (Mulloni, Wagner, & Schmalstieg, 2008).

It is important to state that augmented reality interaction happens visually and often, on a personal level (Kipper and Rampolla 2013). However, there are other methods of interaction in AR, and they are tangible AR interface, collaborative AR interface, hybrid AR interface, and multimodal interface (Kipper and Rampolla 2013). Tangible

AR interfaces give a physical feel to digital information. Collaborative AR interface uses a set of multiple displays to support remote sharing and interaction or co-located activities. Hybrid AR interfaces combine many different but complementary interfaces that allow users to interact with AR content in a variety of ways. The multimodal interface enable users to interact with AR content using multiple sense organs.

The need for user friendliness is critical in AR. The easier it is to manipulate AR devices to interact with the virtual world, the higher the chances of satisfactory user experience. In as much as devices like tablets, smartphones and wristwatches are leading the way regarding control and display; there is room for improvement for these devices to be much friendlier. For example, to eliminate the need to move the head in different directions to see an object or seek information, devices can be made to display images in a user's natural field of vision (Heng 2015). The success of augmented reality hinges on how the interaction between man and machine is controlled (Heng 2015) as AR experiences are different because the computer augments reality by providing computer-generated content and overlaying it in the real world (Curran 2016). The easier it is for humans to effortlessly interact with AR devices, the better. Particularly promising types of control appear to be those that rely on people's intuitive, natural body movements, sound (especially gesture control) to interpret commands (Heng 2015).

2.6 Summary

In this chapter, I described the role physical activity plays in obesity and how increased physical activity can be beneficial to one's health. Then I moved on to review literary work on the impact/role technology is playing in the physical activity sphere as well as

social interaction, particularly face-to-face interaction. I concluded this chapter by providing a brief history of augmented reality, AR games, and interaction in an AR environment.

CHAPTER 3: METHODOLOGY

A qualitative interview study was conducted to explore the impacts of playing Pokémon Go on the physical activity and social interaction of college students.

3.1 Method

Two researchers conducted semi-structured interviews with 20 college students; 11 of them were current Pokémon Go players while 9 of them had stopped playing. The interviews were conducted at a mutually agreed location. Interview questions focused on examining their game experience, their motivation to play the game, their perceived benefits particularly concerning their health and social interactions, and their concerns or perceived barriers. Each participant received a \$15 gift card for their participation. The interviews were audio-recorded with verbal consent of the participants and were transcribed verbatim.

The transcribed interview data were analyzed by open coding using an inductive approach. I looked for distinct concepts and categories in the data to form basic units of the analysis. These ideas and categories were then broken down into sub-themes by identifying and naming common themes and patterns as found in the transcripts.

3.2 Participants

Participants were recruited through emails sent to all students at several urban universities and colleges in the Midwestern region of the U.S. All the interviewees were full-time college students. Twelve participants were female, and eight were male. Thirteen of the twenty participants were between the ages of 18-25, and the remaining seven were between 26-35 years of age. Also, participants consisted of 7 seniors, five freshmen, three juniors, 3 Masters Students, one sophomore and one doctoral student.

Sixteen of the participants were domestic students while the remaining four were international students from India (1), Sudan (2) and Kenya (1). All the participants have played Pokémon Go in Michigan, while two participants have also played in Florida and Kentucky.

Some participants had prior knowledge and experience in playing Pokémon games, specifically on Nintendo Gameboy console, or watching the cartoon. Nine of the participants had played Pokémon games on DS or Nintendo Gameboy while they were growing up, one had only seen the cartoon while the remaining 10 participants had never played or watched Pokémon.

CHAPTER 4: FINDINGS

4.1 Information sources for Pokémon Go

4.1.1 Multimedia Promotion of Pokémon Go before Launch

All participants were aware of the impending launch of Pokémon Go before its official launch in July 2016. Unsurprisingly, 12 participants heard about Pokémon Go from Facebook through the news feed, advertisement or their friends' post.

“Word of mouth” was the next popular source through which they learned of Pokémon Go; at least 6 participants heard about the game through family and friends. It is noteworthy that P12 learned about Pokémon Go through her children and she started playing since then. *“I have two boys, 12 and 6 and it was the new craze at the time that they wanted to play this game. Of course, since I had the phone, I downloaded it, and that's how I came about with the whole Pokémon Go”*. The remaining two participants found out Pokémon Go on other online media like Engadget, Kotaku and major news outlets like CNN, and ABC.

4.1.2 Learning primarily through Social media

All participants, except P7, found the process of downloading, installing and navigating Pokémon Go easy and straightforward. P7 had to seek help, *“unfortunately for me, I'm technologically deficient, and so I had my brother actually do it for me.”*

Regarding the mastery level of playing Pokémon Go, 3 participants rated themselves as beginners, 12 as intermediates and five as experts. The intuitive design of Pokémon Go made learning easy. As such, only 7 of the participants needed to seek assistance from people or online resources to find out how to play Pokémon Go. Four

participants received help from a friend and family members on how to play Pokémon Go. Regular websites, dedicated Pokémon Go websites like <https://thesilphroad.com/> and Facebook forums were also useful tools for 6 participants while 2 participants learned tips and tricks for completing somewhat tricky tasks in the game like catching a Pikachu from YouTube videos. For example, P8 watched a YouTube video to learn how to get more coins at a particular Pokégym by going back to the gym at a given interval.

4.2 Motivation to Play Pokémon Go

We identified from the interviews a variety of reasons why the participants were engaged in Pokémon Go. We found that there were participants with prior knowledge of Pokémon games who were looking forward to playing Pokémon Go, and we also had participants who were entirely new to Pokémon games. Their motivation to play Pokémon Go are enumerated below

Curiosity. Four participants were motivated to play Pokémon Go because they were curious about the game. Pokémon Go attracted a lot of publicity in the news and online media, which has helped generate curiosity among people. For example, P2 wanted to know “*what the hype was about*” especially because Pokémon Go was “*using new technology as far as mobile gaming goes.*” P3 started playing Pokémon Go because “*everybody else was doing it*” and she “*wanted to know more about it. Why are these people walking and playing the game? I wanted to be in the loop, what is so hip about it*”. P8 likes “*discovering games and new applications, his curiosity for new games was a motivation to play Pokémon Go.*”

Childhood Memories and Nostalgia. Three participants wanted to relive their childhood memories of Pokémon because they had all played and enjoyed Pokémon games on Nintendo Gameboy when they were young. Thus, they were eager and excited to see what a Pokémon game has to offer in AR and mobile technology. P19 excitedly said, *“It was just like your childhood, this is what I always wanted to do, closest to real life. Yes, I'm an adult, but it was just kind of cool to relive that.”* P1 reiterated similar words, *“I wanted to relive my childhood, growing I played a lot of Pokémon games on Gameboy. Seeing what was in my childhood, out in the real world is surreal for me.”* These participants thus engaged in the new, enhanced Pokémon game, in the way they have enjoyed as a child.

Exercise and Fitness. Two participants were motivated to play Pokémon Go for the fitness and exercise benefits of walking while playing. In as much as they enjoy playing Pokémon Go, the opportunity to pleurably get some walking steps in and spending time outdoors were motivating factors for these two participants.

Quality time with Family. Playing Pokémon Go was an opportunity to spend quality time with her husband according to P11. She said playing Pokémon Go was *“something really fun for my husband and me to do together”* because *“we don't have this activity that we do together.”* Similarly, the need to have something to do with her children was a reason for P12 to play Pokémon Go. To P12, Pokémon Go represented something to enjoy with her children regardless of their age difference. She said *“To be honest I really wanted to have something to do with my kids because of the age difference. They've six years of difference, and they had a lot of -- they have a hard time finding something to do together. This something actually came, it was*

good. I could be part of it and they could be part of it as well. The only thing is that I really had the one phone. So, of course, they're kind of, "It's my turn, it's my turn." But that just came with -- we had to figure that out. But, I really enjoyed the fact that we were able to do it together and we were outside versus indoors and you got to see different places that you didn't even know".

4.3 Adoption of the game, Frequency and duration of play and attitude towards physical activity in the game

Most of the participants were early adopters of Pokémon Go. Specifically, 13 participants started playing Pokémon Go within the first two weeks of its launch whereas 7 participants started playing weeks and months after it was launched. Two of the later adopters were not able to start playing Pokémon Go sooner because they were outside of the U.S. and did not have access to mobile Internet data required to play the game. P10 only started playing Pokémon Go in September 2016 after returning to the U.S. when he had data service, and P13 started playing Pokémon in February 2017 since he was *"abroad for a while and didn't have a proper service to play it"*.

All the participants said they played Pokémon Go multiple times every day in the first few weeks of playing the game. The frequency of play for most participants went from multiple times a day to once a day, and for some participants, once a week especially during the winter season. P9 did not play Pokémon Go much as he did in the first few weeks of downloading the game because *"the application didn't get sufficient updates to keep me interested"*. He further said, *"Once you play it for so long and nothing new is happening, once you collect certain amount of Pokémon, you just have*

no incentive to keep playing.” P19 reduced the number of times she played Pokémon Go in a week because she needed to commit more time to study. P11 said she quit Pokémon Go soon after she started because *“it was interfering with my [her] studies”*.

While most of the participants spent less time playing Pokémon Go as the weeks went by, P1 spent more time playing Pokémon Go. He said his playing time *“started to increase a bit because I found competition among my friend to see who will catch the most Pokémon in a day or how much of their Pokédex they have completed”*. Social game elements messaging, team/multiplayer mode, gifting and leaderboard were some of the features some participants would like to see in future updates. Multiplayer mode would have kept P8 interested for much longer if his friends and people in his circle could have some sort of competition or rivalry. P8 commented that Pokémon Go *“started to get boring, and many people find it not fun. There are not many people interested in my friend group”*.

More than half of all the participants are still playing Pokémon Go since it was launched in July 2016 and this was attributed to their love for the game. Seven participants stopped playing Pokémon Go within 6 months of playing Pokémon Go, apparently, after reaching their goals. P3 stopped after a month as a result of reaching her goal of catching a Pikachu, she said *“After the first month, my interest started lowering down. I wanted to catch a Pikachu and I did. The game became boring from that moment”*. P2 and P8 got bored and stopped playing Pokémon Go while the weather was too cold for P5 to continue playing as the winter season approached.

While many participants enjoyed playing Pokémon Go for a much longer period, P2 stopped playing Pokémon Go after only 2 weeks, because he *“didn’t think it was*

that fun". P8 stopped playing Pokémon Go because he got bored and many people in his group of friends were no longer interested or playing Pokémon Go.

Pokémon Go by design requires players to walk in the course of fulfilling in-game goals, as such, walking is an integral part of playing the game. Thirteen participants had positive disposition towards walking as a requirement for playing Pokémon Go. Ten participants described walking as a “*good*” part of the game, 4 participants were indifferent, and 1 participant respectively said walking is “*awesome*”, important and necessary. One participant thinks walking was “*not necessary*” as another said it was dangerous and the last participant was “*bothered a little about*” walking.

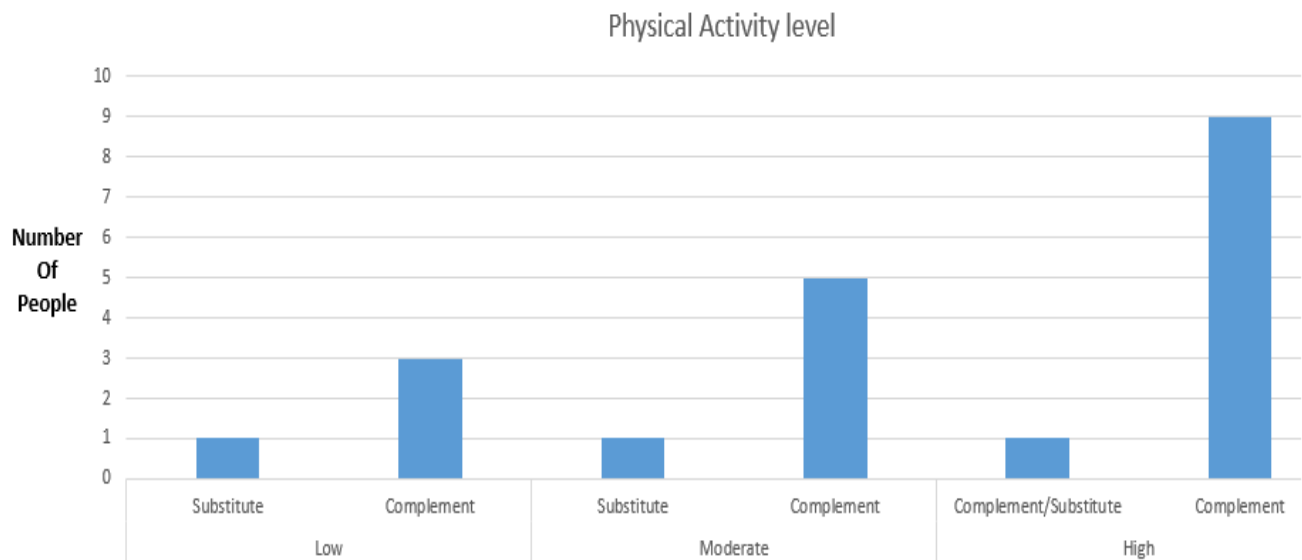


Figure 1. Physical Activity level & reported impact of walking on Physical Activity time (Complemented or substituted Physical Activity time)

Figure 1 shows reported physical activity level of participants. 10 participants reported their physical activity as being high, most of them worked out a minimum of 4 days in a week and 9 of them said walking while playing Pokémon Go complemented their physical activity

while 1 said walking, sometimes complements or substitutes his physical activity tasks. For these set of participants, time spent walking while playing Pokémon represented an extra physical activity in addition to their regular physical activity lifestyle.

Six participants reported their physical activity level as being moderate. 5 of these participants with moderate physical activity level said walking while playing Pokémon Go complemented their physical activity while 1 said walking was a substitute for some physical activity tasks. Lastly, 4 participants reported their physical activity as being low. Three of these participants said walking while playing Pokémon Go complemented they physical activity while 1 said walking was a substitute for some physical activity tasks.

The two participants who substituted their regular physical activity time with playing Pokémon Go supports the idea of pleurably engaging in Physical activity and the potential to encourage people to engage in physical activity through AR games. In other words, a player can derive pleasure from playing a game and simultaneously enjoy the health benefits of walking.

4.4 Benefits of Playing Pokémon Go

4.4.1 Health Benefits.

Seven participants reported some health-related benefits from playing Pokémon Go. As examples, P7 “*lost a lot of calories walking around*”, and five participants (P4, P15, P16, P17 and P20) took walks more often and longer than they usually would. Playing Pokémon Go was an “*incentive to walk*” for participant P16 and for participant P17, it was an opportunity to be “*more active*”. P1 also pointed out that walking while playing Pokémon Go has “*definitely improved my stamina*”, and he experienced noticeable “*leg strengthening*” and “*seeing difference in going up the*

stairs of a building.” For these participants, Pokémon Go represented a good blend of gaming and exercise, and an effective way to improve fitness. Furthermore, more than half of the participants have positive disposition towards walking as requirement of playing Pokémon Go as seen in figure 2.

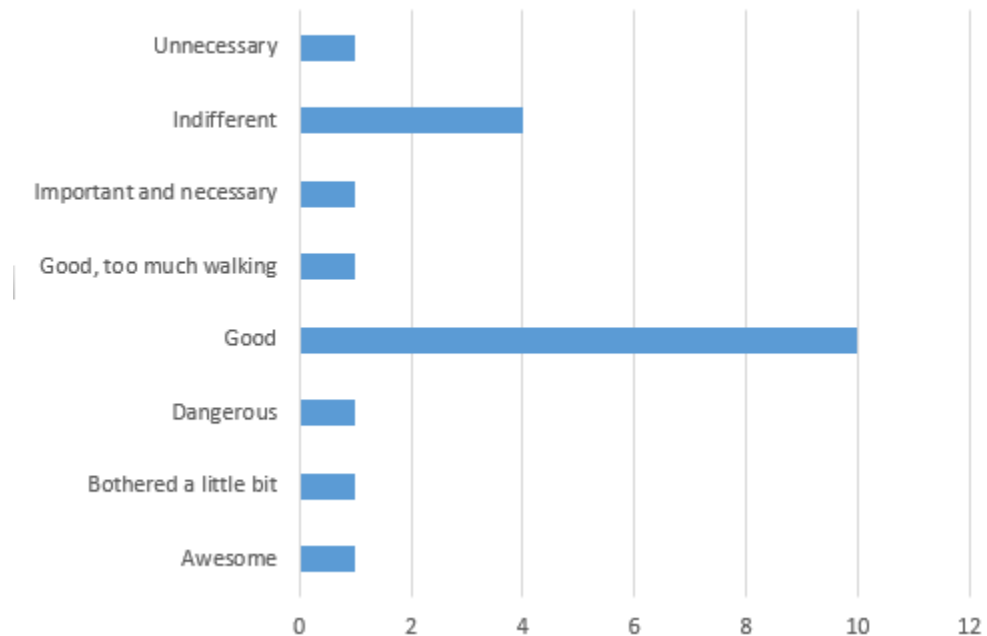


Figure 2. Participants' perception of Walking as requirement of playing Pokémon Go

4.4.2 Increased social interaction.

One of the benefits of playing Pokémon Go according to participants was the opportunity to interact with people. Poké stops and Poké Gyms were some of the features in Pokémon Go that organically bring people to common locations and subsequently aiding interaction. 5 participants counted their interaction with people while playing Pokémon Go as benefits. P1 said “*Strangely enough, meeting people*” was a benefit of playing Pokémon Go because “*there are different teams and you*

kind of form instant comradery with people have never gotten to know". Participant P7 got to "meet some really cool people", "got to say hi!" and maybe get few numbers" referring to the possibility of getting telephone numbers from people should they choose to. P8 said his usually dead neighborhood experience increased traffic at night by Pokémon Go players. He further explained that "it was really surprising to see a lot of people in the city of Flint at night, there were so many people and groups walking around when it used to be dead silent".

All participants expressed that it was easy to talk to people in the course of playing Pokémon Go. Participant P12 mentioned the ease of starting a conversation with a total stranger was because *"the game has already broken whatever ice you guys may have."* In other words, the common knowledge of playing Pokémon Go makes it easy to initiate conversation. Most of the interactions were shallow in terms of content of communication and short in terms of the longevity of their communication. Participants had interactions with people while taking walks, at Pokéstops and Parks. Only 2 participants established relationships that went beyond interactions and communication involved in the course of playing Pokémon Go. Strategies and experiences of playing Pokémon Go were the main subjects of conversation between participants and the people they had interactions with. P16 and P17 were only participants who became friends with people they met while playing Pokémon Go. P17 commented that his relationship with the friends he made while playing Pokémon Go started out as acquaintances when they "kept bumping

into each other while playing” Pokémon Go, then, they exchanged contacts, kept in touch, hung out together and they are “*pretty good friends now*”

P19 mentioned that “*There was a lot more socialization being on the streets*” courtesy of Pokémon Go. Though she has “*always been more of going out and doing things with people*” she did not just “*talk to people that you see on the side of the road.*” But since she started playing Pokémon Go, especially the first few months, she said “*I’m talking to everybody, I’m walking on down the side of the street because they’re all doing Pokémon Go and saying, “Hey, I caught this thing all the way over there.”* In addition, P19 thinks increased social interaction as a result of playing Pokémon Go had positive impact on people. She stated that “*I think that psychologically for a lot of people, there was a positive impact on that. If you were more of a withdrawn person that didn’t come out and talk to people, now you had a reason to get out of the house and you interacted with more people*”

- **Engaged in outdoor activities** For P3, P6, P17, and P18, “*Opportunity to go out*”, getting fresh air outdoors and taking a break from the couch, television and laptop screens were some of the benefits they received in the course of playing Pokémon Go. Playing Pokémon Go provided an opportunity to spend *more* quality time outdoors with friends and family for participants P5, P6, P11, and P12. P12 said “*it was more quality time than our quality time now. We don’t have this activity that we’re doing together*” because “*We were competitive. We had different strategies. We had so much fun doing this. It’s much better than just watching TV*”. P15 said “*It’s definitely fun,*

- Yes, I love it*” that Pokémon Go kept her off Facebook. According to her, Playing Pokémon Go was a more beneficial alternative to spending time on Facebook.
- **Interaction with Family members.** Family members spent more time together, formed stronger bond as well as helping one another while playing Pokémon Go. Eleven participants played Pokémon Go on a regular basis with family members. P11, P16 and P17 played Pokémon Go with their spouse. P11 particularly described playing Pokémon Go with her husband as *“something fun for me and my husband to do together”*. P12 found Pokémon Go to be a unifying factor for her and her two sons, one is 12 years old in middle school and the other is 6 years old. She said, *“I think one of the big benefits is that my children can actually see me as more than just mom. That I could be interacted with them and that they can be opened and fun. I could still be fun with my kids and not just be in a disciplinary mode. That was a huge thing which actually opened up the doors for future things that came after this game that I could be part of. They saw me being able to explain the game to them, show them different techniques that they didn't think their mother had any intellectual aspects to a game like that. So, anything that came out afterward whether it was on an app or a game board they were more open to ask me to about it and come to me for it. It was a good experience.”*
 - **Interaction with friends.** Eighteen participants played Pokémon Go with their friends. Pokémon Go in addition to the list of activities friends could share together according to most Participants. Participants P5 said she and her friends go out *“a lot more because of Pokémon Go”*. Pokémon Go provided an opportunity for these friends to do

something they enjoy together in addition to spending more time together, chit chatting, catching up on gist while playing the game.

4.4.3 Educational Benefits.

There are educational benefits of playing Pokémon Go and they are listed below as found in our research.

- **Reinforcement of learning** is one of the educational benefits of playing Pokémon Go. Participant P15 was able to recollect and identify a piece of art she had learned about in school while playing Pokémon Go at a children's hospital in Hanover, Michigan. She said *“I was walking around with my Pokémon trying to hatch my eggs and I found one of the Pokéstops was a piece of art that I had just learned about in my art class, so I got to see it”*.
- **Experience-based learning.** Learning about historical landmarks, sites and places in person, is one of the benefits of playing Pokémon Go. Participants ventured into their immediate environment and places unknown in pursuit of Pokémon creatures at Pokéstops, thereby getting to know their neighborhood and discovering new places, landmarks, statues and parks. Pokéstops in Pokémon Go are usually landmarks and historical markers with information about them. P19 said *“I was up in near Port Huron and they have a lot of historical things and it tells you that this is what this is, this is what the style is, it represents the boat that sank, whatever how many years ago. That's cool that they incorporated that.”*

Participant P5 was of the opinion that she knew her neighborhood very well until she discovered new businesses in a part of the city she thought she knew well. P5 discovered *“a restaurant and a couple of stores I've never seen before”*, though she

thought she knew her city very well. P12 was thrilled to find a *Dash* store, owned by the Kardashians by South Beach Florida while playing Pokémon Go having been a fan of the reality show “keeping up with the Kardashians”.

4.4.4 Attaining business benefit.

P17 used his Pokémon Avatar to advertise his restaurant by naming his avatar after his restaurant although he could not verify the impact of his action. He said “*I named my character after my restaurant. And, so when people look at the gems in the area of my restaurant they can see my restaurant's name. It's sort of like this weird version of advertising. I like to think that people may have come and get a sandwich at some point.*”

4.5 Challenges and concerns of Playing Pokémon Go

4.5.1 Safety.

Participants were most concerned about their personal safety and the safety of others in terms of road/traffic safety as well as the neighborhood in which they were in while playing Pokémon Go

- **Personal/neighborhood Safety.** Participants P2, P3, P5, P6, and P15 were particularly wary of playing Pokémon Go in suspicious and gray areas of their localities especially at locations where there have been reports of crimes/injuries to people chasing Pokémon creatures. P3 said “*I did not play Pokémon Go at night outside. I played in my room*” although she thinks the high number of people in Downtown Flint, Michigan “*could be a bad thing but also a good thing*”. For P8, the high number of people in a rather “dead silent” Downtown Flint, Michigan made him “*feel more safe*” about walking late at night. He explained, “*I used to*

come back home after late from a job, and I felt more safe, because there were more people around". Participant P12 was concerned about the safety of her home as a result of a feature in Pokémon Go that lets you add people and they have access to your location. She said *"You have the opportunity to add people and if you don't know them and they meet you somewhere or even putting a status out saying you're playing Pokémon Go. Then, they know you're not home and then you get worried about someone's going to break in your home."*

- **Safety of other people.** P7 was concerned about seeing children stay up late in the streets with their parents while their parents are playing Pokémon Go in the early hours of the morning. She said *"I saw parents having their five-year-old at two o'clock in the morning out. I'm like, "Why aren't you sleeping? They should not be out."* Ideally, children should not be found in the streets of a city at 2am, having them outside exposes these children to personal security and safety should the parents get carried away with playing Pokémon Go
- **Road safety and Traffic.** P2's concerns centered on traffic and road safety. He was concerned about *"a lot of teenagers walking around town a lot more than the usual with their eyes glued to their phones"*, these teenagers risk being hit by vehicles as they give full attention to their smartphones.
- **Potential addiction to playing Pokémon Go.** Participants P1, P3 and P8 were wary of spending a lot of time playing Pokémon Go. These participants were concerned that they might become addicted to playing Pokémon Go to the extent of substituting work and study time for Pokémon Go or risk their personal safety. P1 said *"I didn't want to becoming addicted to it to the point that I will be oblivious*

to where I was going, if I was going to a dangerous territory trying to catch Pokémon.”

4.5.2 Privacy Issues.

Collection of user data and location were one of the major concerns for several participants (P2, P9 and P12). They were concerned about their user data being adequately protected, about their locations being available or visible to unauthorized persons, what phone features were available to Pokémon Go on the phone when granting full access. Smartphone Applications generally require and request for varying access to a players' phone features/components like GPS, internet, and phone book among others. When full access is granted to an application like Pokémon Go, the user becomes potentially vulnerable to threats, invasion of privacy, financial loss, and theft of personal information as well as identity.

4.5.3 Circumventing game design.

Some participants found their way to circumvent some of the required activities of completing various tasks in Pokémon go. As such, these players were able to complete in-game contrary to game design. Participants P5 and P12 confessed to finding an alternative to walking to complete some tasks in Pokémon Go. P5 completed most of the tasks in Pokémon Go by driving around in her vehicle, park close to Pokéstops or Pokégym, catch a Pokémon, then move on to the next location. P12 would drive to a rural area with low vehicular activity then drive slowly. This was a way of cheating the game to assume the participant is walking

the minimum distance of 2.5km required before an egg can be hatched. Hatching an egg comes with in-game benefits of adding a Pokémon creature to a player's experience, getting more Dust and Candy. In a nutshell, participants found a way to complete game tasks and goals without explicitly following the physical activity requirements of the game by design.

4.5.4 Application-based Challenges.

There were some application related challenges that some participants faced while playing Pokémon Go. P16 did not like the fact that the game would not record distance walked and other details while the game is not active on the phone screen especially when you have to answer a call or respond to an email/chat while the game is open. P20 saw Pokémon Go application crash or stop functioning multiple times. Limited number of Pokéstops in rural areas was also a challenge for some participants. Pokéstops and Pokémon creatures are abundant in urban areas, consequently, participants sometimes have to drive to city centers in order to play the game

- **Phone Battery.** Pokémon Go is a processor and memory intensive application. As such, it consumes a lot of power when the game is actively or passively open on a smartphone. Participants P2, P11, P14, P17 and P18 were concerned about the rate at which Pokémon Go drained their phone battery which might prevent them from being able to perform other tasks on their phones should the battery go flat. P11 turned off augmented reality mode to conserve phone battery in addition to carrying a portable power bank to charge her phone. Although these

portable mobile power banks have become very affordable, only P11 mentioned using it.

4.6 Summary

In this chapter, we presented our finding from the twenty participants we interviewed. We found out that social media was a major source of information for most participants. Curiosity, childhood memories and the desire to exercise were some of the motivating factors that let participants to play Pokémon Go. Participants also reported that their time playing Pokémon Go was accompanied by benefits such as increased social interaction, health and educational benefits. We also found that participants had some concerns and challenges in the course of playing Pokémon Go. There were some personal concerns that borders on safety and privacy in addition to application based challenges like high power consumption and unequal distribution of game elements.

CHAPTER 5: DISCUSSIONS

5.1 Social Game

Kristian Segerstrale, the chief executive officer of EA Playfish defined a social game as a game where the main reason why you play involves direct interaction with friends (competition, cooperation, expression, gifting and so on) as opposed to interacting purely with imaginary characters in an imaginary world on the screen (Lovell 2016).

Pokémon Go certainly provides interaction with imaginary characters in real life and possibilities for human interaction at Pokégym or Pokéstops but currently lack other important elements of social games like one-on-one in game competition, gifting and cooperation other than at Pokégym. Incorporating trading of Pokémon, one-on-one combat among many of other social game features, have the potential to drive participation, engagement, and behavior change. P8 was one of the participants who expressed quitting Pokémon Go because people in his circle of friends were no longer playing the game. P8 and his friends could have possibly enjoyed playing Pokémon Go for a longer period of time if a feature like one-on-one combat was available in the game. Points reward and bragging rights, when attached to in-game combats can subsequently create competition among friends, potentially maintain and sustain their interest in the game while indirectly enjoying the benefits of increased physical activity. Features like trading, one-on-one combat and in-game instant messaging were some of the features many participants would like

to see in future updates of Pokémon Go and these features can make Pokémon Go a full-fledged social game.

5.2 Implications for technology design

In our study, we found that there are potentials for Pokémon Go to be a full-fledged social game that encourages social interaction and increase the number of people embracing healthy lifestyle through increased physical activity when challenges like cheating and privacy concerns are addressed. Also, addressing safety concerns and incorporating features like one-on-one combat, multiplayer mode, and leaderboard may sustain people's interest in the game for a long time.

5.2.1 Personal and communal safety

Our study revealed that some participants residing in rural areas complained about having limited Pokéstops in their neighborhood. This forced them to go to city centers to play Pokémon Go where Pokémon creatures are in abundance. Sometimes, places with abundant Pokémon creatures are in sketchy or dangerous neighborhoods and an incognizant player could fall prey to any negative vices in such neighborhood. Fair allocation of Pokéstops, Pokégym and Pokémon creatures will ultimately allow players to at least enjoy playing the game in their neighborhood before venturing into other locations in search of Pokémon creatures and potentially risk their safety. Pokémon creatures and places can be allocated based on the number of players in a given neighborhood relative the size of the neighborhood in a manner that can maintain a player's safety and interest.

There were reported cases by participants about finding Pokémon in private homes and yard thereby leading to owners/occupants having to deal with unwanted guests around the vicinity of their yards and homes. It is not enough for Niantic Lab, the developers of Pokémon Go, to just allocate game elements on their geographical databases, they should go the extra length to ensure players can enjoy the game responsibly without unintentionally bothering anyone. The source of Pokémon Go maps is not known, but the developers of Pokémon Go can create an algorithm to take advantage of geotagging on popular maps like Google maps, Apple to correctly identify locations. This can help improve the correct allocation of Pokémon, Pokéstops and Pokégym

5.2.2 Addressing circumventing game design

Pokémon Go by design require players to walk to different locations to perform various game-related tasks. But some participants were able to circumvent the provision/requirements of the game by using other means of transportation other than walking to achieve in-game goals. In the case of P12, to avoid walking or when tired, she would drive to a rural area with few vehicular movement, this allowed her to drive very slowly to trick the sensors of her phone to assume that she was walking. Consequently, she was able to hatch an egg by driving up to 2 kilometers. She had the motivation to want to play Pokémon Go, complete in-game tasks but the physical demands at times were tiring or too demanding. A player like P12 can be encouraged to quit cheating while maintaining her interest through

storytelling or narration. Whenever a known circumvention is detected, there should be narratives within the game informing the player of the benefit of taking shortcuts.

P5 also found a similar workaround to P12 in that she drove to Pokéstops and places where there are Pokémon creatures throughout her duration of playing Pokémon Go. Her interest in playing Pokémon Go was on lockdown but how can a player like her be enticed to engage in walking while playing the game? I have two suggestions, first, permit some level of circumvention when players have shown intent to complete in-game task especially when it seems like they were having troubles completing such tasks. This will give some gratification and maintain/sustain their interest in the game.

Second, completely banning any form of circumvention whenever it is detected. This can be achieved by developing a highly responsive interaction between Pokémon Go application and sensors on smartphone. Pokémon Go developers should develop a very intelligent algorithm to interact sensors such as GPS and Gyro such that it will be super sensitive to spatial movement of the player as it relates to location, pace/speed and orientation of the player. The faster Pokémon Go app can detect game circumvention by any action of the player, the quicker the game can respond and prevent such action from getting to completion or repeated.

5.2.3 Transparent privacy options

Pokémon Go developers should endeavor to be transparent and explicit as regards requesting for access to resources on users smartphones. Being transparent involves explicitly asking for each permission one at time in addition to giving reason(s) why Pokémon Go app requires such permissions. Also, people should be notified that a given permission request is a one-time permanent access or a temporary access in addition to having the ability to make a choice between granting/denying permanent or temporary access. The Pokémon Go App requires access permission to camera, contacts, device IDs, location, memory, and device type and activity recognition. Access to every feature mentioned above with the exception of contacts are required to play the game. The Camera is needed for the AR mode, location because the game requires physically going from one location to another. So, why does Pokémon go App request access to contacts? Especially when multiplayer feature is not yet available. Implicitly gaining access to user data as in the case of signing in with a Google account could be detrimental to the user should there be a compromise the game's users database.

For example on Android smartphones, Pokémon Go started out by making a blanket request for access as seen in figure 3(a)

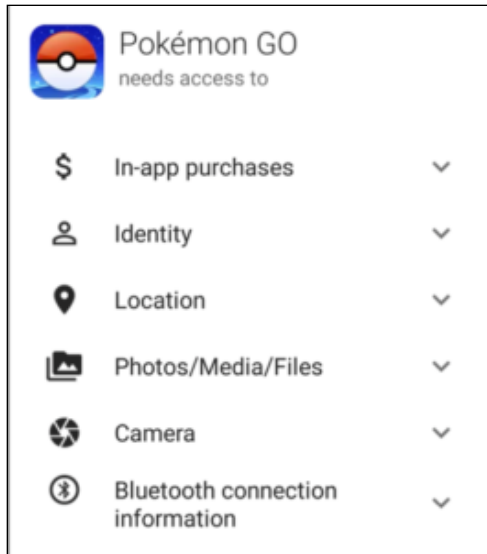


Figure 3a: First permission request on Android phones

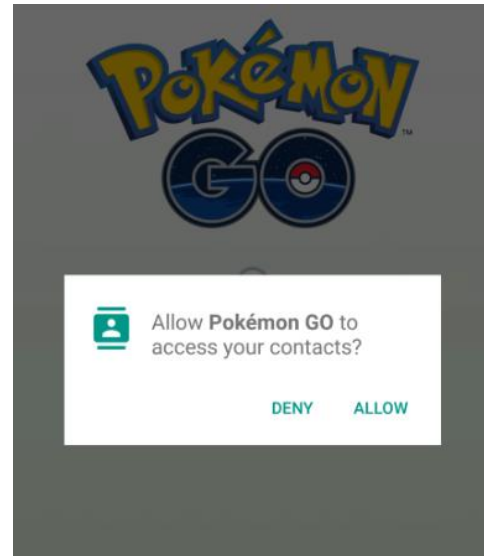


Figure 3b: Current permission request on Android phones

Niantic labs made some adjustments to permission request as seen in figure 3(b). Albeit with the aid of the disclaimer feature that pops up in Android Marshmallow operating system whenever there is a request. Permissions are now requested on need basis, one-by-one but with no explanation for the purpose of the request. For those using iPhones, permissions are requested on need basis with a short explanation of the purpose of the request.

5.3 AR gaming challenges the notion that technology is making humans less sociable

Our study suggests that the use of augmented reality technology in the design of Pokémon Go encouraged people to experience gaming in a different dimension that involves physically navigating their neighborhoods in the course

of playing Pokémon Go. Consequently, Pokémon Go players are exposed to the possibility of meeting people and socializing at different locations like Pokéstops, where Pokémon creatures are placed and Pokégym where various teams battle to gain ownership. For example, P17 met people in the course of playing Pokémon Go who later become friends. P19 commented about increasingly socializing and interacting with people particularly playing Pokémon Go. The game is usually the first subject of discussion according to our participants especially with the people they just met. They talk about game features, tricks and tips. When in the company of friends and family, their conversation touch on other subjects about personal life.

Hampton (2014) thinks the effect of technology is responsible for community parks that are filled with silence, lack of personal relationships and low esteem. On the contrary, our findings showed that technology is not only capable of filling up community parks with people and activities as in the case of Pokémon Go, it also breeds an environment for establishing personal relationships. Pokémon Go organically brings people together at Pokéstops, and according to our findings, the game itself is a subconscious icebreaker that enabled people to easily start a conversation, chat about the game and life, and also build relationships.

Furthermore, Drago (2015) found evidence in her survey of 100 Elon University students that the rapid expansion of technology is negatively affecting face-to-face communication. "People are becoming more reliant on communicating with friends and family through technology and are neglecting

to engage personally, uninhibited by phones and devices, even when actually in the presence of others” (Drago,2015). The gathering of people at Pokéstops, Pokégym and the possibility for interaction challenges the notion that technology is replacing face to face interaction as well as making people anti-social. The same devices as found by Drago (2015) to encourage reliance on communication through technology at the detriment of face to face communication, can also foster face to face interaction through the use of technology. Findings in our research show that AR technology, employed in the deployment of Pokémon Go on smartphones actually encourages and facilitates face to face communication. Participants met people at Pokéstops and Pokégym where they had face to face interaction about the game, life, and in some cases, they became friends over time.

5.4 Potential health benefits of increased physical activity using AR games

Our findings showed that most of the participants were actively focused on achieving in-game goals of playing Pokémon Go while paying little attention to the physical activity required to attain these goals.

For example, the least possible distance required to walk in order to hatch an egg in Pokémon Go is 2 kilometers (KM) and a player is ideally required to cover this distance by walking. Based on calculations at www.kylesconverter.com, assuming a stride length of 0.762 meters or 2.5 feet per step, 2624 steps will be required to walk a distance of 2KM in order to hatch an egg. Although the primary goal for playing Pokémon Go may be to hatch an egg, by walking, the player is indirectly engaging in a physical activity with

potential health benefits like prevention of heart diseases and stroke, lowering blood pressure and cholesterol and overall cardiovascular health. American Heart Association (AHA) stated that being physically active is important to prevent heart disease and stroke, the nation's number 1 and number 5 killers (American Heart Association 2014). "The simplest, positive change you can make to effectively improve your heart health is to start walking" (American Heart Association 2014). As such, it is safe to say that Pokémon Go by design, encourages people to partake in mobile gaming activities that promotes wellbeing.

5.5 Limitations

The participants in our study may not be representative of Pokémon Go players in other part of the world. Our research was carried out with students attending different colleges in mid-western region of the US. Most of the participants were domestic students while others were from Asia and Africa.

Data collected in this study are self-reported. Participants self-reported the ratings of their behavior changes and other information collected for this study between May 2017 and July 2017. Self-reported data present validity issues which may be addressed by coupling this kind of study with observation/shadowing to enrich the data.

5.6 Summary

This chapter discussed the components of a social game as it relates to Pokémon Go, in terms of the features that are already incorporated and the ones that can be incorporated in future updates of Pokémon Go. This chapter also made some

recommendation as regards to the technological implication of AR games like Pokémon Go. These recommendations included personal safety, privacy and game design circumvention.

Chapter 6: Conclusion

In this concluding chapter of this thesis, I present the research problems addressed in this thesis, the contributions this research make to the field of Human-Computer Interaction, specifically, in the use of AR technology in gaming as a technology to help cultivate healthy lifestyle in terms of physical activity and social interaction, and possible directions for future research.

6.1 Research Problem

The focus of this research was to examine the impact of augmented reality game like Pokémon Go on college students in terms of social interaction and physical ability. The majority of college students represent a group of people in our society who have embraced and applied various technologies to enhance their lifestyle. Some of these technologies have proven to positively impact people's lives, particularly mobile phone technology. Smartphones have evolved so much that people can now communicate, study, complete business transactions and navigate to various destination at the comfort their fingertips. Other technologies like video games have resulted in sedentary lifestyle, lack of social skills and obesity.

Augmented reality is a technology that often requires physical activity. The adoption of this technology in Pokémon Go presented an opportunity for users to play a game on smartphones that engages them in physical activity. Thus, we aimed to investigate how this technology impacts the lives of college students and their social interaction and physical activity. We further explored

opportunities in AR games that may promote healthy lifestyle and social interaction.

6.2 Contributions

First, I have provided new knowledge on the first location-based and arguably the most successful augmented reality mobile game that has hit the mainstream and popular culture. This research has also showed how AR game like Pokémon Go impacted social interactions and physical activity. The knowledge acquired can help game designers and developers gain insights into the use AR technology for the creation of games, like exergames, that may encourage engagement in physical activity with the potential for health benefits, and interpersonal social interaction.

Second, my findings can help AR game industry practitioners to design better games in terms of players' longevity of play and game experiences. We found unequal gaming opportunities that led to negative experiences for some participants. For example, people residing in rural areas were disenfranchised in terms of Pokémon and Pokéstops availability in the neighborhood whereas those residing in urban cities had more Pokémon creatures and Pokéstops. Games designers should avoid this kind of discrimination and unlevelled playing ground. Furthermore, I suggest incorporation of social game components like messaging, multi-player mode and leaderboard. These components have the potential to create one-on-one interaction that may foster competition, collaboration, and players' interests.

Third, my findings can help AR game industry practitioners to take into account the security and safety precautions associated with the use of AR technology. While designing games, game designers should consider the possible safety and security issues of AR technology that requires physical contact with the environment in order to better protect the players during gameplay. It is imperative that players' security and safety are not jeopardized in the course of playing such a location-based AR game.

Finally, this research can also help game designers develop an integrated social game and exergame, a.k.a. a social-exergame. This type of game can take advantage of the dynamics of face-to-face interaction and physical activity through gamification deployed with augmented reality technology.

6.3 Future Works

The data collected in this research were reported by participants. Therefore, future work may include conducting an experimental study to examine the impact of Pokémon Go on social interaction and physical activity to complement the self-reported data collected in this research.

The physical aspect of using AR technology calls for more investigation into security and safety concerns that are associated with the application of augmented reality. Findings in this study can help inform AR game designers and developers about the real-life challenges that are associated with using augmented reality technology particularly with safety and circumvention of game design.

Findings from this study have shown that augmented reality has great potential to aid healthy lifestyle and social interaction through gamification. Further studies can be done to specifically explore how the dynamics of face-to-face interaction can be mimicked in AR gamification, and how healthy living can be further promoted through game induced physical activity.

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Appendix

A. Appendix- Interview questions

IRB Approval Number: HUM00127063

Demographics

Name.....

Gender: Male Female Others:

Age: 18-25 26-35

Year of study: Freshman Sophomore Junior

Senior Graduate (Masters) Graduate

(Doctoral)

Major:

Full time/part time

Interview Questions

- **How did you get to know about Pokémon Go?**

Probe: when and where

- **When did you start playing Pokémon Go?**

Probe: How long have you (been playing/played) Pokémon Go?

How often did you play Pokémon Go in the first few weeks of you playing?

How often have you played afterwards?

Did/do you have a specific day and time of the week that you Pokémon Go?

- **Describe your primary reason(s) for playing Pokémon Go.**
- **What benefits do you think you have received from Playing Pokémon Go?**
- **How would you describe the process of installing and setting up Pokémon Go on your smartphone?**

Probe: did get assistance or by yourself?

If assisted, who or where did you get assistance from

- **Describe how you learnt to play Pokémon Go**

Probe: If assisted, who or where did you get assistance from

- **How would you describe your mastery of playing Pokémon Go?**

Probe: are there regular updates? Do you keep on updates?

- **What feature in Pokémon Go do you like the most or readily comes to mind?**

Probe: why?

- **What concerns about playing Pokémon go did you have?**

Probe: were they personal or environmental?

If personal, please describe

If environmental, (suggest weather, safety)

- **What do you think about having to walk while playing Pokémon go?**

Probe: what difference did it make to you?

Was it a major a major determinant of when and for how long you played Pokémon Go?

What is the average time you spend each time on Pokémon Go?

What is the average distance you have walked while playing Pokémon Go?

What is the estimated longest distance you have walked while playing Pokémon Go?

Is that the longest you have ever walked?

Do you think playing Pokémon Go complemented or substituted time spent exercise?

- **How would you describe your physical activity level?**

Probe: did you use the gym? If yes, how often?

What do you do at the gym?

Do you walk, jog?

How often? In addition, for how long each time?

- **What kind of impacts playing Pokémon Go had on your physical activity? Would you say you were actively/passively aware of the physical demands of playing Pokémon Go?**

Probe: If active, was it a substitute or complement to some of your physical activity/exercise time?

- **Where did you play Pokémon Go?**

Probe: did you make new discoveries - places and things you have probably not take notice of?

- **Did you meet people in the course of playing Pokémon Go?**

Probe: How would you describe the setting of your meeting?

How would you describe your initial interaction? In addition, what was the main subject of conversation?

Did/do you maintain regular communication with any of those people?

How would you describe the relationship? Gamer, Acquaintance or Friendship?

- **Would you describe Pokémon Go as a fun game to play Alone, Team, or both?**
- **Did/Do you Play Pokémon Go by yourself or with people you know?**

Probe: Friend, Acquaintances, Family?

How often did/do you play with these people?

- **Is there a significant difference between playing Pokémon Go alone and with people?**

Probe: If Yes, please describe

- **Are you still playing Pokémon Go?**

Probe: If yes, why? What has kept you playing? How often do you play in a week? Is there a particular day/time of the week that you play?

If no, why? How long did you play before you stopped?

Do you think you might go back to playing Pokémon Go?

What game do you currently play instead, if any?

What other exergames that they have played before?

Is that game just as active as Pokémon Go is?

What changes would you make to Pokémon Go to play it again?

B. Appendix- Game concepts

Appraise: This involves team Leaders/Trainers determining the individual values of each Pokémon. This feature was added to Pokémon Go in version 0.35.0 (Android) and 1.5.0 (iOS) (Pokémon Go Glossary)

Badge: A badge refers to refer to an achievement that can be earned by a player for meeting certain goals/milestones (Pokémon Go Glossary). There are over 28 badges that can be earned by travelling and capturing Pokémon or by battling in a gyms. The three classifications of Badges are Bronze, Silver and Gold

Battle: Battle takes place at rival Gyms, it is a fight with other teams' Pokémon for a chance at claiming the Gym. Each rival Pokémon you defeat reduces the Gym's Prestige and potentially lowers the Gym's level (Glossary). When the Gym's Prestige get to zero, you can capture the gym for your team.

Berry: A Berry is an Item in Pokémon Go that can be collected and stored in a player's inventory (Berry). Berries are usable on wild Pokémon to make them easier to capture. (Pokémon Go Glossary)

Candy: A Candy is acquired by catching Pokémon, hatching Eggs, and transferring Pokémon to the Professor- a tutorial in Pokémon go with different names Professor Willow, Oak, Elm. A professor explains how to catch Pokémon, and rewards you with candy when you send him extra Pokémon you've caught (Ballou, 2016). Candy is used in the evolution and strengthening of Pokémon.

Experience Points (XP): Your advancement is measured in Experience Points (XP). Increase your XP to advance to higher Trainer levels.

Fainted Pokémon: A Pokémon faints when its HP is depleted to zero. Fainted Pokémon must be revived using the items Revive or Max Revive.

Fast Move: A quick move that can be used during battle. Fast Moves help to replenish Stamina more quickly. A Fast Move is a Type of Pokémon attack that deals less damage than a Charge Move. However, Fast Moves can be used much more often during a battle and also help to replenish Stamina. (Pokémon Go Glossary)

Gyms: Gyms are locations where you can battle the Pokémon of rival teams, or train your Pokémon by battling against the Pokémon assigned there by other members of your team. Gyms belonging to your team are known as friendly Gyms, and Gyms that have been claimed by other teams are known as rival Gyms.

Gyms that have not yet been claimed are known as open Gyms.

Hit Points (HP): A Pokémon's health is measured in Hit Points (HP). A Pokémon with zero HP faints. Use a Revive or Max Revive item to revive fainted **Pokémon**.

Incense: Incense attracts wild Pokémon to your location with its aromatic scent.

Pokéballs: Poké Balls are items used to capture wild Pokémon. They can be found at PokéStops and purchased in the shop.

Great Balls, Ultra Balls, and Master Balls are high performance Poké Balls with a greater ability to catch wild Pokémon.

Pokédex : Your Pokédex is where you'll find info about all the Pokémon species you've caught or encountered.

Pokéstops: PokéStops are locations where you can gather items such as Poké Balls, Potions, and Eggs. A PokéStop will change its shape when you walk close enough. Touch it to interact with it, and spin the Photo Disc to get items.

Potions: There are various Potions you can use to heal Pokémon. These items restore their HP (Hit Points).

Power-up: Using Stardust and Candy, Trainers can power up their Pokémon to increase their CP and HP.

Prestige: Prestige is how a Gym's progress is measured. Prestige is earned when Pokémon train at the Gym. Increase a Gym's Prestige to advance the Gym to higher levels.

Razz Berry: During an encounter, you can feed this item to a wild Pokémon to make it easier to catch.

Training: At friendly Gyms, Trainers can battle Pokémon assigned there by other members of their team to increase their XP and the Prestige of the Gym.

Trainer: Trainers are people who play Pokémon GO.

Wild Pokémon: Pokémon that have not been caught are known as wild Pokémon.

C. Appendix- Minimum Game specification

Pokémon Go is available and supported by smartphones with the following minimum specifications;

a. Android Smartphones

Android 4.4+, Rooted devices are not supported, Preferred resolution of 720x1280 pixels (Not optimized for tablet), Strong internet connection (Wi-Fi, 3G, or 4G), GPS and Location Services. (Supported devices, 2016)

b. iOS Smartphones

iPhone 5+, iOS 8+, Strong internet connection (Wi-Fi, 3G, or 4G), GPS and Location Services, Jailbroken devices are not supported. (Supported devices, 2016).

D. Appendix – Recruitment Material

C.1 Email

Hello fellow students

I would like to invite you to participate in an exciting research study on Pokémon Go!

I am working on a thesis for the completion of my Master of Science in Computer Science and Information Systems and would appreciate your help.

You are invited to participate in a face-to-face interview that will last about an hour.

The goal is to examine the impact of Pokémon Go on college students' physical health and social interaction. In appreciation of your participation, you will receive a \$15.00 gift card.

You must be at least 18 years old and have played Pokémon Go to be eligible to participate in the study.

The Institutional Review Board at the University of Michigan-Flint has approved this study and the IRB approval number is HUM00127063.

If you are interested in participating in the interview, please email Adedotun Ojelabi (aojelabi@umflint.com)

Please contact me, or my faculty advisor Dr. Charlotte Tang (tcharlot@umflint.edu) if you have any questions or concerns.

Thank you and look forward to your participation.

Sincerely,

Adedotun Ojelabi

MS student, Computer Science and Information Systems

University of Michigan-Flint

Go Blue!

C.2 Flyer

Get **\$15.00** Gift card



**You must be 18 years old, a college student, and have played Pokémon Go.
Participate in an interview for about an hour.**

The aim of the research is to examine the impacts of Pokémon Go on the physical Health and Social interaction of College students.

If interested please email Adedotun Ojelabi – aojelabi@umflint.edu

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