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FitPlay Games: Increasing Exercise Motivation
Through Asynchronous Social Gaming

Dario Carlos Gonzalez

A thesis submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of
Master of Science

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ABSTRACT

FitPlay Games: Increasing Exercise Motivation Through Asynchronous Social Gaming

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Many factors contribute to people's physical inactivity, but among the leading factors is a lack of motivation. Fitness trackers have been shown to encourage an increase in exercise, but they are frequently abandoned within a few short months. For this thesis I developed and asynchronous-play social gaming platform, FitPlay Games, to fill the gap in motivation left by current fitness trackers. By providing users with a variety of asynchronous cooperative and competitive gaming styles, this platform enable them to find a motivation technique that works best for their lifestyle and fitness prowess.

The platform encourages prolonged use of fitness trackers, helping users to have more healthy lifestyles. Individual games are designed to allow both the novice and the maven to have a chance at winning, leveling the playing field, and increasing motivation to win. The effectiveness, usability, and enjoyability of the social games will be assessed, with an emphasis on understanding differences in play habits due to gender and lifestyle.

Keywords: fitness tracker, FitPlay, motivation, exercise, games, step counter; mobile, exergames, health behavior, Fitbit

ACKNOWLEDGEMENTS

I would like to thank Dr. Hansen for all his help and guidance in completing this project; his help was invaluable. I would also like to thank the others members on my graduate committee, Dr. Helps and Dr. West, who gave critical help and insights. I would like to thank the team that worked with me to design and develop FitPlay Games (Logan, Kurtis, Cody and Sarah). And finally I would like to thank my family, especially my wife Paula, who has been my support during all this time. Thank you for continually believing in me and encouraging me to do my best on this work.

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1 INTRODUCTION

The objective of this research is to motivate people to increase their activity levels and help them to increase their fitness level by developing a mobile app that uses fitness tracking data and social games to increase users' physical activity. The effectiveness, usability, and enjoyability of the social games will be assessed, with an emphasis on understanding differences due to gender.

1.1 Nature of the Problem

A growing number of people in the US, and around the world, do not get the recommended daily amount of exercise, despite the known health benefits of exercise and risks of inactivity (Fletcher, 1996). Many factors contribute to people's inactivity, but among the leading reasons is a lack of motivation (Kravitz, 2010; Anshel, 2007). As smartphones and wearable fitness trackers, such as Fitbit, have become more popular, new apps designed to motivate increased physical activity have emerged. Many of these apps incorporate gamification elements, though those apps do not integrate behavior change principles that are known to be successful (Lister, 2014).

Furthermore, studies of their effectiveness are lacking. There is a great need for novel apps that effectively motivate increased exercise using intrinsically rewarding techniques (e.g., game

elements) based on sound behavior change theories, along with comprehensive studies of them that will deepen our understanding of the opportunities and challenges in this space.

1.2 Purpose of the Research

The aim of this research is to create and evaluate a novel intervention in the form of a mobile app that leverages fitness tracker data and several social collaborative and competitive games designed to motivate users to exercise more often.

Health and fitness games have been proven as an effective way to increase people's activity, especially those working with a partner as an essential part of the game. Studies such as the one conducted by (Feltz, 2011), among others, have shown that users do not want to be the “weak link” in a group or partnership, which pushes and motivates them to exercise more often and improve their endurance. Studies that use step counts as a measure for physical activity have also shown a tendency to improve people's physical activity level (Qiu, 2014; Tudor-Locke, 2013; Colley, 2011; Welk, 2000). Most studies have examined basic pedometers and accelerometers that register step counts rather than the new wearable fitness trackers. Studies that do examine fitness trackers are focused on their accuracy and efficiency (Stackpoo, 2014; Fitness Tracker Review, 2015) rather than their contribution to motivating increased physical activity.

This research will study the changes in users' exercise behavior that result from the use of different mini-games inspired by behavior change research, within a novel app that uses wearable fitness tracking data. The study will focus on Fitbit, the most popular fitness tracker on the market at this moment. According to the International Business Time (IBT), Fitbit accounts for 70% of the market for fitness-trackers (Market, 2014). For this study the application will be developed only for Android devices and Fitbit bands. Apple watch was released on April 24,

2015, after I started with this research, that is why smart watches were not considered on this research, because of their low popularity and usage, but Apple watch revolutionized the market getting an interesting share of the market. Even though, Apple watch caught the attention of a big portion of users, Fitbit is still leading the tracking fitness market. According to IDC Fitbit still has a 24.5% market share on the global market (IDC, 2016).

1.3 Justification

At the beginning of this research no study related to exergames and Fitbit trackers has been conducted to demonstrate how this combination can help to improve and change health behavior. As outlined in the literature review chapter, studies have examined mobile exergames and how they can be used to affect and improve such behavior. Meanwhile, studies have also shown that fitness trackers can encourage increased exercise. However, studies that leverage both of these components are lacking. There are many new opportunities to combine mobile social games and fitness data with promising potential, but so far this has been untapped and untested potential.

1.4 Project Approach

Dr. BJ Fogg quoted, “When you know how to create tiny habits, you can change your life forever”. This research will focus on developing a mobile novel app and testing its effectiveness (at increasing steps) and enjoyability (via surveys and interviews) through a field study. Simple games will be created with the intent of creating habits to help users to improve their health behavior.

1.5 Research Questions and Hypothesis

The following questions and hypothesis are addressed in this research:

- Question 1 (Q1): Will the use of the application stimulates the user to increase his/her physical activity? To what extent?
- Hypothesis 1 (H1): The use of the application will motivate people to exercise more often through the use of short competitive games based on awareness of steps count.
- Question 2 (Q2): Which game elements and social aspects of the application were the most appealing to the participants?
- Question 3 (Q3): How did findings from research Q2 differ across gender?
- Hypothesis 2: Competitive games will be more motivational for men than women.
- Hypothesis 3: Games that emphasize positive affect (e.g., winning) over negative affect (e.g., avoiding losing) will appeal more to women than men.

1.6 Definitions

- Fitness tracker: a device or application for monitoring and tracking fitness-related metrics such as distance walked or run, calorie consumption, and in some cases heartbeat and quality of sleep.
- Mobile App: software installed on a mobile device, such as a cell phone or tablet. Mobile apps are typically made available via an app store such as the Google Play store.
- Exergames: games (console or mobile) that require physical activity to play such as Just Dance.
- Fitbit: a fitness tracker device made by Fitbit Company.

1.7 Limitation

The following are limitations in this research:

- The application will be only developed for Android devices, and is expected to work properly only in those devices compatible with a Fitbit tracker.
- The only tracking device utilized for this study will be the Fitbit.
- Only two mini-games will be developed for this research, one that emphasizes positive feelings and one that emphasizes the avoidance of negative feelings.
- The scope of this study is on short-term behavior change, not long-term behavior change, since users were only tracked for 4 weeks while using the application.

2 LITERATURE REVIEW

Many studies have been carried out with the aim to understand motivational behavior, trying to promote the increase of physical activity and how to motivate people to stay active. This chapter will review several studies focused on the need of promoting behavior changes and also trying to understand the role that mobile exergames and fitness trackers play in such scenario. Through this chapter I will review topics such as why people do not exercise and which interventions work best to promote physical activity. I will also review some popular games and technologies (mobile and other types) and the benefits of using fitness trackers as a motivational tools to stay active.

2.1 The Need for More Exercise

A growing number of people in the US, and abroad, do not get their recommended daily amount of exercise. This is unfortunate, as regular exercise has been shown to reduce obesity, improve mental health, and improves numerous other health outcomes such as cardiovascular health (Fletcher, 1996).

Health professionals recommend 30 minutes of moderate intensity exercise per day, but most people do not accomplish this recommendation. According to the President's Council on Fitness, Sports & Nutrition (President's Council on Fitness, 2013):

- Only one in three children are physically active every day (President’s Council on Fitness, 2013).
- Less than 5% of adults participate in 30 minutes of physical activity each day (Promotion, 2010).
- Only one in three adults receive the recommended amount of physical activity each week (Healthy People - HP 2010 Final Review, 2010).
- Only 35 – 44% of adults 75 years or older are physically active, and 28-34% of adults ages 65-74 are physically active (BRFSS, n.d.).
- 28% of Americans, or 80.2 million people, aged six and older are physically inactive (Council, 2014).

According with the US Department of Health and Human Services, being physically active on a regular basis improves your chances of living longer and living healthier, helps protect you from developing heart disease and stroke or its precursors, high blood pressure and undesirable blood lipid patterns, helps protect you from developing certain cancers, including colon and breast cancer, and possibly lung and endometrial (uterine lining) cancer, relieves symptoms of depression and anxiety and improves mood, prevents weight gain, promotes weight loss (when combined with a lower-calorie diet), and helps keep weight off after weight loss, improves heart-lung and muscle fitness and improves sleep among other benefits (Americans 2008).

Studies have validated and demonstrated that:

"Persons who perform moderate to vigorous physical activity on a regular basis manifest a plethora of physiologic benefits and experience reduced risk of chronic disease and premature mortality and also have reported that sedentary behavior is associated with a variety of health risks" (Pate, 2008).

Studies have also associated sedentary life style with reduced longevity and impaired health. There are also benefits for decreasing sedentary time even if people are active but not to the level of exercise. Even when people meet physical activity guidelines, sitting for prolonged periods can compromise health.

"TV time and objective-measurement studies show deleterious associations, and breaking up sedentary time is beneficial. Sitting time, TV time, and time sitting in automobiles increase premature mortality risk" (Neville, 2012).

2.2 Why People Do Not Exercise?

There are many reasons people fail to exercise. According to (Kravitz, 2010) the main reasons people get discouraged in their aims to exercise include: lack of motivation, need for support, setting unrealistic goals, failing to establish short-term goals, and comparing oneself to other people in unhealthy ways, negative thinking, having an inadequate total game plan, scheduling/priority issues and failing to be informed. Any interventions that are going to be successful at promoting exercise must overcome these challenges and leverage new opportunities, such as those made available by fitness trackers and smartphones.

"While the likely reasons for not exercising have been studied for many years, to date, researchers and practitioners have not found interventions that effectively and permanently change health-related behavior" (Anshel, 2007).

So, why do people remain inactive? A lack of information and motivation are the main obstacles when trying to inculcate healthy habits. Also people who over-estimate their

expectancies from exercise are more likely to drop out. The lack of realistic goals keep people from exercising.

“Furthermore, a person with low self-worth (i.e., self-doubt, insecure, negative self-talk) and a poor body image is more likely to be an exercise dropout. These individuals tend to place less value on the benefits of exercise as compared to those who adhere to exercise. Also exercise dropouts often worry a lot about how others perceive their exercise abilities (or lack of them)” (Kravitz, 2010).

2.3 What Interventions Work at Promoting Exercise?

The term motivation comes from the Latin word, “movere”, meaning “to move”. So something that motivates means to feel “moved”, or induced, to start and action toward a certain goal. “More specifically, it is the tendency for the direction and selectivity of behavior to be controlled by its connections to consequences, and the tendency of this behavior to persist until a goal is achieved. Thus, a person’s decision to exercise reflects the importance he or she places on the meeting a certain need and achieving a particular outcome” (Anshel, 2007).

Research by (Feltz, 2011; Lister, 2014) has shown that working with (or against) a partner is a successful strategy to motivate people to improve their fitness attitudes. Having a workout buddy can significantly improve motivation (Murphy, 2008; ProQuest, 2008). Research by (Payne, 2015) shown that existing health and fitness apps introduce some sort of health behavior theory construct or strategy, even if only implicitly. Among the most common interventions to promote exercise were found to be: self-monitoring, followed by cues to action and feedback and social support. Although some of the mechanisms that motivate people to exercise are understood, implementing them in compelling and engaging ways that fit into people’s everyday lives remains a challenge.

2.4 Games That Promote Exercise

Low levels of physical activity are coupled with ubiquitous electronic media use in the home. Nearly all households with children in the US have access to computer games (Barnett, 2013). A promising strategy to promote physical activity has been through implementing and developing video games with the aim to promote such behavior. According to (Yim, 2007), games have become a means to increase exercise motivation and many companies have embarked on this endeavor. Technologies such as Microsoft Kinect (now Kinect of Xbox One), Nintendo Wii (now Nintendo Wii Fit) and PlayStation Move (from Sony) have deployed sophisticated controllers and games which promote physical activity.

A great example of success has been Wii Sports, played by millions of people around the globe. Within the wide range of games (or exergames) the most important features that motivate people to exercise are integrated music, guides for novice players, achievable short and long term goals, environment where the player feels confident, social support and a sense of fun that maintains the user's attention. The premise is that if we combine the fun of video games with physical activity, people will be more likely to exercise (Yim, 2007). However, all these conditions are constrained to an indoor environment which limits opportunities for physical activity.

Hence that mobile applications, to increase physical activity, have become a focus point for promoting such behavior.

“An interesting development in active games play are mobile active games that allow game play to become pervasive (through continuous tracking via a personal mobile device), accumulative (encouraging multiple informal physical activities on an ongoing basis), and persistent (through logging and scoring over an extended duration), whilst removing game constraints that limit games to a fixed location. Smartphones are particularly universal devices that can be used to support and facilitate mobile active games, especially as they are well integrated into an individual's daily activities, have sufficient processing

capability to present a personalized experience to the user, and can utilize a range of built-in sensors (e.g., Wi-Fi, GPS) and features (e.g., audio, camera)” (Barnett et al., 2013).

2.5 Competitiveness and Cooperation

Studies have documented that women often response less favorable to a competitive environment than men. Men are often more eager to compete, and their performance often tends to increase in a competitive situation, but women are often more reluctant to compete than men (Niederle, 2011). Research by (Soll, 2004) has shown that one reason for this difference is that women are usually less confident than men about their abilities; psychologists find that men tend to be more overconfident than women. Studies such as (Fehr, 2006; Bergkvist, 2014) have shown that women have more adverse to inequity, and they feel more comfortable with cooperation instead of competition.

2.6 Mobile Exercise Applications

New opportunities for socio-technical interventions that promote exercise are emerging, in large part due to the integration of smartphones and games. We interact with our phones not only to talk, but to text, check reminders, take notes, surf the web, video chat with friends, meet new people, play games and so on. Mobile technology is now an integral part of our daily life and is here to stay. The latest generation of smartphones are increasingly viewed as handheld computers rather than as phones, due to their powerful on-board computing capability, capacious memories, large screens and open operating systems that encourage application development. More than half of Americans own a smartphone, “such rapid uptake in mobile phone ownership has transformed many aspects of our lives. It is impacting, not only in the manner in which we

communicate, but also on our sense of culture, community, identity and relationships” (Boulos, 2011).

This interdependent relationship makes them ideal platforms for promoting behavior change in people. The expansion and adoption of new technologies provide new opportunities for delivering health behavior change interventions. According to (Fjeldsoe, 2009) positive health behavior change outcomes were observed in 14 studies targeting preventive health behaviors (e.g. smoking cessation) and clinical care (e.g. diabetes self-management). The study suggests that mobile apps interventions can have positive short-term health behavioral outcomes.

Apple started a new business model by creating the Apple Store in 2007, which allowed any developer to release iOS apps after approval by Apple. Google soon followed this trend with a store for smartphones running the Android operating system. Android and iOS devices have taken over this rapidly growing market where, according to a study published by Pew Research Center in 2014, 58% of American own a smartphone (Project, 2014). Many 3rd party developers have recognized the potential of smartphones to promote healthy behavior. By 2015 more the 31,000 applications were available in the Health and Fitness category (Essany, 2015). “With mobile phone ownership and the number and complexity of health apps likely to increase, the potential for technology-based health interventions to impact populations is possible like never before” (Payne, 2015).

2.7 Fitness Trackers and Steps Counters

Meanwhile, wearable fitness trackers that communicate with smartphones are becoming increasingly used. Studies made by Nielsen (Nielsen, 2014) shown that about 15% of consumers are using wearable tech products. This tendency is growing, especially among young people 18

to 34 years old). What motivates consumers to purchase wearable tech depends on the type of device and the benefits each offers for their everyday lives. The majority (57%) of fitness band buyers said that the ability to self-monitor was a major factor, along with concern for their health (Nielsen, 2014). A study made by The Consumer Electronics Association (CEA, 2014), has shown that the top reasons for wearing a fit band tracker are: motivation (52%), monitoring fitness goals progress (47%) and monitoring physical activity levels or intensity (46%).

According to Flurry Analytics, from Yahoo, the daily usage of health and fitness applications in mobile devices has grown 62% in 2013 (Flurry, 2014). This increase was related to fitness accessories capable of tracking fitness activity and their integration with social networks that enables social support and competition. This study demonstrates that new technologies such as smartphones and fitness trackers in conjunction with health games are beginning to play an important role in customers' daily activities.

Even with thousands of applications in the Health and Fitness category, as of March 2015, there are only 37 Fitbit compatible applications. According to the International Business Time (IBT), Fitbit accounts for 70% of the market for fitness-trackers (Market, 2014) – by Q1 2016 Fitbit accounted the 24.5% of the market share, still being the most popular fitness tracker in the market (IDC, 2016). There may be more applications using Fitbit technology and API, but there are only 37 “certified” by Fitbit. They are listed in the Fitbit website (Compatible Fitbit App, 2015). From the 37 applications 19 were mobile applications and only 13 applications were developed for Android devices (see Table 2-1). A few of these applications utilize some of the methods described before to motivate people, such as competitiveness and social support, but their effectiveness has not yet been studied.

Table 2-1: Fitbit Compatible Applications

<i>Application Name</i>	<i>PC</i>	<i>Android App</i>	<i>iOS App</i>
Lose It!	Yes	Yes	Yes
MyFitnessPal	Yes	Yes	Yes
SparkPeople	Yes	Yes	Yes
IFTTT channel	Yes	Yes	Yes
Balance Rewards	Yes	No	No
Microsoft Health	Yes	No	No
Digifit	Yes	No	Yes
MapMyRun	Yes	Yes	Yes
TactioHealth	No	No	Yes
Endomondo	Yes	Yes	Yes
FitStar	No	No	Yes
Fitabase	Yes	No	No
Stir Kinetic Desk	Yes	No	No
Tappy Fit	No	No	Yes
Tictrac	Yes	No	No
MyNetDiary	Yes	Yes	Yes
Beeminder	Yes	Yes	Yes
about.me	Yes	No	No
EveryMove	Yes	Yes	Yes
MoveMeFit	Yes	No	No
Zenobase	Yes	No	No
FitDataSync	Yes	No	No
Earndit	Yes	No	No
Foodzy	Yes	Yes	Yes
Welly	No	No	Yes
Health Month, the game	Yes	No	No
WeightGrapher	Yes	No	No
Low Battery Notifier	Yes	Yes	Yes
FitBlot	Yes	No	No
Sleep Debt	Yes	No	No
DisciplineXgames	Yes	No	No
TrendWeight	Yes	No	No
FitTap	No	Yes	No
Calories 3	Yes	No	No
myKilos	No	Yes	No
MyFitLeague	Yes	No	No
Wokamon	No	No	Yes

Even with this abundance of applications available in the market ready to be used, and even though many customers are more than eager to try and explore health and fitness applications, their effectiveness has rarely been studied. Regardless of the acceptance or popularity of the health and fitness applications, their effectiveness in increasing physical

activity remains unknown (Yang, 2015). Setting goals, as step counts, may be a motivational key for increasing physical activity and some guidelines even recommend a goal of 10,000 steps a day. Although there is not detailed evidence of the effectiveness of fitness trackers in helping to motivate healthier behavior in users, they have experienced a surge in popularity as a tool for motivation and monitoring physical activity (Bravata, 2007). This shortage of evaluation is a cause for concern because that on average mobile users have installed 41 apps (Relaxnews, 2013), where 52% are using their phones for health purposes and 19% using health apps (Smith, 2012), and yet their efficacy is unknown.

2.8 Conclusion

With the widespread use of fitness trackers and smartphones, and the strong interest in social games and fitness apps, there are new opportunities to combine them to create novel interventions designed to motivate exercise. As discussed, current applications do not fully support evidence-based behavior change principles, and existing apps that utilize fitness tracking data have only rudimentary game mechanics. There is a need for research that shows what can be done when combining these elements into an engaging social game that leverages fitness tracking data in a mobile app, and evaluates its effectiveness. Furthermore, there is a need to better understand the effects of such games on those of different genders, since prior research has found significant differences.

Although fitness trackers, mobile apps, and games already exist to motivate people to exercise, most existing apps do not leverage behavioral theory principles (Lister, 2014). We agree that “apps represent a very promising, burgeoning market and landscape in which to disseminate health behavior change interventions” (Lister, 2014) and that research in this area

“necessitates the in-depth study and evaluation of the potential of gamification to change health behaviors” (Lister, 2014).

3 METHODOLOGY

3.1 Overall Approach

For this research I developed a novel game platform for smartphones (only Android devices), using a fitness tracker (only compatible with Fitbit trackers) to study how this type of applications could help to shape healthy behavior in users. The aim of this research was to understand how to stimulate users to increase physical activity, what motivated them, how competitive and social aspects affected their behavior, and how positive and negative affect impacted their motivation. All these aspects were studied differentiating behavior changes in men and women users. An iterative development process was used to develop the app to assure it met the target demographic needs and was fully tested. In the following sections I will describe the initial prototype and how it was tested and improved upon, followed by a description of the final version used in the field trial.

3.2 Prototype

3.2.1 First Prototype and User Feedback

Following an iterative design and methodology, I first released a demo application and evaluated its use with a small number of beta testers (5-10). For the first evaluation, I recruited a convenience sample of users drawn from BYU students and close relatives, mainly by word of

mouth. In this first stage an Android phone and a Fitbit band were required in order to test the application. This initial test lasted less than 3 weeks, and I gathered valuable feedback about the application, how people were using it and what should be improved, added, or removed. The demos also helped to find bugs in the app.

3.2.2 Final Product (Mobile Application)

After updating the application based on the feedback received from users testing the prototype, the application was uploaded to the Play Store (Google Store). Because users were able to download the application from the Play Store, it was available to everybody to try it; but to get a full experience using the application, a Fitbit band was required in combination with an Android phone. This research only targeted devices with Android 4.0.3 or higher (according to Google over 98% of the Android devices run on this version or higher (Android, 2016)). This is in accordance with Google's own recommendation and avoided problems related to backward compatibility. There was not a minimum age required to use the application.

In this stage, we targeted 50 people to use the application during a 4 weeks period, although we only had 28 people using the app. The application was promoted on BYU campus, to be sure that the minimum amount of users was reached, and also was available for anyone to download via the Play Store. A total of 4 weeks of activity data was tracked and compared to the prior 4 weeks of activity data, which was collected when the users registered. Those downloading the application were informed that data would be collected for research purposes and that as described in the privacy policy. Each registered users was emailed with an email of consent, and by responding to the email gave us permission to use the collected data for research purposes (this was done in compliance with the IRB polices, see Appendix A).

3.2.3 Functionality

The app was designed to offer users a handful of social games that rely on activity data. The core app functionality lets individuals synchronize their Fitbit device with the app, keep track of active minutes and steps (to track progress), and participate in a handful of social games with friends or strangers. The games in the application were divided into two categories: competitive and cooperative. Because of lack of time, I designed both games' categories, but only implemented the competitive games.

3.2.3.1 Competitive Category

Players competed against each other in this game. The game was of the style of the “Hot Potato” game. A user was able to select a distance (e.g., walk 2,000 steps) and then to challenge another user. When the initial user finished the challenge the undesirable, virtual “hot potato” was sent to another player. When the player accomplished the challenge, the virtual “hot potato” was passed to a different player. A random timer was set, so nobody knew when the game would be over (i.e., the “hot potato” exploded).

Once the game was over, the player who was still trying to accomplish the goal (steps count), lost. A chat system enabled users to send message among the game' players, to cheer up or to mock each other. The chat was used to communicate feelings, ideas and so on while users were participating in the game. Using this game, the study was focused on how competitive games could help to improve health behavior in users.

Two versions of the game were created, one focused on positive reinforcement and the other based on negative reinforcement. The version described above focused on negative reinforcement – the “loser” was announced to the team. A different version focused on positive

reinforcement was also implemented. In that game, instead of a hot potato that would burn the loser, a “Crown” was passed between the players and whoever had it when the game ended won the game and was congratulated. Users had to compete to “capture the crown” and stay alert in case another user took it from their hands. Chapter 4 explains with more details the games’ rules.

Both versions were tested with users to verify that they considered the games to have a negative and positive affect. For this study was also important to know which version of the game was the preferred choice of the users.

3.2.3.2 Cooperative Category

In this category, the conceptual design of the game consisted in a physical activity, but instead of competing against other users, the game was a group challenge, where everyone in the game had to accomplish certain tasks in order to reach a goal. It was kind of “do not let people down” style game, where even though everybody in the team had a goal to reach, cooperation was the key to move forward as a team toward the goal. Again this game enabled a chat room where users could cheer up for each other. With this game the study was focused on how cooperative games could help to improve health behavior in users.

This game also had a “negative” and “positive” versions. The negative version denominates the “weak link” (negative affect), where the chain gets longer until someone does not complete the specified challenge (e.g., walk 12,000 steps in a day) and is called the “weak link” to everyone. The team won the game if they make a chain of a specific length at a certain time (the length and time were set at the beginning of the game), but loses otherwise. The positive version was based on the same idea, a specific length and time were set at the beginning of the game, but every time the team reached a smaller goal a “reward” was brought to the whole

team and they were encouraged to keep moving toward the main goal. If someone did not do so, they were not necessarily called out – everyone was just notified that the goal was achieved.

3.2.4 Field Test and Data Collection

Application data was collected from all users of the application, including the following types of data:

3.2.4.1 Analytics

Yahoo Flurry and Parse.com Analytics were configured to track how users interacted with the application. This included which features they used, their social connections, step count data, active minutes and time spent on various aspects of the application. This data helped to understand which games and features led to increases in step count and active minutes.

The main data collected by these analytics tools was the as follow:

- Time the user spent playing a game.
- Time the user spent on the application.
- Time spent in each section of the app.

Yahoo Flurry and Parse.com Analytics were added only for the final version of the application.

3.2.4.2 Fitbit Tracker Data

The first time the user logs in the application and connects to his/her Fitbit tracker account, through the app, the previous 4 weeks of data are downloaded to be compared with the following

4 weeks (4 weeks was the time expected for the application to be used by the users). The data collected from the Fitbit website was steps.

The application connected to the Fitbit website using Fitbit's Programming Application Interface (API). Through the API my app was able to log in and access the data previously mentioned. The application was authenticated to Fitbit using OAuth protocol. Also the credentials to access data were requested only one time, and the application was able to re-login (or re-authenticate) the user every time without requesting the user's credentials every time the user accessed the application. In the case when the user logged out from the application, next time he/she tried to log in, the Fitbit credential are requested again in order to connect the application to the Fitbit website.

3.2.4.3 Survey

Users were expected to fill out one survey at the end of the field test. They filled out the surveys following a link that was sent to them (see Appendix B). The purpose of the surveys was to collect information about how motivated the users were, which features of the application they found more engaged and fun, and other perceptions of the application.

3.2.4.4 Application Database

The app collected the registration basic data and also was in charge of storing the steps information collected from Fitbit. Data was collected and sent to the central database. The data collected from the application were:

- Username
- Email
- Age
- Gender
- Steps
- Other information needed for the application to be reliable and stable while users were playing.

Because of the architecture and design of the application, data about what games the user played was also collected. From this information I was able to know what kind of users were interacting with the application (age range and gender) and how engaged they were.

To save the data related with the application, a service called Parse.com was used. Parse.com is a service thought to build applications on any platform. It focuses on creating user experiences and hides complex infrastructure. Parse.com offered the following functionalities:

- Cloud database; giving the ability to forget about complex database administration tasks, and helping the developer to focus in functionality.
- Push notification services; sends notification to users every time it is needed.

Analytics tracking; giving the ability to understand how users were interacting with the application.

3.2.4.5 Data Analysis

All the data collected was analyzed in order to make it easy for evaluation. To process the data some tools were used. Analyzed data was used to confirm the hypotheses for this study, or to show the deviation from the expected results.

3.3 Limitations

The following were limitations in the study:

- Data was collected only through the means mentioned in section 3.2.
- The application was developed only for Android smartphones running version 4.0.3 or higher.
- The application was only compatible with the fitness tracker Fitbit.

4 FITPLAY GAMES

FitPlay Games is an asynchronous social gaming platform where individuals from various backgrounds and lifestyles can find a fitness game designed to consistently challenge and motivate them. Each game on the platform has its own set of strategies, giving all players a way to ‘win’ that best suits their needs; this allows both the fitness novice and maven to enjoy a reasonable probability of success. All games are based on step-counts and use an asynchronous style of play, allowing players to resume the game at times that work best with their schedule. The games allow players to invite and challenge their friends. FitPlay Games is currently implemented as a native Android mobile app, which pulls data from the Fitbit API (Skriloff, 2016).

The goals of FitPlay Games are as follows:

- To motivate the user to be more active and continue the use of a fitness tracker.
- To appeal to different player types: novices and gurus, busy and flexible schedules, and various gaming preferences.
- To serve as a research platform to understand asynchronous social exercise games.

Each game was designed to have a sibling game, allowing us to gather data on positive versus negative motivations for game play. For example, “Hot Potato” and “Capture the Crown” are mirror opposites. While Hot Potato only has one loser, Capture the crown only has one

winner. With this feature, I will be able to understand which groups are more motivated by winning and which are more motivated by fear of losing. For this thesis four games were designed: “Hot Potato”, “Capture the Crown”, “Weak Link” and “Skyscraper” but only two of them were implemented and tested: “Hot Potato” and “Capture the Crown”.

4.1 How to Use FitPlay Games

4.1.1 Getting Started

When a user first downloads the app, the first step is to create an account. In order to do so, the user has to register by creating a FitPlay Games account and linking it to their existing Fitbit account as shown in Figure 4-1.

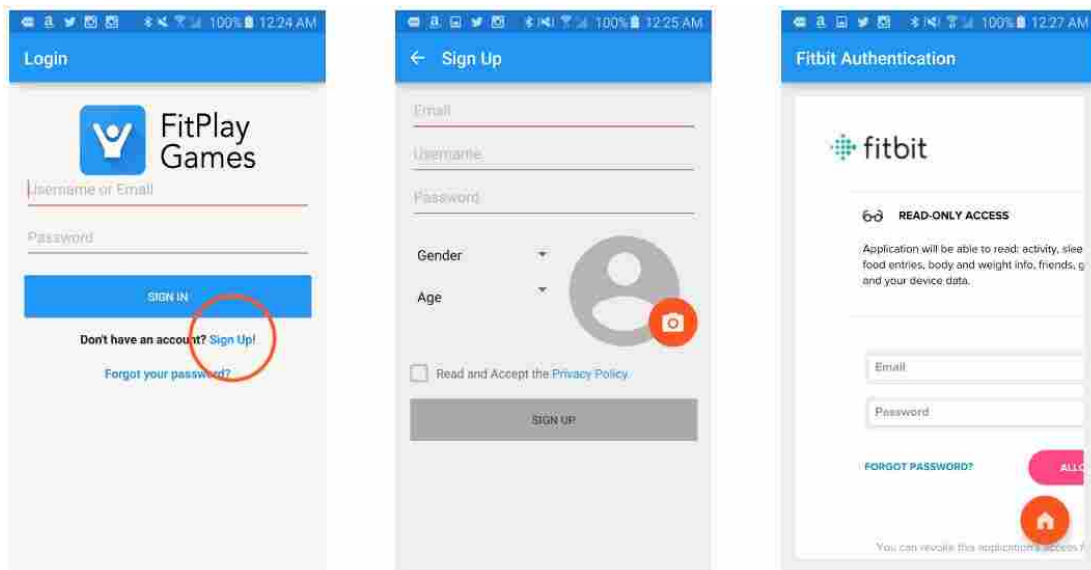


Figure 4-1: Initial Configuration

4.1.2 Initial Setup

Following the Fitbit connection, the user is redirected to the home screen. Before the user can start playing, they will need to add friends using the “Invite Friends” tab. Since most of the participants on this research project did not know each other, we initially helped them to connect with each other. The application has an option to search for players to send a friendship request, most of the players did not know each other, we facilitated their connections by email; by including player’s username in these emails, and we made the process easier for participants.

To invite a new friend, a player selects the users he wants to invite and sends an invitation. The invited player receives a notification which they can either accept or reject. If the invitation is accepted, both players become friends; otherwise, the invitation is ignored. Once “friends” are added, players are ready to start participating in games. Figure 4-2 shows the screen the players have to follow to send a friend request.

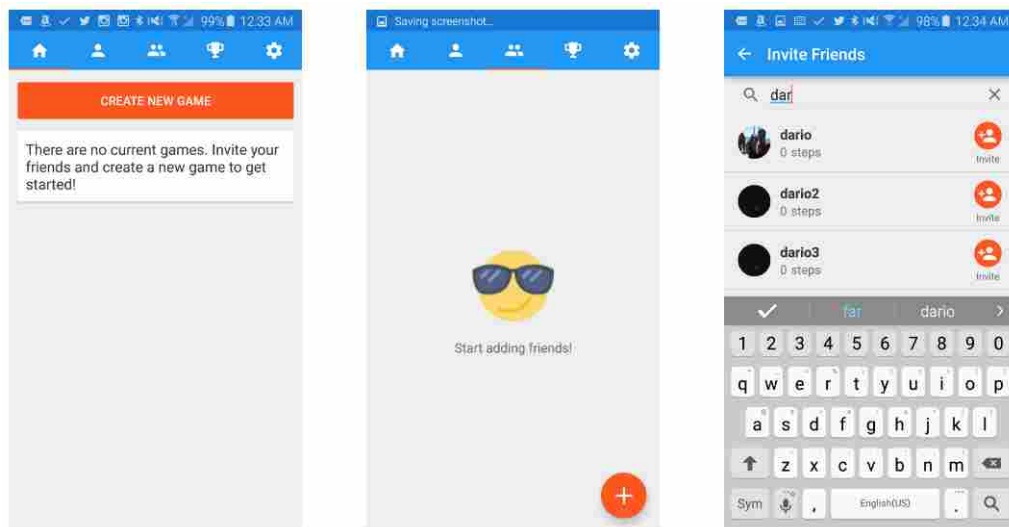


Figure 4-2: Getting Started

After having added friends, and following the invitation(s) being accepted, it is time to challenge these newly added friends. Figure 4-3 shows the process to invite a friend to play a game. For the field test, only the “Hot Potato” and “Capture the Crown” games were implemented. After selecting which game to play, filling out the game information, and inviting friends, participants were ready to start playing.

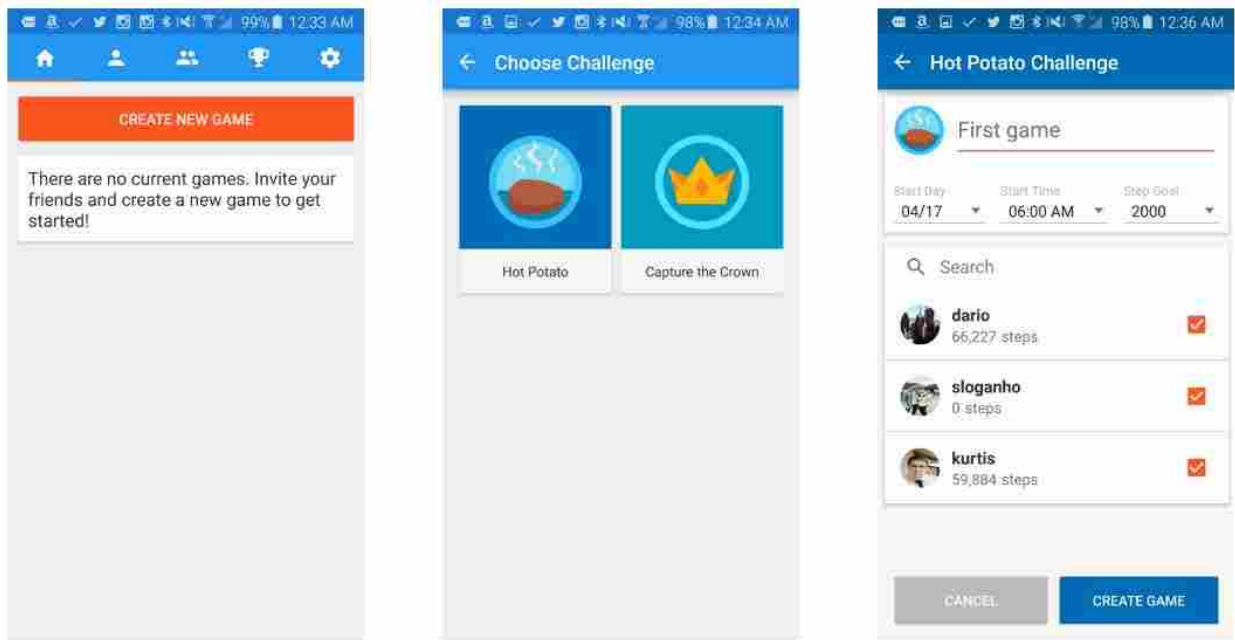


Figure 4-3: Creating a New Game

4.1.3 Home Page and Game Information

Once a game is created, it is listed in the Pending list on the home screen, waiting for the invited participants to accept the invitation to play the game and also for the date-time to start the game. The home screen shows three lists with games: Playing, Pending and Finished. The “Playing” list shows the games the user is playing at the moment, the “Pending” list shows the

games waiting to start, and the “Finished” list shows the list of games already played. Figure 4-4 is a screen shot showing the lists.

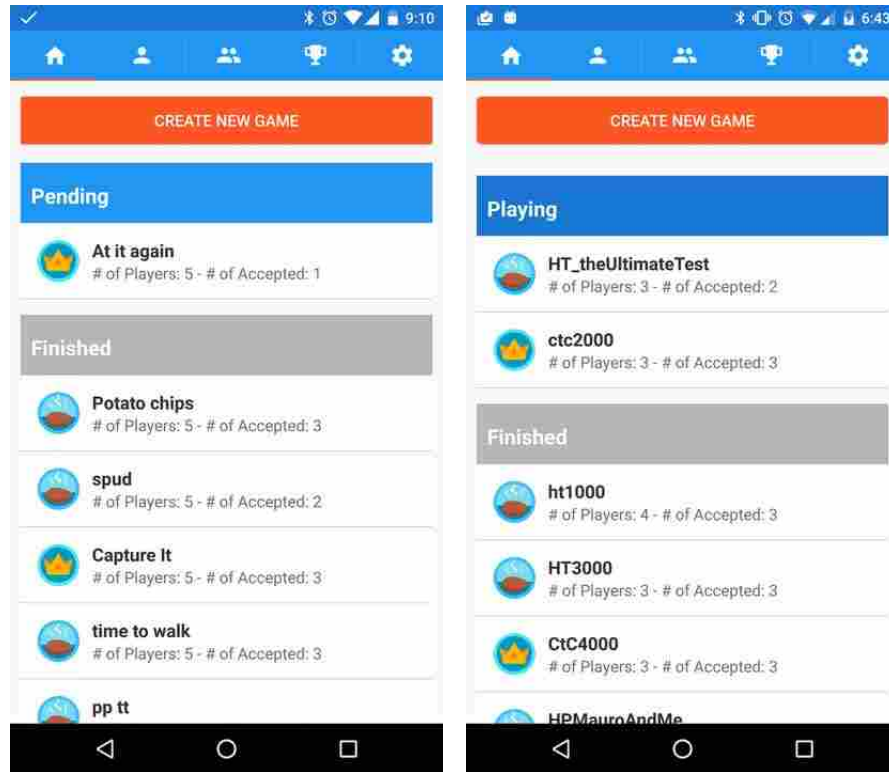


Figure 4-4: Main Screen

After selecting a game in any of the lists, a screen showing the information about the selected game appears (see Figure 4-5). Depending on the game’s status, different screens are shown displaying various details.

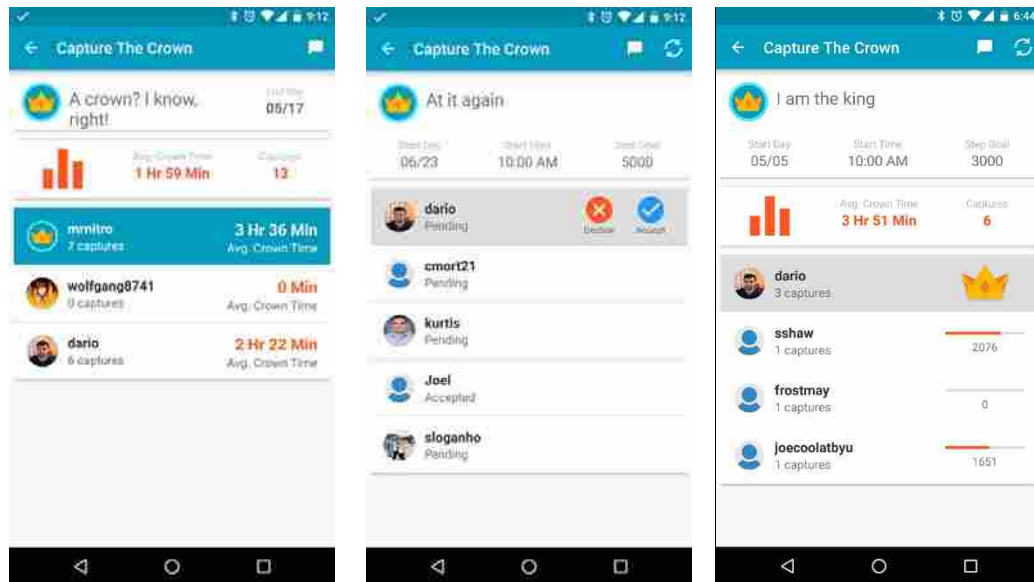


Figure 4-5: Game Information

4.1.4 Application Navigation

Using the the top bar in the main screen, the user is able to select different options. Available options from the main screen are, “Home”, “User Profile”, “Friends”, “Leaderboards” and “Settings” (see top of Figure 4-4). These options allowed users to visualize important information and keep them engaged using the app while exercising.

We also tried to create a clean, readable interface to appeal to a wide range of players, and we worked to make sure that information is presented visually, rather than with text, whenever possible. This approach is also found in the leaderboards. Figure 4-6 shows leaderboard examples for “Hot Potato” and “Capture the Crown” games.

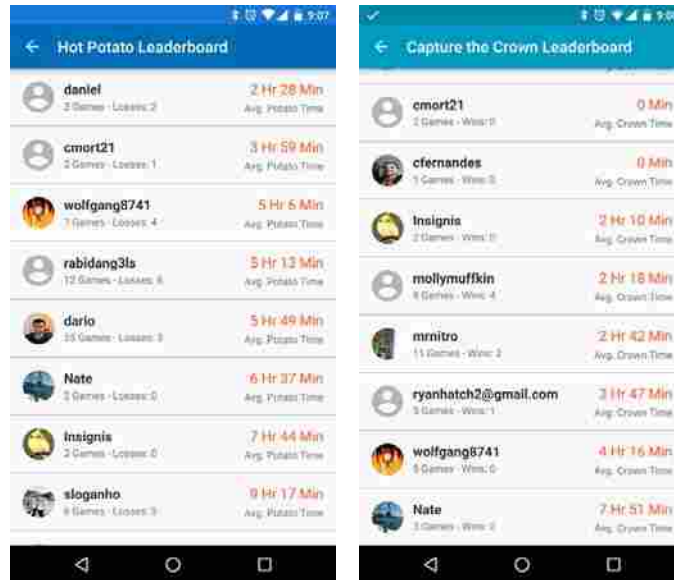


Figure 4-6: Leader-boards

The profile page (see Figure 4-7) was by far the most visited by users (discusses in chapter 5). This screen shows all the stats for the user, displaying the information by games and also displaying the stats for each game, also profile information is displayed as a quick view for the user. Additionally, a profile screen was created to display information for each of the users' friends where stats for each game type were displayed. This screen allowed the player to see and also compare stats data among different players. In this way the player was able to visualize at any time all his friends' information and know how his friends were performing. From this screen players can playfully taunt and motivate each other through direct player-to-player messaging

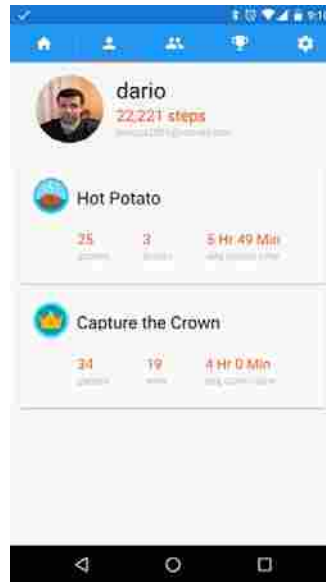


Figure 4-7: Profile Page

4.1.1 Chat Room

Another important aspect of the app is the chat rooms (see Figure 4-8). Users are able to communicate with each other at any time. Two different types of chats are implemented: a group chat and a one-on-one chat. Users can send messages to the group they are playing with in each game, allowing all participants in the game to receive notifications and messages every time another player sends a message to the group. This facilitated communication at all times during the game.

The second option is one-on-one chat. A user can select a friend from his/her friend list and start a private conversation with the selected user. The chat option was a very powerful tool to facilitate social interaction, which is the key ingredient in these games.

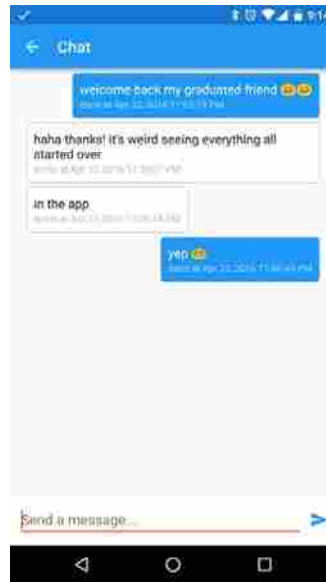


Figure 4-8: Chat Room

4.2 Design Justifications

This section presents the key game mechanics and design choices made to fit the game’s goals. It pulls from text written in our ACM-CHI Student Game Design Competition Extended Abstract (Skriloff, 2016)

4.2.1 Multiple Ways to Win or Lose

Every game was designed with a purpose in mind, a cooperative element or a competitive element to appeal to various play preferences. For example, in the game “Hot Potato”, players strive to not get ‘burned’ by passing the potato to another teammate (which is done when they reach a certain step count). At the end of the game, the person with the potato “lost” the game. However, players are also ranked in order of “average potato time” (average amount of time they held the potato), which creates a leaderboard based on individual performance.

4.2.2 Anyone Can Win

Consistently losing can act as a de-motivator, making it difficult for fitness novices to get ahead within traditional game structures. Some of the mini-games assure that anyone has a chance of winning, even if they didn't take the most steps. For example, in "Capture the Crown", whoever happens to have the crown when the randomly generated timer goes off wins the game. While those who perform better have a better chance of winning, everyone still has an opportunity to win. Similarly, the "loser" of "Hot Potato" is chosen at a random time to ensure that everyone has a chance of not getting 'burned'.

4.2.3 For Every Lifestyle

All games are asynchronous, which allows people to leave and pick up play at different times. Games are meant to blend into existing schedules, which extends the "magic circle" of the game into their everyday lives (Montola, 2005). For example, "Hot Potato" and "Capture the Crown," cater to individuals who can drop everything they are doing and walk 1,000 steps all at once. Other games, including "Weak Link" and "Skyscraper," cater to individuals who need to plan ahead, but can reach challenging step goals ("Weak Link" and "Skyscraper" games were not implemented).

4.2.4 Interface Design for All

Games were designed to be gender-neutral in our phrasing. While many team members liked the game name "King of the Hill" for what is now "Capture the Crown," we ultimately decided that it was too gendered and perhaps too exclusive.

We also tried to create a clean, readable interface to appeal to a wide range of players, and we worked to make sure that information is presented visually, rather than with text, whenever possible. This approach is also found in the leaderboards.

4.2.5 Support Rich Social Interactions

Different groups have different social dynamics, and FitPlay Games accommodates this by allowing players to have multiple games in-play simultaneously with different groups of friends. When players invite their friends to individual mini-games, they can playfully taunt and motivate each other through in-game chat and direct player-to-player messaging. This allows group dynamics that exist in reality to be perpetuated in the gameplay.

4.2.6 Notifications

A notification system was also put in place, which allows players to not have to spend time “checking” the application all the time. Notifications were sent to users to inform them of important events. For example, every time the “Potato” was passed to a player, a notification announced the action to the user so they would be aware that it was their turn to play.

Another notification was sent to the player every time the user received a chat message. This way, players could focus on other activities and be notified when something significant was happening with their games and/or friends.

4.2.1 Games Description

This section describes each game that has been designed and/or implemented. Each game is played with a small group of participants who accepts an invitation from the game creator, who can be any FitPlay Games player. Multiple games may occur at any given point in time,

since a player may be playing different games and with different groups of people. The steps they take will count toward all of the games they are currently playing.

4.2.1.1 Hot Potato (Designed and Implemented)

This is a variation of the common children’s “Hot Potato” game, where an object (i.e., potato) is passed from player to player until the music stops (or a timer goes off), at which point the player with the potato loses. In this case, a virtual potato is passed when a player achieves a specified step goal. One player, chosen randomly, will start with a virtual potato shown in the application. When the player reaches the goal step count, the virtual potato is passed to another player (chosen at random from the app), who will again attempt to hit the step goal to pass the potato to the next player. When the random timer goes off, the player with the potato is the loser.

4.2.1.2 Capture the Crown (Designed and Implemented)

“Capture the Crown” is Hot Potato’s sibling game. A step goal is selected and the app will choose the first player to hold the crown. All players without the crown race each other to reach the step goal. When the first player reaches the step goal, they “capture the crown,” at which point the steps counter is reset for each player, and all remaining players race again to capture it. When the randomized timer goes off, whoever has the crown is the winner.

4.2.1.3 Weak Link (Designed, Not Implemented)

A steps goal is selected and a player is randomly chosen to start playing. Players take sequential turns to reach an increasing daily step goal, which results in an added link on the chain every time a player reaches the daily goal. For example, a player may receive a notification that says “Don’t be the weak link, walk X steps in the next 24 hours” and has a list of all of the prior

people who have met their goal and added a link to the chain. When someone fails to meet the goal, the chain breaks, the game ends, and all players are notified of who the weak link was and the overall chain length and participants. The player who didn't reach the goal is the loser. The total chain length is a team score, while the number of chain links that each person added is an individual score.

4.2.1.4 Skyscraper (Designed, Not Implemented)

This is Weak Link's sibling game, where all players work to reach an increasing daily step goal. A new skyscraper level is added for each participant when they meet the step goal. When none of the players meet the daily goal, the game ends. The winner is the person with the most levels added and the total number of levels on the building acts as a team score.

5 EVALUATION AND RESULTS

5.1 Application

The purpose of this work was to help people to increment their activity levels by using a novel mobile application (FitPlay Games) which incorporates a set of mini-games designed to motivate people to stay active. As described in Chapter 3, a field trial was conducted to gather data on the impact of FitPlay games on steps taken, as well as better understand which game elements and social aspects of the app were most appealing. Data from several sources was used to address the research questions. These include step count data from Fitbit, analytics data from FitPlay games, and a survey administered after all participants completed the trial.

After describing presenting and analyzing the data, Chapter 6 will address each research question and hypothesis.

- Question 1: Will the use of the application stimulates the user to increase his/her physical activity? If so, to what extent?
- Hypothesis 1: The use of the application will motivate people to exercise more often through the use of short competitive games based on awareness of steps count.
- Question 2: Which game elements and social aspects of the application were the most appealing to the participants?
- Question 3: How did findings from research question 2 differ across gender?

- Hypothesis 2: Competitive games will be more motivational for men than for women.
- Hypothesis 3: Games that emphasize positive affect (e.g., winning) over negative affect (e.g., avoiding losing) will appeal more to women than men.

5.1.1 Trial Participants

Table 5-1 shows participants' characteristics. Initially, 80 users registered to use the app and to be part of the study, including 45 males (56.25%) and 35 females (43.75%). From the 80 registered users, 59 completed the whole registration process, 35 male and 24 female, meaning that they created a FitPlay Games account and also connected the FitPlay account with their Fitbit accounts and authorized FitPlay Games to access their step count information from Fitbit servers. Of the 59 users who completed the whole registration process, 28 of them played at least one of the mini-games (24 male and 4 female). Even when one of the requirements for the participants was to use the app during the 30 days of the field test, not all of them stayed active for the whole period of time; the average time of app usage was 18 days.

Table 5-1: Participants' Breakdown

	<i>Male</i>	<i>Female</i>	<i>Total</i>
# of registrations	45	35	80
# of completed registrations	35	24	59
# of player (at least one game)	24	4	28

Downloading apps to see how they work, but not using them, is a common phenomenon and to be expected when an app is made publicly available on the Google Play store, as this one was. It may be that some users downloaded the app without realizing they needed a Fitbit to use the application. Unfortunately, we were not able to collect data on why people did not play any

mini-games. The remainder of the analysis focuses on the 28 participants who actually used the app by playing at least one mini-game. We are only interested in step count data changing for those who actually played games.

Figure 5-1 shows for each player (y-axis) the games distribution during the field test period (x-axis represents Date; dots size depends on number of games played, the bigger the size the more games the user has played that day). At the beginning of the field test, players were more likely to play and test the app; halfway through the field test a decrease in the number of games played can be observed, and towards the end of the field test we can appreciate a small increment in the activity. This can be a consequence of how hard it is to maintain motivation during an extended period of time. There is no notable difference in activity during weekends compared to weekdays (weekend days are highlighted, see Figure 5-1).

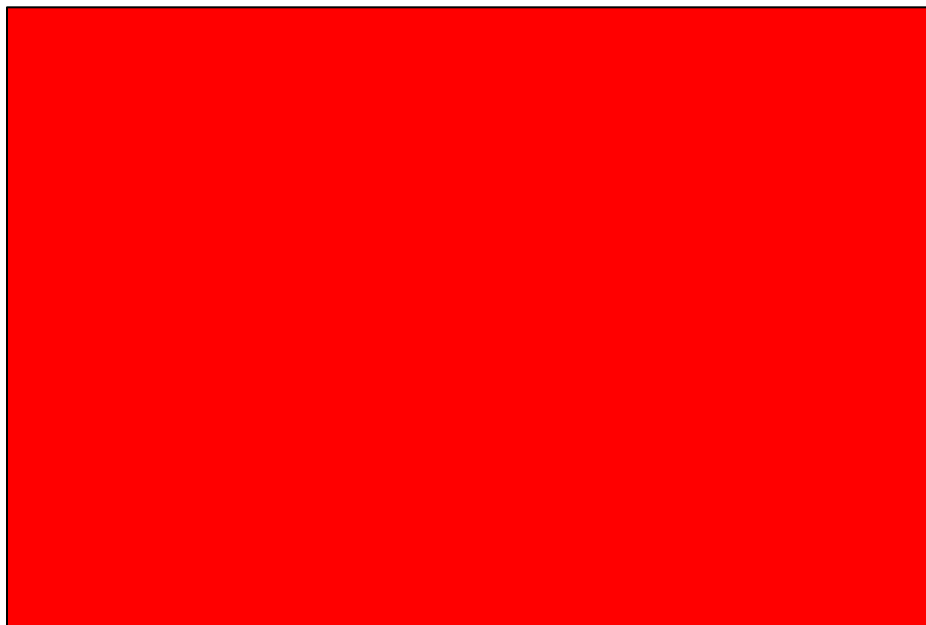


Figure 5-1: Game Participation for Each Player Over Time

5.1.2 Application Usage

The 28 players completed a total of 84 games during the 30 days. Game distribution was even, having basically the same number of games for each game type. According to the collected data, 1,000 and 2,000 steps challenges were preferred over longer step goal distances (see Table 5-2), suggesting that shorter and faster games were more appealing to players.

Table 5-2: Games Distribution

<i>Game Type</i>	<i>Game steps goal</i>	<i># of Games</i>	<i>Avg. Time per Game in hours</i>
HOT POTATO	1000	22	32
HOT POTATO	2000	13	39
HOT POTATO	4000	1	48
HOT POTATO	5000	5	72
CAPTURE THE CROWN	1000	12	31
CAPTURE THE CROWN	2000	15	39
CAPTURE THE CROWN	3000	8	60
CAPTURE THE CROWN	4000	3	40
CAPTURE THE CROWN	5000	5	60

Table 5-3 shows the distribution of players by game type, meaning the data of invited players and invitations accepted by game type. Of the 86 games created during the field test, only 2 did not reach the minimum of players to start the game; 97.7% of the games were played (at least 2 players were needed to start a game). On average, having 2 players was common for “Hot Potato” games and 3 players was the standard for “Capture the Crown” games, while the invitation rate average was 4 players in both games.

Table 5-3: Games Participants

<i>Game Type</i>	<i># of Games</i>	<i># of Started Games</i>	<i>Avg. Invited Players per Game</i>	<i>Avg. Players per Game</i>	<i>% of Players Accepting Game</i>
HOT POTATO	42	41(97.6%)	4	2	61.4%
CAPTURE THE CROWN	44	43(97.7%)	4	3	64.2%

Table 5-4 shows the distribution in games started by gender. The tested games were both competitive games, and given that men are more competitive than women, according to (Niederle & Vesterlund, 2011), this may explain the higher number of games played for males than females, although with only 4 women it is hard to draw conclusions. This is not conclusive data, but men showed higher interest in playing and/or starting games, on average, than women did.

Table 5-4: Games Created, by Gender

<i>Gender</i>	<i>Game Type</i>	<i>Games by Gender</i>	<i>%</i>
Female	HOT POTATO	2	5%
Male	HOT POTATO	38	95%
Female	CAPTURE THE CROWN	2	4.5%
Male	CAPTURE THE CROWN	42	95.5%

Table 5-5 shows the percentage of games created by gender. Although only four females participated in the field test, data shows that 50% of them created or started a game, while 67% of males started a game. The difference here is not that wide, comparing with previous data (Table 5-4) where the number of male participants was much higher than females.

Table 5-5: % of Players Who Created a Game

<i>Gender</i>	<i># of Players</i>	<i># of players who created a game</i>	<i>%</i>
Female	4	2	50%
Male	24	16	67%

Table 5-6 compares male and female game invitations and acceptance rates. Males and females received on average almost the same number of invitations to play games, but the ratio of acceptance was almost double by males than by females.

Table 5-6: Games Invitations

<i>Gender</i>	<i># of Invitations</i>	<i># of Invitation Accepted</i>	<i>% Accepted</i>	<i>Avg. Invitation/player</i>
Female	46	18	39%	11.5
Male	328	218	66.5%	13.6

5.1.3 Steps Count Impact

The research project studied the physical activity (steps count) of the previous 30 days of installing and using the application, as well as the first 30 days of the application usage. The field test started on April 25th 2016. The starting point to begin collecting data for each player was at the moment when the user completed the registration steps and synced with Fitbit. At that point the app collected the previous 30 days of the user’s activity (from Fitbit servers) and started to gather information while the player stayed active using the app (the goal was to collect 30 days of activity playing games). In this way I had the information needed to compare data by users on their number of steps before and after installing the app FitPlay Games.

For people who participated in at least one game (n=28), players had an average of 353 steps/hour previous to installing the app and 237 steps/hour while using the application. This difference shows a decrease in the average steps after installing the application. Table 5-7 shows the comparative data.

Table 5-7: Avg. Steps and Days Before and After Installing FitPlay Games

<i>Avg. Steps Before / Hour</i>	<i>Avg. Days Before</i>	<i>Avg. Steps After / Hour</i>	<i>Avg. Days after</i>
353	30	237	18

Table 5-8 shows the participants’ data during the period of time they have the application installed on their phones (an average of 18 days). For the 28 people who participated in at least one game, we measured their average steps per hour for the period of time where they were actively playing a game versus those where they were not playing any games but still using the app. The average steps for the players while not participating in a game was 237 steps per hour, while the average steps while playing was 299 steps per hour. The results showed that users did take more steps while actively playing a game. Even though the difference was not significant at the 10% level ($p = 0.109$) the tendency to increasing steps was present, particularly given our small sample size.

Table 5-8: Avg. Steps After Installing the App

<i>Avg. Step / Hour</i>	<i>Avg. Steps Hour (Playing)</i>
237	299

5.2 Survey

The survey was sent to the users after the field test finished, and we gave them a period of two weeks to complete it. A couple of emails were sent during this period as a reminder. From the 28 players who played the games, 18 answered the survey (64%), but 2 of the responses were incomplete resulting in 16 (57.14%) valid survey responses. The participation distribution was 12 males (75%) and 4 females (25%). The survey consisted of 37 questions (see Appendix B) with a mix of closed and open ended questions.

Table 5-9 shows a comparison of enjoyment playing the mini games (the question was enunciated as follows: On a scale of 1 (not at all fun) to 5 (extremely fun), how much fun did you have playing the Hot Potato/Capture the Crown mini game?)

Table 5-9: Players Enjoyment

<i>Level of enjoyment</i>	<i>Hot Potato</i>	<i>Capture the Crown</i>
1 (lowest)	5.88%	11.76%
2	23.53%	5.88%
3	35.29%	52.94%
4	17.65%	11.76%
5 (highest)	0%	11.76%
Did not play	17.65%	5.88%

Data collected about games enjoyment suggests that people enjoyed playing “Capture the Crown” more than “Hot Potato”. About 76.46% found “Capture the Crown” at some level enjoyable, compared to 52.94% of respondents indicating that they found “Hot Potato” somehow enjoyable.

When players were questioned about what they liked the most about the games “Hot Potato” and “Capture the Crown”, two main categories were highlighted: the game’s concept (meaning the game’s mechanism for winning) and the competition factor.

In the first category (game’s mechanism for winning), the appealing part was knowing that there was a chance to win even when the player was not the one who walked the most. The phrase “I liked the concept of the game” was mentioned multiple times, and the phrase “I liked that there is not a significant advantage to walking more than others except how much you walk in the short period time” summarized the rest of the comments and quotes regarding the concept of the game. Nearly all existing fitness tracker games focus solely on who walks the most in a given time period, so the novel game design that focuses on quickly walking the most, as well as an element of randomness in who wins (or loses) was appealing for its novelty.

The second most popular category was the concept of competition, which players universally mentioned in a positive way. The quote “Competition” and “Competitiveness” were widely used to support this idea. Motivation was also mentioned a few times to describe the appealing factor on the games. Competition was a focus point of each game and seemed like that motivated people to walk.

We also received useful feedback on how to improve the games, but the most mentioned issue was the fact of the rules were unclear. This issue was mentioned by almost 50% of the respondents. Phrases like “The rules were unclear”, "I wish it was more clear who the loser was" or “Tell me the rules”, strongly emphasized how important is for users to have a clear and engaging onboarding experience.

It seemed that I overlooked this aspect of the application, maybe because I thought it was clear and the users would figure out easily how to play the games. Even though I created a “How to” type document (and sent it to the players via email), a good onboarding experience would have likely worked better when launching a new app.

When asked which game was their favorite, most people answered that they liked them equally or that Capture the Crown was their favorite (see Table 5-10). This finding lines up with a previous question related with their level of “satisfaction” for each game.

Table 5-10: Game Favorite Distribution

<i>Game</i>	<i>%</i>
Hot Potato	26.67%
Capture the Crown	33.33%
Both	40%

Table 5-11 shows how likely players were to continue using the app. The average response was neutral, half of the users were motivated enough to continue using the app, and the other half were not. Quotes including the word “fun” and/or “motivation” were mentioned in most than 50% of the reasons to continue using or recommending the app.

Table 5-11: Continue to Use the App

	<i>%</i>
Extremely likely	12.50%
Somewhat likely	32.25%
Neither	0.0%
Somewhat unlikely	31.25%
Extremely unlikely	25.0%

When questioning about how likely they were to recommend the app to other people, again, half of them were motivated and the other half not too much.

Table 5-12: Recommend the App

<i>Recommend the app</i>	<i>%</i>
Extremely likely	18.75%
Somewhat likely	25.00%
Neither	8.75%
Somewhat unlikely	25.00%
Extremely unlikely	12.50%

The top reason for not continuing to use or recommend the application was again the lack of game explanations. Also the fact of not knowing other players who were using the app, was another negative reason for not recommending or keep using the app. Quotes like “I'd need more friends with Android phones and Fitbits to play” and “It would be more fun to play with my friends than random people” emphasized how important was to the players to have real friend to greater enjoyment of the games. Another negative fact, mentioned in several comments was the slow sync between the app and Fitbit (this was a known issue caused because of Fitbit constraints; the app was able to sync only every 15 minutes).

In total, 7 users mentioned that they will be willing to keep using the app and/or will recommend it to a friend. Table 5-13 shows these users’ gameplay compared to the rest of the users who would not recommend or would not keep using the app. There is not a substantial difference in the way each group participated in the games. On average, those who would recommend/keep using the app received more invitations, but the ratio in acceptance was basically 1:1 and the same ratio is observed in the action of starting a game.

Table 5-13: FitPlay Games and Survey

	<i>Recommend/use the app</i>	<i>No Continue using/recommend the app</i>
Total people	7	21
Game created	11 (13%)	73 (87%)
Avg. Game created	1.6	1.5
Game invitations received	106 (28.4%)	268 (71.6%)
Avg. Game invitations received	15.2	12.7
Invitation accepted	58 (57.7%)	178 (66.4%)
Avg. Invitation accepted	8.3	8.5
Avg. steps/hour before installing app	300 steps/hour	370 steps/hour
Avg. steps/hour after installing app	229 steps/hour	241 steps/hour
Avg. steps/hour actively playing	363 steps/hour	287 steps/hour

Table 5-14 presents data about if the players found the app easy to use (63% of user found the app easy to use). Data from this question was contradictory with previous responses. Most of the users found the application easy to use, while the biggest “complaint” about the app was the lack of an onboarding experience explaining how to play the games, as previously explained in this chapter.

Table 5-14: App User-friendly Usage

<i>User-friendly usage</i>	<i>%</i>
Extremely easy	6.25%
Somewhat easy	56.25%
Neither	31.25%
Somewhat difficult	6.25%
Extremely difficult	0.00%

Table 5-15 shows data for the overall satisfaction using the app was positive (56.25%), even though there are several points where the app must be improved, players had an overall good experience using the app.

Table 5-15: Overall Satisfaction

<i>Overall satisfaction</i>	<i>%</i>
Extremely satisfied	6.25%
Somewhat satisfied	50.00%
Neither	25.00%
Somewhat unsatisfied	18.75%
Extremely unsatisfied	0.00%

When users were asked about how often they used the app, notifications played a crucial part. Users presented a higher tendency to use the app when they were notified that when an action was taking place in the app.

Table 5-16 show the data distribution about why the players used the app. The use of the app was a mixture of fun and exercise, showing that a mix of both characteristics is crucial.

Table 5-16: App Usage

<i>App usage reason</i>	<i>%</i>
Mainly for fun	31.25%
Mainly for exercise	18.75%
Both	37.50%
Not sure	12.50%

Table 5-17 shows how the participants said the app affected their physical activity. Most players felt that FitPlay Games did not change their physical activity, although statistical data did show a change in the users' levels of activity (see section 5.1.3).

Table 5-17: Physical Activity Change Distribution

<i>Change in physical activity</i>	<i>%</i>
Significantly increased activity	0%
Somewhat increased activity	31.25%
Did not change activity	68.75%
Somewhat decreased activity	0.00%
Significantly decreased activity	0.00%

Table 5-18 shows the comparison between those who increased their physical activity and those who did not. Those who affirmed that FitPlay Games affected their physical activity positively had more dispositions to continue using the app and share the app with other users. They also found their overall satisfaction to be positive and declared a change in their behavior. For those who answered that there was no change in their physical activity, their willingness to keep using, recommend and overall satisfaction levels were considerable lower.

Table 5-18: Physical Activity Change

<i>Affect Physical Activity</i>	<i>Yes</i>	<i>No</i>
Total people	5	11
Will continue using the app	60%	36%
Will recommend the app	80%	27%
Find the app easy to use	80%	55%
Overall satisfaction (positive)	80%	45%
Change in behavior	60%	9%
Exercise more than 30 min/day	40%	55%
Use Fitbit tracker for more than 6 months	80%	55%
High level of competitiveness	40%	55%
Avg. steps/hour before installing app	338 steps/hour	355 steps/hour
Avg. steps/hour after installing app	313 steps/hour	224 steps/hour
Avg. steps/hour actively playing	481 steps/hour	276 steps/hour
Gender distribution	100% (M) 0%(F)	64%(M) 36% (F)

When players were questioned about if FitPlay Games interrupted their daily life, most of the participants felt like the app did not interrupt their daily life activities in a negative way.

Unfortunately, they did not feel like playing FitPlay Games had affected their actions towards exercising more.

Table 5-19: Did the App Interrupt Daily Life Activities?

<i>Interrupt daily life activity</i>	<i>%</i>
Yes	25.00%
No	75.00%

Table 5-20 shows that most of the participants recognized at least a certain level of competitiveness, which aligns with the idea of the games being tested. Previous questions also highlighted “competition” as a very attractive factor to have users engaged in playing games.

Table 5-20: Competitive Level Distribution

<i>Competitive Level</i>	<i>%</i>
Extremely competitive	18.75%
Very competitive	31.25%
Moderately competitive	18.75%
Slightly competitive	12.50%
Not at all competitive	18.75%

Table 5-21 shows a comparison between those who considered themselves extremely competitive and very competitive with those who considered themselves with a low degree or any degree of competitiveness. Those who considered themselves competitive were more willing to keep using the app and share it with friends than those who considered themselves less or not at all competitive. Positive overall satisfaction was higher among the less competitive players. This result aligns with data previously presented in this chapter where players enounced as one of the main reasons to keep playing and/or recommending the app to their friend to the fact of

being able to win without being the one who walked the most. In both groups, the change in their behavior and change in physical activity was considerable low.

Table 5-21: Competitive Level

<i>Level of Competitiveness</i>	<i>High</i>	<i>Low/None</i>
Total people	8	8
Will continue using the app	50%	38%
Will recommend the app	50%	38%
Find the app easy to use	50%	75%
Overall satisfaction (positive)	50%	62%
Affected physical activity	25%	38%
Change in behavior	13%	38%
Exercise more than 30 min/day	88%	13%
Use Fitbit tracker for more than 6 months	63%	63%
Gender distribution	75% (M) 25%(F)	75%(M) 25% (F)

Table 5-22 shows that at least 50% of the players do exercise at least 30 minutes a day, which is not the common rule. Most people do not exercise enough every day, according to data from the President’s Council on Fitness, Sports & Nutrition (President’s Council on Fitness, 2013).

Table 5-22: Hours of Exercise Per Week Distribution

<i>Hours</i>	<i>%</i>
Less than 1 hour	6.25%
Between 1 and 3 hours	43.75%
Between 3 and 5 hours	6.25%
Between 6 and 7 hours	18.75%
Between 8 and 9 hours	12.50%
More than 9 hours	12.50%

Table 5-23 shows the distribution about those who exercise at least 30 minutes a day, and those exercising less than that. Players with higher hours of activity were more willing to keep

using the app and share it with other people than players with lower weekly physical activity. The overall satisfaction was also higher for those in the first group. Behavior change in both groups was low.

Table 5-23: Hours of Exercise Per Week

<i>Hours of exercise per week</i>	<i>More than 3 hours/week</i>	<i>Less than 3 hours/week</i>
Total people	8	8
Will continue using the app	50%	38%
Will recommend the app	63%	25%
Find the app easy to use	63%	63%
Overall satisfaction (positive)	63%	50%
Affected physical activity	25%	38%
Change in behavior	25%	25%
Use Fitbit tracker for more than 6 months	75%	50%
High level of competitiveness	88%	13%
Gender distribution	63% (M) 37%(F)	88%(M) 12% (F)

Table 5-24 shows that most of the players (62.5%) have been using the Fitbit tracker for more than 6 months, which is not the usual case. According to the research that firm Endeavor Partners has made, about a third of all fitness trackers are abandoned after six months of use, and this number increases (Endeavor Partners, 2014) after that period of time. This can be a direct result of the data collected from the previous question where most of the participants were physically active people.

Table 5-24: Fitbit Tracker Usage Distribution

<i>Time using Fitbit tracker</i>	<i>%</i>
Less than 1 month	0.00%
1 to 3 months	6.25%
3 to 6 months	31.25%
6 to 12 months	31.25%
12 to 24 months	12.50%
More 24 months	18.75%

Table 5-25 shows a comparison between players who have used a Fitbit tracker over 6 months and those who were newer in using the device. Overall, players with longer time using a Fitbit tracker reported a better experience and willingness to keep using the app than those who were newbies using the tracker. Also, the first group showed to be more active.

Table 5-25: Fitbit Tracker Usage

<i>Fitbit usage</i>	<i>More than 6 month</i>	<i>Less than 6 months</i>
Total people	10	6
Will continue using the app	50%	33%
Will recommend the app	60%	17%
Find the app easy to use	50%	67%
Overall satisfaction (positive)	60%	50%
Affected physical activity	40%	17%
Change in behavior	40%	0%
Exercise more than 30 min/day	60%	34%
High level of competitiveness	50%	50%
Gender distribution	70% (M) 30%(F)	83%(M) 17% (F)

Table 5-26 shows a comparison between genders. Overall, females had a greater tendency to keep using the app and sharing it with other friends, while on the other hand, males had a better overall experience and reflected a change in their behaviors and physical activities.

Table 5-26: Gender Comparison

<i>Gender</i>	<i>Male</i>	<i>Female</i>
Total people	12	4
Will continue using the app	37%	50%
Will recommend the app	37%	50%
Find the app easy to use	58%	75%
Overall satisfaction (positive)	58%	50%
Affected physical activity	42%	0%
Change in behavior	25%	25%
Exercise more than 30 min/day	42%	75%
Use Fitbit tracker for more than 6 months	58%	75%
High level of competitiveness	50%	50%

Table 5-27 shows a comparison between those who plan to continue using the app and those who don't.

Table 5-27: Will Continue Using the App?

<i>Will continue using the app</i>	<i>Yes</i>	<i>No</i>
Total people	7	9
Will recommend the app	86%	11%
Find the app easy to use	57%	67%
Overall satisfaction (positive)	85.7%	33%
Affected physical activity	43%	22%
Change in behavior	57%	0%
Exercise more than 30 min/day	57%	44.5%
Use Fitbit tracker for more than 6 months	71.5%	55.5%
High level of competitiveness	57%	44.5%
Gender	72% (M) 28% (F)	78% (M) 22% (F)

5.3 Yahoo Flurry and Parse.com Analytics

Yahoo Flurry and Parse.com analytics were used to capture information that we would not be able to collect using the sources mentioned in previous sections of this chapter. The information presented in this section helps to better understand other aspects of the application usage.

Figure5-2 shows the application usage frequency. Most session length were really short, averaging between 10 - 60 seconds. The intent of the app was oriented to interact with the players while mostly checking notifications and act according to the notification received. It was not expected that the users would spend a long period of time using the app, except when checking profiles, leader boards, etc. Also, total time spent in the app was higher at the beginning of the field test, decreasing over time. This may be because users were learning how to use the app initially, and later the spent time in the app decreased since they were familiar with it.

Alternatively, users' may have lost of interest or motivation in using the app, decreasing the time they spent using it (see Appendix C for detailed information data for session's length distribution by day).

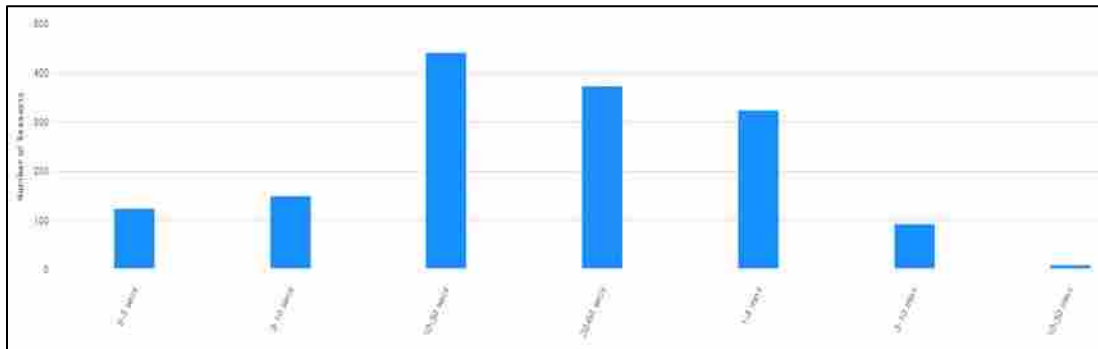


Figure 5-2: Session's Length Distribution

Median daily sessions were 2.5 per day, with a peak between the 05/02 and 05/06 (see Figure 5-3). Aligned with data presented previously in this chapter, seems like the days of the week did not make a big difference. Unfortunately, there is no additional information available to know why a high-peak on sessions was found on that week.

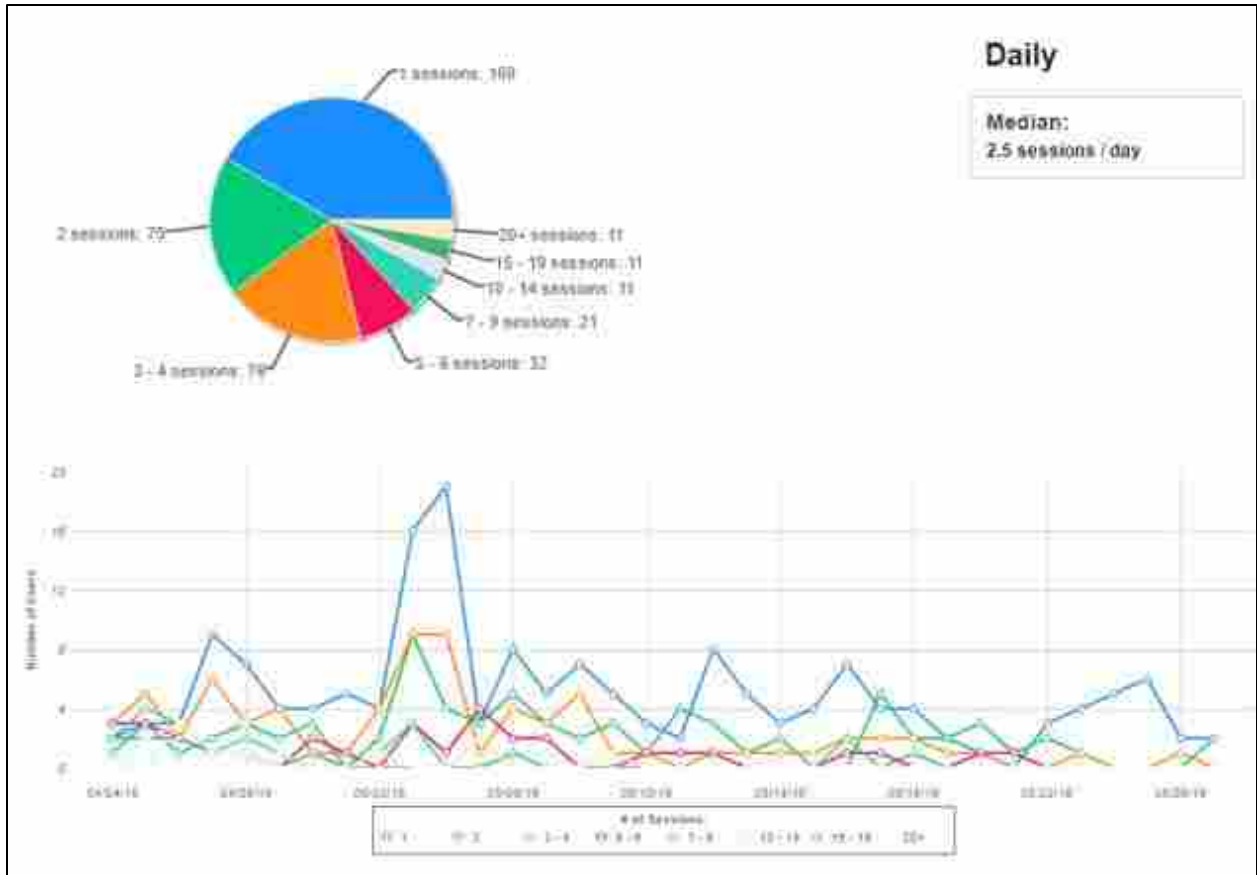


Figure 5-3: Daily Sessions

Table 5-28 shows connections to the app by carrier. Most connections were done using Wi-Fi connectivity, which was sort of contradictory to what was expected. Because the app was developed for smart phones, the connections through carriers were expected to be at the top of the list. But this discovery can open the door for a new perspective in the development plan of future releases of the app, increasing the focus of the design and efforts towards tablets where Wi-Fi connections are the norm.

Table 5-28: Connections by Carrier

<i>Carrier</i>	<i>Sessions</i>	<i>% of Sessions</i>
Wifi / Other (US)	604	38.70%
Unidentified	574	36.80%
Verizon (US)	109	7.00%
Qwest (US)	99	6.30%
WDSPCO (Other) (US)	46	2.90%
Embarq (US)	33	2.10%
Wifi / Comcast (US)	24	1.50%
T-Mobile (US)	17	1.10%
Wifi / Other (CA)	16	1.00%
AT&T (US)	12	0.80%
Rogers (CA)	7	0.40%
Wifi / TelePacific Communications (US)	6	0.40%
Wifi / Other (PT)	5	0.30%
Wifi / Other (MX)	2	0.10%
Wifi / Other (GB)	2	0.10%
Orange (ES)	2	0.10%
Wifi / Other (ES)	1	<0.1%
Wifi / Cablevision (US)	1	<0.1%

There were no surprises about the operating system distribution. It was expected that most of the players would install and use the app in newer versions of the Android operating system (OS). Even though the app supported earlier version of the OS, according to Google (Android, 2016), most Android users are actually using the newest versions of their OS (Lollipop – Android 5.x.x - and Marshmallow – Android 6.x.x), see table 5-29.

Table 5-29: Android Version Used to Install the App

<i>Firmware version</i>	<i>Sessions</i>	<i>% of sessions</i>
Android 6.0.1	610	39.10%
Android 6.0	42	2.70%
Android 5.1.1	238	15.30%
Android 5.1	176	11.30%
Android 5.0.2	219	14.00%
Android 5.0.1	184	11.80%
Android 5.0	55	3.50%
Android 4.4.4	6	0.40%
Android 4.4.2	4	0.30%
Android 4.3.1	1	<0.1%
Android 4.3	2	0.10%
Android 4.2.2	23	1.50%

Even when most player were using the most updated Android version, the percentage of users using older Android version must be considered. The percentage was high enough to be aware of backward compatibility it is always a key point when trying to reach a broader audience.

6 DISCUSSION AND CONCLUSIONS

For this research I've developed a novel game platform for smartphones (only Android devices), using a fitness tracker (only compatible with Fitbit trackers) to study how this type of applications could help to shape healthy behavior in users. The aim of this research was to understand how to stimulate users to increase physical activity, what motivated them, how competitive and social aspects affected their behavior, and how positive and negative framing of games impacted motivation. All these aspects were studied differentiating behavior changes in men and women users.

6.1 Summary Relevant to Research Question #1

Research question #1: Will the use of the application stimulate the user to increase his/her physical activity? If so, to what extent?

Hypothesis 1: The use of the application will motivate people to exercise more often through the use of short competitive games based on awareness of step count.

Data collected during the field test showed that there was not an increase in the physical activity of the players. As described in section 5.1.3, players' steps decreased during the period of time while the players installed the app on their devices, compared with the data collected during the month prior to use. However, this may be due to other factors that could not be controlled such as the weather, time of year, etc.

Even though the total step count decreased compared to the prior time period, while playing a game, players walked more often than when they were not actively playing a game. Though the difference was not statistically significant ($p = 0.109$), the increase in average steps from 237 per hour to 299 per hour is suggestive, particularly given the small sample size. Survey results were consistent with this, in that only 5 of the 16 people who participated in the survey, said they increased their steps as a result of the app. None said it decreased their activity.

A few factors were identified that may have reduced the impact of the app on exercise:

- Several people mentioned that they were confused about how to play the mini-games, due to a lack of an onboarding experience.
- Several people mentioned that they would have been more engaged had they been playing with friends and family as opposed to strangers. Unfortunately, many of them had friends that used iPhones or other fitness trackers, making it difficult to allow people to play with their existing contacts.
- Some players only participated in one or two games, which limited the amount of data we had to measure step counts.

It is important to highlight that there are health benefits from reducing sedentary time, even if the activity is simply walking and not vigorously (Katzmarzyk, 2009; Owen, 2010). Our mini-games were designed to reduce sedentary time, and even though there is not enough data to draw strong conclusions on the health impacts, a tendency in the reduction of sedentary time was observed.

6.2 Summary Relevant to Research Question #2

Research question #2: Which game elements and social aspects of the application were the most appealing to the participants?

There were two main aspects of the games that promoted the use of the app resulting in an increase in steps count. The first one was the competitive aspect. Data showed that the competitive piece was an important factor to motivate participants to play the games. This was an expected and desired effect when the games were designed. Capture the Crown had a more explicit and frequent competition model than Hot Potato, since players had to compete each round to take over the crown, whereas in Hot Potato only the person with the Potato had to take steps.

The second element was the game's concept, meaning the game's mechanism for winning. There were two novel design features that players picked up on. First, there was a random timer (nobody knew when the game would end), which players recognized as giving them a chance to win even if they weren't the one who walked the most. A little bit of suspense, driven by the unknown time, seemed to help players to maintain interest in the games. Second, the main way to increase a player's chances of winning was to quickly take a lot of steps when the player had the potato or were trying to capture the crown. In other words, total steps taken weren't as important as a player's ability to complete a step goal in a short amount of time (see section 5.2).

Since there are many games based on total step count, this alternative mechanism for winning was interesting and appealing to some players. Additionally, another interesting aspect to highlight was the fact that even the players who considered themselves having a low level of competitiveness or not being competitive at all found the game and characteristics appealing to them, making this possibly an area for future study. Players also enjoyed the ability to play short and fast steps games, promoting a reduction on sedentary time.

Even though the elements mentioned in the previous paragraphs were related with both games, according to the analyzed data, the most appealing game to play was Capture the Crown, though not by a large margin (see Table 5-10 for details).

The chat room also played an important role. Players were able to send group messages (while playing a game) and also direct messages to their friends. 50% of the participants (according to data analyzed from the surveys) were satisfied with this feature, although no other data was collected on this regards, the chat was a feature extensively used by the players.

Unfortunately, there was not enough information to draw strong conclusions, but the trend in the information collected and analyzed suggested that players found several elements of the application interesting enough to keep their attention and motivate them to play and stay more active. It has been a mixed success considering that almost 45% of the participants would recommend the application (see Table 5-12 for details).

6.3 Summary Relevant to Research Question #3

Research question #3: How did findings from research question 2 differ across gender?

Hypothesis 2: Competitive games will be more motivational for men than for women.

Hypothesis 3: Games that emphasize positive affect (e.g., winning) over negative affect (e.g., avoiding losing) will appeal more to women than men.

From the total of 28 players who participated of the field test, 4 were females and 24 were males. For this project only 2 games were developed. The developed and tested games were focused in the competitive aspect (for a better description, see Chapter 4), “Hot Potato”

emphasizing in the “Loser” aspect and “Capture the Crown” highlighting the “Winner” aspect of the game.

Having 86% of the participants being male could be a direct consequence of only implementing the “competitive” games, supporting the hypothesis that competitive games will be more motivational for men than for women. But it is important to highlight that the data sample was not big enough to support such a hypothesis.

Because cooperative games were not developed for the field test the hypothesis based on this premise could not be studied and could not be confirmed.

Capture the crown, was the favorite game to play, suggesting that an emphasis on the positive aspect (winning) of the game was more appealing than a negative aspect. Again, data suggested that tendency, but the sample model was not big enough to draw strong conclusions.

6.4 Recommendations for Future Developments or Similar Applications

As obesity in the US has become a big issue and concern (President’s Council on Fitness, 2013) exergames (games that require physical activity to play) that provides both exercise and gaming have emerged as an innovative tool for combating this crisis. Exergames are not only prevalent in homes but are also becoming part of our daily life. Video games are played universally, among youth data shows that 99% of boys and 94% of girls play them (Staiano, 2011). People enjoy them, and exergames are emerging as a profitable market (see Chapter 2 for a review). There are also benefits for decreasing sedentary time even if people are active but not to the level of exercise.

Designing and developing FitPlay Games was a process of several months. Numerous approaches and technologies were tested in order to come up with a product able to motivate physical activity in players. During the field test we discovered things that could be improved.

This section will articulate recommendations, actions and design implications to consider for future developments of FitPlay Games or similar applications.

6.4.1 Backend

Backend can be defined as the support components of an information system. It often refers to the database management system, which is the storehouse of the data residing on a server. It may also refer to the software on a Web server or application server that performs the processing initiated by a person using an application. A stable and responsive backend is essential for securing the success of any software development. Nowadays, most apps require a web connected backend that enables an app to manage a centralized database that lets the users share content via the cloud.

Parse.com was the option chosen as a backend for this FitPlay Games. Reviews and a short research about the product were enough evidence to select it as the backend option for the app.

The most appealing characteristics to use this product were:

- No need to install any extra software, other than the Android API to interact with the service.
- Database creation on the fly, meaning that database objects were created as needed being flexible enough to evolve with the time.
- Push notification services.
- Analytics services.

- Easy dashboard and administration tools.
- Free. For the expected usage during the field test, using Parse.com was free of charge.

Scaling applications can be challenging. It is difficult to estimate demands prior to launch and even during the development phase, and most of the time a backend that scales effectively as the demand grows is fundamental.

Although, at first Parse.com seemed to cover all our needs for this project, as soon as FitPlay started to evolve and getting more complex, Parse.com showed a lack of consistency and instability, making the development really complex and as a direct consequence slowing down the project. Issues like latency, asynchronous calls, server reliability among others, were present during the development of the app.

Hence, choosing a reliable backend would be fundamental for future development on FitPlay Games, and it is also needed to consider when developing similar applications. So, to keep moving forward with this project a new backend must be considered. There are several options in the market that can be researched and used as a new backend for the app, a quick search on the web will return several interesting options that can be analyzed and used as a possible solution. Kumulos, Kinvey, AnyPresence and Kii, among others, are possible options that the team will need to spent time to analyze to check whether these services have all the capabilities needed for this type of project.

Another possible option would be to implement the backend services. There are several tools that can be used to implement a backend that would fit the requirements for a project like this. This option would require extra resources (economic, hardware, software and time) that

need to be considered, but this option will give the flexibility to scale implementing services as they are needed.

6.4.2 Platform

Selecting the ideal platform it is not an easy task. With a technology market evolving at a fast pace, this task can be a challenge. Currently Android, iOS and Windows Phone are the three top platforms in the market with the 96.3% market share, with a distribution of 66.87% for Android, 27.2% for iOS and 2.3% for Windows Phone devices (NetMarkerShare, 2016). So focusing on these three main platforms would be the focal point when developing an application for mobile devices.

For this research the Android platform was selected with support for version 4.0.3 or higher; according to Google this option will support over 98% of the Android devices in the market (Android, 2016). The main reason for selecting this platform was the team background, they were all Android developers.

While recruiting players to test FitPlay Games we found out an interesting fact that we did not anticipate, the combination of Fitbit and Android users were harder to find than Fitbit and iPhone users. Even when Fitbit is the most popular fitness tracker (Market, 2014) it seemed that iOS users were the most common users. So keeping in mind the implementation of the app for other platforms, especially for iOS users will increase substantially the target public able to use the app. Other platforms, such as Windows Phone, may be considered too.

Also, depending on what is the reason for developing such applications, market presence and monetization can be an important factor to consider while deciding on a mobile platform. More details on these two aspects are considered in section 6.4.6.

6.4.3 Step Tracking Services

With the increasing popularity of fitness tracker in the form of an app or a device has become very popular. There are hundreds of mobile apps ranging from free to a few dollars, and tracking devices, as cheap as \$10 to devices costing a few hundred dollars, so finding the ideal device for every person can be a complex task.

Fitbit was the steps tracking service selected for this research because of being the most popular device at the time this project started and also because studies demonstrate that Fitbit trackers were the most accurate in the market at that moment (Mohan, 2015). During the process of designing and developing the app new services came out into the market creating a new trend of use. One example was the Apple Watch, released into the market in the second quarter of 2015 and positioning in second place as one of the most popular fitness tracker being used in the market. Also smartwatches supported by the Android platform are gaining market shares and should be considered.

Existing applications also have shown that their accuracy that they can keep the pace compared with costly fitness trackers (Mohan, 2015). Therefore future development should consider the integration of new steps tracker services into the platform, such as Google Fit (for Android) and Apple Health (for iOS) will help with the goal of reaching a wider audience to use the app.

Also, there a wide market outside to select from to integrate with FitPlay Games, such as Jawbone, Mistfit and so on, that can be considered; but in this section I have only limited my recommendations to the most popular in the market. Also all the options considered in this section provide APIs that would make the integration easier with a platform like FitPlay Games.

Investing time and resources in other platforms and options will be up to the person or team that will implement the new functionalities.

6.4.4 Sync Services

A known constrain in FitPlay Games was the limitation of being able to sync data with Fitbit only every 15 minutes. Users complained about this issue, because at times the app seemed slow in updating the players' information. This was also in part aggravated by our backend, Parse.com, and the poor implementation of the database update, making it difficult to reliably access Fitbit services often and database updates without getting “throttle” notifications.

Depending on third party entities is always a risk when working on a project and should be minimized when possible. Unfortunately, this type of project depends on these services and there is not reasonably possible to avoid such dependency. Implementing our own backend, as mentioned in section 6.4.1, would in part alleviate this issue and considering some other ways for syncing information will be needed to be re-evaluated in order to offer a faster and more fluid user experience. Unfortunately the dependency of the steps count services is something that cannot be avoided. Developments reasonably possible third party services, depending on their reliability.

6.4.5 Social Elements and Engagement

According to the data collected, players had a difficult time playing with the application because of main two elements: onboarding experience and friends.

Onboarding experience was a significant concern in motivating people to play and keep using the app. Onboarding is about teaching users the rules and tools to use the app. Onboarding

starts as soon as the user signs up, and ends when the users have mastered the fundamental skills needed to use the app. The lack of well-organized direction on how to use the app and how to play the games appeared to be a factor to decrease the level of interest of playing and keep using the app. Hence the design and implementation of a well-thought onboarding experience will be essential for the success of future versions of FitPlay Games or any other app.

Another important aspect of the onboarding experience would be to keep players informed all the time of their progress. Profile, leaderboard, push notifications, and so on would help keep users' engagement, but also an important element would be avoiding overwhelming them. Placing relevant context in the right places would help to keep users' interest.

The second element to consider is the friend relationship among the player. Research into the social interactions during game play has indicated positive effects on performance and motivation. Research with adolescents and adults has also demonstrated that playing games with others adds to the game experience, demonstrating that playing against a co-present friend causes higher engagement, excitement and more positive emotions (fun) than playing against a stranger (Feltz, 2011; Kort, 2007).

For this test, most of the players did not know each other, and even though the participants knew about this, it seemed that they would prefer playing with friends than with people they did not know. Playing with friend can also apply to the peer pressure factor. There is also a need to implement better ways to connect players with their friends within the app, and solution to consider could be adding integration with third party services such as Facebook, Twitter and other social apps and services.

6.4.6 Other Considerations

New games will be considered for future releases. For this field test 4 games were designed, but only 2 of them (Hot Potato and Capture the Crown) were implemented. Weak Link and Skyscraper should be implemented in future releases.

From the data collected, players seemed to want quick active games reducing step goals and/or allowing players to manually entry the step goal selection. Another interesting fact was that those who considered themselves noncompetitive really enjoyed the games, suggesting that we have tapped into a different niche.

Another interesting feature to consider in future works would be adding the ability to monitor heart rates. This would help to estimate different levels of physical activity intensity, letting the researchers to know if a player has been actively engaged in a physical activity or just moving (reducing sedentary time).

There is an overabundance of mobile applications in the market today and the number of mobile application downloads has kept increasing during recent years. According to Yahoo Flurry data, collected for FitPlay Games, more than 40% of the usage data connections (see table 5-27) were made through Wi-Fi. This information opens the door for a new implementation not considered before, tablets. The app was designed, developed and optimized for smartphone usage, but data has shown that it may also be a market for tablet usage of the app. So, it may be worth considering a new tablet design and implementation in a future iteration.

Strategies for making an app like FitPlay Games profitable is another area of future research. It is a highly competitive space, yet relatively few apps have novel games that utilize fitness tracker data. Several strategies are possible: in-app ads, freemium, affiliates and referrals

and in-app purchase options. There are several options and services available in the market to integrate these monetizing strategies into an app. Future research needs to be done in order to find the best solution, but it is important to consider these options as an alternative to fund future development.

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APPENDICES

APPENDIX A. IRB DOCUMENTATION

According to the Institutional Review Board (IRB) to determine if an activity is human subject research there are three questions that must be answered, being the highlighted, for this research: Does the research involve human subjects? Human subjects are defined as “living individuals about whom an investigator conducting a research obtains data through intervention or interaction with the individual”. This research fell under such definition, so we have to get IRB approval in order to perform this project.

The process took over two months of preparation. During that time all the needed documentation was prepared and went through process with the IRB were have to be changed several times until it was approved. After the approval the following images show the approved permission and accepted documents by the IRB.

Focus Group Consent

Hello! My name is Dario Gonzales, and I am a masters student at Brigham Young University studying Information Technology with the help of my mentor, Dr. Derek Hansen, an IT professor at Brigham Young University.

For the study, you will be invited to participate in a focus group with other participants once the 4-week play period is over. We will discuss your experience with the game, feelings about exercise, and how the game affected your exercise routine. Because focus groups include discussion of personal opinions, extra measures will be taken to protect each participant's privacy. We will begin the focus group by asking the participants to agree to the importance of keeping information discussed in the focus group confidential. We will then ask each participant to verbally agree to keep everything discussed in the room confidential and will remind them at the end of the group not to discuss the material outside.

The focus group will be conducted in late June on BYU's campus in the Crabtree Building in room 145. The focus group will take no more than 1 hour, and the individual interviews will take no more than 15 minutes. Refreshments will be served.

Only the researcher will have access to the data collected. Any tapes and transcripts of the focus group will be destroyed after one year or at the end of the study. The material recorded will not be shared with the public.

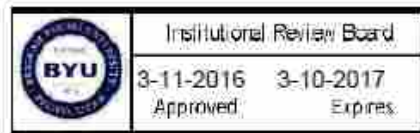
Although we will work hard to protect your confidentiality, we cannot control other participants, and cannot ensure that they will not share confidential material once the study has ended. This may lead to a loss of privacy is a potential risk. If you would like to participate in the focus group, please sign below.

If you have any questions, please feel free to contact myself at dariogs2001@gmail.com or 845 554 2418, or Derek Hansen at dlhansen@gmail.com or 801 422 7467.

Questions about your Rights as a Research Participant: Please feel free to contact the IRB administrator at (801) 422-1461, A-285 ASB, Brigham Young University, Provo, UT 84602, irb@byu.edu.

Signature: _____

Date: _____



Implied Consent(Email sent to participants)

"My name is Dario Gonzalez, I am a graduate student at Brigham Young University and I am conducting this research under the supervision of Professor Derek Hansen, from the School of Technology. You are being invited to participate in this research study of Exergames and Motivation Using a Novel Mobile Application. I am interested in finding out about how games that use smartphones and fitness tracking influence physical activity and enjoyment.

Your participation in this study will require you to use a new Android app called FitPlay Games, which syncs with your Fitbit data. The app will capture the past 30 days of your Fitbit data (only steps counts), in order to compare your past physical activity with the activity when you use the app. All app data including fitness data, app usage, and chat messages will be captured and analyzed by the research team, though it will be aggregated and/or anonymized in any publications. If you consent to joining this research, you will be sent a link to download the application, which should take no more than 2 minutes to download and create an account. Once downloaded, you will be instructed to play two games over a 4 week period, each gameplay time lasting two weeks. The order in which you play them will be random. You can participate as much or as little as you see fit, but we don't imagine you spending more than an hour a day on the application. The games rely on step-count, and you can invite your friends to play with you. After finishing the the 4-week play time, you will be asked to complete a questionnaire, that should take approximately 10 minutes. Finally, some participants may be asked to participate in an interview or focus group after the 4 weeks period, which will take no more than an hour and 15 minutes. Such interviews and focus game will be recorded, only for study purposes, and will not be published or shared with anybody other than the research team. This study involves minimal risk to you. The benefits, however, may impact society by helping increase knowledge about-exercise games that use fitness tracker data.

You do not have to be in this study if you do not want to be. You do not have to answer any question that you do not want to answer for any reason. You may discontinue using the app at any time. We will be happy to answer any questions you have about this study. If you have further questions about this project or if you have a research-related problem you may contact myself, Dario Gonzalez at fitplayGames@gmail.com or 845 489 6836, or my advisor, Derek Hansen at dihansen@byu.edu or (801) 422-7467.

If you have any questions about your rights as a research participant you may contact the IRB Administrator at A-285 ASB, Brigham Young University, Provo, UT 84602; irb@byu.edu; (801) 422-1461. The IRB is a group of people who review research studies to protect the rights and welfare of research participants.

By replying "YES" to this email, you imply your consent to participate. Further instruction on how to download the application and how to participate will be sent by email.

Thank you!
The FitPlay Games Team



Audio Release Form

As part of this project, our team will be making audio recordings of our interviews and focus groups. Please indicate what uses of this video you are willing to permit, by initialing next to the uses you agree to and signing at the end. This choice is completely up to you to sign, or participate in the interviews and focus groups. Signing this doesn't mean that you are contracted to appear for focus groups or interviews. I will only use the video in the ways that you agree to. You will not be identified by name in these recordings.

Audio can be studied by the research team for use in the research project.

Audio can be used for scientific publications.

I have read the above descriptions and give my express written consent for the use of the video as indicated by my initials above.

Name (Printed): _____ Signature _____ Date: _____



DO YOU LOVE COMPETITION?

DO YOU HAVE AN ANDROID DEVICE
AND A FITBIT? IF SO...

Participants are needed in a research study to test out a fun new Android app, aiming to increase your activity level with a little friendly competition.



Email fitplaygames@gmail.com
to join in the fun!



APPENDIX B. SURVEY QUESTIONS

Appendix B contains images for all the questions and logical selection for the survey sent to all the participants. A detailed study of the gathered data is presented in section 5.2.

FitPlay Games

 This survey is currently LOCKED to prevent invalidation of collected responses. Please unlock your survey to make changes.

▼ Default Question Block

Q1 What is your FitPlay Games username?



Q2 On a scale of 1 (not at all fun) to 5 (extremely fun), how much fun did you have playing the Hot Potato mini game?



1

2

3

4

5

I didn't play Hot Potato mini game





Q3 What did you like the most about Hot Potato?



Q4 What would you change about Hot Potato?




Q5 On a scale of 1 (not at all fun) to 5 (extremely fun), how much fun did you have playing the Capture the Crown mini game?


 

1 2 3 4 5 I didn't play Capture the Crown mini game


Q6 What did you like the most about Capture the Crown?




Q7 What would you change about Capture the Crown?




Q8 Which game was your favorite?



Hot Potato
 Capture the Crown
 I liked them equally well

Display This Question:
 If Which game was your favorite? Hot Potato is Selected
Or Which game was your favorite? Capture the Crown is Selected

Q9 Why?



Q10 How likely are you to continue using FitPlay Games?

Q10



- Extremely likely
- Somewhat likely
- Neither likely nor unlikely
- Somewhat unlikely
- Extremely unlikely

Q11 How likely are you to recommend FitPlay Games to a friend or colleague?

Q11



- Extremely likely
- Somewhat likely
- Neither likely nor unlikely
- Somewhat unlikely
- Extremely unlikely

Display This Question:



- Or How likely are you to recommend FitPlay Games to a friend or colleague? Extremely likely is Selected
- Or How likely are you to recommend FitPlay Games to a friend or colleague? Somewhat likely is Selected
- Or How likely are you to recommend FitPlay Games to a friend or colleague? Neither likely nor unlikely is Selected
- Or How likely are you to recommend FitPlay Games to a friend or colleague? Somewhat unlikely is Selected
- Or How likely are you to recommend FitPlay Games to a friend or colleague? Extremely unlikely is Selected

Q12 Why?


Q12




Q13 What was the most appealing part of FitPlay Games? Why?


Q13



Q13 What was the most appealing part of FitPlay Games? Why?


Q14 What was the least appealing part of FitPlay Games? Why?




Q15 Do you have any suggestions for improving FitPlay Games?


Q16 Did you find the application easy to use?

 Extremely easy
 Somewhat easy
 Neither easy nor difficult
 Somewhat difficult
 Extremely difficult


Q17 How would you rate your overall satisfaction with FitPlay Games?

 Extremely satisfied
 Somewhat satisfied
 Neither satisfied nor unsatisfied
 Somewhat unsatisfied
 Extremely unsatisfied

Q18 Please indicate your level of satisfaction with the following attributes of the application.

	Extremely satisfied	Somewhat satisfied	Neither satisfied nor dissatisfied	Somewhat dissatisfied	Extremely dissatisfied
 Chat	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
 Leaderboards	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Notifications	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Fitbit Sync	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Profile Page	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Specific Game Pages	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q19 On average, how often did you "think" about the FitPlay Games you were currently playing while you were awake?


 Never

Only when you received a notification

Occasionally, even without a notification

Frequently, even without a notification

Q20 Did you play FitPlay Games for fun or exercise?


 Mainly for fun

Mainly for exercise

Both

Not sure

Q21 How did you play FitPlay Games?

 Mainly with existing friends

Mainly with strangers

Both

Q22 How has FitPlay Games affected your physical activity?

- Significantly increased activity
- Somewhat increased activity
- Did not change activity
- Somewhat decreased activity
- Significantly decreased activity

Display This Question:

- How has FitPlay Games affected your physical activity? Significantly increased activity Is Selected
- How has FitPlay Games affected your physical activity? Somewhat increased activity Is Selected
- How has FitPlay Games affected your physical activity? Did not change activity Is Selected
- How has FitPlay Games affected your physical activity? Somewhat decreased activity Is Selected
- How has FitPlay Games affected your physical activity? Significantly decreased activity Is Selected

Q23 Explain

Q24 At what physical exertion level did you typically play FitPlay Games?

- Light (no sweating or accelerated breathing)
- Moderate (some sweating and accelerated breathing)
- Vigorous (strong sweating and accelerated breathing)
- Cannot say

Q24 At what physical exertion level did you typically play FitPlay Games?

- Light (no sweating or accelerated breathing)
- Moderate (some sweating and accelerated breathing)
- Vigorous (strong sweating and accelerated breathing)
- Cannot say

Q25 Did FitPlay Games interrupt your daily life in any negative ways? If so, explain.

- Yes
- No

Display This Question:
If Did FitPlay Games interrupt your daily life in any negative ways? If so, explain. Yes is Selected

Q26 Explain

Q27 Did FitPlay Games change your behavior?

- Yes
- No

Display This Question:
If Did FitPlay Games change your behavior? Yes is Selected

Q28 Explain



Q29

How easy is it to interrupt your typical workday schedule to go on a spontaneous walk?



- Extremely easy
- Somewhat easy
- Neither easy nor hard
- Somewhat hard
- Extremely hard



Q30

How competitive do you consider yourself to be?



- Extremely competitive
- Very competitive
- Moderately competitive
- Slightly competitive
- Not at all competitive



Q31

On average, how many hours do you spend exercising in a typical week?



- Less than 1 hour
- Between 1 and 3 hours
- Between 3 and 5 hours
- Between 5 and 7 hours
- Between 7 and 9 hours
- More than 9 hours



Q32

For how long have you been using your Fitbit tracker?



- Less than 1 month
- 1 to 3 months
- 3 to 6 months
- 1 to 12 months
- 12 to 24 months
- More than 24 months

Q33: How often do you participate in Challenges in the regular Fitbit App?

- At least once a week
- 2-3 times a month
- once a month
- Less than once a month
- I've never played a Challenge.
- x I don't know

Display This Question:

- If How often do you participate in Challenges in the regular Fitbit App? At least once a week Is Selected
- Or How often do you participate in Challenges in the regular Fitbit App? 2-3 times a month Is Selected
- Or How often do you participate in Challenges in the regular Fitbit App? once a month Is Selected
- Or How often do you participate in Challenges in the regular Fitbit App? Less than once a month Is Selected

Q34: Which do you like better, Fitbit App challenges or FitPlay Games challenges? Why?



Q35

What is your current age? (U.S. Census)



- 18 or less
- 19 to 29
- 30 to 39
- 40 to 49
- 50 to 59
- 60+



Q36

What is your gender?



- Male
- Female



Q37

What is the highest level of education you have completed?



- Less than High School
- High School / GED
- Some College
- 2-year College Degree
- 4-year College Degree
- Masters Degree
- Doctoral Degree
- Professional Degree (JD, MD)

APPENDIX C. SESSION'S LENGTH DISTRIBUTION

The following table shows a detailed explanation of frequency of the application daily usage. More information and a more detailed data study is shown in Section 5.3.

<i>Date</i>	<i>Median Session Length</i>	<i>Total Time Spent in App</i>	<i>Avg. Session Length</i>
04/24/16	35 sec	1 hr 11 min 43 sec	55 sec
04/25/16	31 sec	2 hr 55 min 0 sec	54 sec
04/26/16	33 sec	3 hr 1 min 55 sec	54 sec
04/27/16	29 sec	1 hr 8 min 33 sec	43 sec
04/28/16	30 sec	1 hr 33 min 21 sec	50 sec
04/29/16	38 sec	30 min 30 sec	46 sec
04/30/16	46 sec	1 hr 6 min 58 sec	1 min 38 sec
05/01/16	20 sec	11 min 21 sec	48 sec
05/02/16	1 min 12 sec	2 hr 46 min 49 sec	2 min 33 sec
05/03/16	50 sec	1 hr 59 min 7 sec	1 min 12 sec
05/04/16	37 sec	50 min 33 sec	51 sec
05/05/16	26 sec	3 hr 8 min 31 sec	1 min 43 sec
05/06/16	29 sec	50 min 53 sec	45 sec
05/07/16	29 sec	32 min 22 sec	47 sec
05/08/16	28 sec	20 min 58 sec	44 sec
05/09/16	27 sec	33 min 28 sec	57 sec
05/10/16	36 sec	10 min 19 sec	44 sec
05/11/16	48 sec	16 min 31 sec	1 min 6 sec
05/12/16	20 sec	9 min 55 sec	28 sec
05/13/16	17 sec	6 min 32 sec	35 sec
05/14/16	23 sec	4 min 33 sec	34 sec
05/15/16	37 sec	5 min 24 sec	40 sec
05/16/16	31 sec	30 min 45 sec	49 sec
05/17/16	23 sec	13 min 30 sec	35 sec
05/18/16	36 sec	24 min 21 sec	52 sec
05/19/16	33 sec	5 min 33 sec	37 sec
05/20/16	33 sec	18 min 10 sec	1 min 12 sec
05/21/16	2 min 30 sec	25 min 11 sec	3 min 35 sec
05/22/16	1 min 0 sec	4 min 49 sec	48 sec
05/23/16	45 sec	8 min 9 sec	1 min 1 sec
05/24/16	20 sec	1 min 41 sec	25 sec
05/25/16	1 min 0 sec	8 min 17 sec	1 min 22 sec
05/26/16	30 sec	5 min 49 sec	58 sec
05/27/16	1 min 0 sec	9 min 55 sec	1 min 39 sec