Chapter 12
Leveraging Play to Promote Health Behavior Change: A Player Acceptance Study of a Health Game

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Abstract Games have become a prominent medium for empowering individuals to manage their health. However, the use of games for health behavior change remains largely understudied; little is known about the mechanisms through which games can effectively engage players or how such mechanisms can affect behavior change. This chapter presents *SpaPlay*—a game designed to motivate players to adopt healthy eating and exercising behaviors. To evaluate the effect of the mechanisms embed in *SpaPlay*, we conducted a mixed-methods study to assess acceptance and adoption of the game. Using game telemetry data and corroborating it with repeated and weekly participant interviews, we document the extent to which rewards to incentivize healthy eating and exercise in the game remained effective. Based on our findings from our study of *SpaPlay,* we also tackle several challenges that remain inherent to designing pervasive health games that can impact long-term motivation and persistence for sufficiently bringing about health behavior change.

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12.1 Games and Health: Opportunities and Challenges

Obesity is a persistent health epidemic, with less (or no) sustainable solutions in sight. Obesity imposes significant financial and health strain on individuals; it is one of the leading causes for several long-term health risks such as coronary heart disease, high blood pressure, or type 2 diabetes [1, 2]. Obesity-related annual healthcare costs have been estimated to be as high as $147 billion and at an individual level. This means, obese individuals tend to spend $1,429 more on healthcare annually than their non-obese peers [3, 4]. Largely, these rising trends are caused by persistent and life-long patterns of inactivity and sedentary lifestyle. For instance, the CDC reports that over 50 % of adult population do not meet even the rudimentary federal recommendations for aerobic activity or muscle strengthening [2]. In elderly individuals, the rates are even higher: over 70 % of older adults between ages 40 and 70 do not meet the requirements for physical activity. Hence, for any obesity-related intervention to remain successful, it ought to be able to sustain a longitudinal commitment towards healthier living. There is, thus, an increasing need to develop affordable and motivating technological interventions that can promote long-term engagement and also be integrable to individuals' life style. As such, recently, there has been a growing emphasis to design and implement solutions to help individuals to manage weight-gain and obesity, and to develop pervasive technologies that can facilitate and sustain long-term engagement in healthy eating and exercise.

12.1.1 Gamification and Long-Term Health Outcomes

While effectiveness of traditional behavioral interventions that can bring about sustainable health behavior change has yet to be determined, there is a great potential for digital games to become a compelling medium to motivate individuals to adopt healthier lifestyle. Considering the reach and popularity of health-based ubiquitous technologies—a recent Pew survey reports that the number of people using smartphones to manage or track personal health went up from 9 % in 2010 to 29 % in 2011 [5]—games can be compelling motivators to incentivize health behavior change. Based on the 2011 report by the Entertainment Software Association (ESA), 72 % of American households play computer or video games, with the rates of 18 % for individuals under 18 years old, 53 % for 18–48 years old, and 29 % for 50+ years old. Internet use and game playing have also been found to be associated, and it has been estimated that 64 % if adult users of the Internet also play video games [6]. This pervasiveness of online social games and social networking is manifested not only in the percentages of users playing games, but also in higher game retention and adherence among on-line players—i.e. a decisive majority of online gamers in the US (89 %) play Massive-Multiplayer-Online Games at least a few times a week [6].

Gamification approaches have already become popular among software vendors and are now being used to improve participant engagement in software products.

Gamification entails integration of game features (e.g., quests, points) into non-game software products in order to make them enjoyable and attractive [7–9]. According to Deterding and colleagues, "…video games are designed with the primary purpose of entertainment, and since they can demonstrably motivate players to engage with them with unparalleled intensity and duration, game elements should be able to make other, non-game products and services more enjoyable and engaging as well (2011)." In short, these researchers argue that games can be compelling motivators that can incentivize behavior change and thus, vouch for designing and studying innovative approaches to iteratively design *playful* experiences to enhance technologies developed to promote activities, such as eating, exercising, teaching and learning [7].

However, in the context of health, there has been limited research examining the potency of *gamification* techniques in effectively fostering healthier eating and exercise habits in individuals. The few research that has been conducted in this domain, has to a large extent, focused on new ways of framing theory of health behavior change in order to evaluate efficacy of health-based technologies. Studies argue that initiating and sustaining health behavior change through games and technologies entails designing technologies based on behavioral theories, such as addressing various stages of change as proposed by the Trans-Theoretical Model (TTM) of behavioral change [10] or the Goal-setting theories as well as addressing social and psychological influences on individuals' lives [11]. Additionally, they further argue that ubiquitous technologies impact behavior through "encroaching upon" individuals' personal as well as their social worlds [11]. Some other works include feature reviews that list design features like content catering to different personality types and multiple challenge levels in the game that can engage players in health-related activities [12]. Yet, none of these have attempted to empirically examine or investigate the impact of such gamification techniques on individuals' longitudinal health behavior change.

12.1.2 Research Questions and Objectives

In this chapter, we present key findings from a research study investigating players' participation, motivation, and adherence to a health-based social media and game environment—*SpaPlay*. *SpaPlay* was designed to promote healthy eating and exercise habits through integration of game-related and real-life activities. We posit that characterizing player motivation and engagement, is an important first step towards developing intervention mechanisms through games that can have a persistent impact on players' health-related behaviors. We adopted a mixed-methods approach, making use of game telemetry data to formulate follow-up interview questions and investigate specific design metrics of the game. In other words, we sought to understand how and to what extent do the game mechanics in *SpaPlay* impact the way participants make choices about food or physical activity in their daily routine? And, finally what makes the participants care about the game and to what extent might SpaPlay have the potential to permeate players overall living style?

12.2 Previous Research in Games and Health-Behavior Change

There are several products (mostly, commercial) that use game elements and real-time tracking for behavior change. These products are designed to increase (a) exercise through exergaming or through tracking of behavior (b) awareness about nutrition and (c) exercise through social networks or gaming. Below we review each of these techniques.

12.2.1 Exercise Through Exergaming

The major principle of Exergaming is to include motion-sensing devices to track movement (e.g., patterns and intensity of activity) and, through positive feedback, motivate players to exert themselves physically. As an example, a user may see a simulated virtual representation of themselves (an Avatar) or a part of themselves (tracked limbs) that reflects real-time movements (e.g., dancing, jumping, stretching etc.). Some popular examples include Nintendo's Wii Fit and Wii Sport for golfing, skiing, running, Zumba for dancing, My Weight Loss Coach and Pokémon HeartGold for walking. Again, studies about exergames show that, through avatar representation and visual display of ongoing real-time activity, players are motivated to engage in physical activity for a longer play session [13, 14] (O'Donovan and Hussey 2012). Further, Song et al. [13] found that the use of avatars is especially beneficial for players with lower body image. One of the core limitations with these types of studies is that they make an inherently limited assumption about health behavior change, thereby only focusing on the immediacy of the activity, how much calories they tend to burn and which game design metrics help promote player engagement within the scope of a play session. While these studies are useful to refine the technological sophistication in videogames and how sensitive they can get to players' needs, they remain challenged in being able to measure the impact of the game on longitudinal health outcomes. In short, while effectiveness of exergames in a single session is encouraging, less is known about adoption of these games and their long-term impacts.

12.2.2 Games to Increase Awareness About Nutrition

When it comes to persistent behaviors related to nutrition, several studies have investigated the efficacy of games in bringing behavior change through empowering participants with information via stories in the game [15–17]. In an in-depth case study, [18] has argued that certain eating habits like selective preference in food that persist for years, are hard to change and posits that simplistic behaviorist techniques, like reinforcement when used in isolation remain ineffective in

bringing about behavior change. Rather, a game-based approach is more likely to be effective, particularly in cases where the reason for chronic refusal of certain foods is related to the child trying to establish control and independence. Similarly, a wide-scale study with 241 subjects Amaro et al. (2006) found that an experimental group of 153 children who played a game designed for encouraging healthy eating, showed a significant increase in their knowledge about nutrition ($p < 0.05$) and in their weekly intake of vegetables ($p < 0.01$) compared to the control group with 88 children. Similarly, Thompson et al. (2010) developed and investigated the efficacy of DIAB, an adventure game that sought to increase awareness about different food choices and physical activity by presenting moral dilemmas to the players through the game narrative, whereby the players learn about right and wrong choices for the body (Thompson et al. 2010). Again, this study does not report on measures of efficacy, as much as it advocates for certain theories for behavior change that fit better with health games. In short, such studies, in some fashion, narrativize content or health information and argue that through empowering users with knowledge about right and wrong health choices will allow them to eventually adopt these practices in real-life [15]. Through documenting findings from the player acceptance study of *SpaPlay*, we seek to leverage several of these principles, while also evaluating the efficacy of how well these practices get imbibed in players' lives outside of the game.

12.2.3 Gamification and Persuasive Games

Health behavior change is a complex mechanism that entails more nuanced understanding of individuals' motivation and perceptions about health (Bogost 2007). Thus, evaluating the efficacy of design in health games may become exceedingly limiting if behavior change is tackled within a narrower notion of the intervention [19]. Few research projects within games and health conceptualize health-behavior change as an ongoing and a life-long process for personal health improvement and list out some key aspects in health devices that can improve player adherence. Features, like goal-setting, tracking and monitoring of goals, varying forms of feedback for performance (participatory and individualized) and determining the right balance between goal time frames with individuals' existing routine are critical for designing effective and compelling games-based health systems [11, 20, 21].

12.2.4 Games and Health-Related Social Behavior

Finally, a crucial aspect in gaming that has yet to be explored in the context of health games is social behavior and its influence on health behavior change. Several recent studies point that choices related to food, exercise and even chronic cases of obesity spread through friendship-based or other social

networks of individuals [22–24]. These studies argue that *social capital* or an affiliation with a specific social circle, frequency of socialization and level of participation in clubs or associations impact individuals' choices of and trust on sources of information related to health [25]. Social support is also a key determinant of how likely an individual is to seek treatment for an ailment [26] and how well individuals adhere to exercise and nutritional eating habits 27. However, most of these works have been predictors of human behavior related to health in non-game contexts and to our knowledge, not much has been done to exploit social affiliation within games to promote healthy lifestyle choices. In this chapter we also focus on *social dimensions of play* as a critical component that can further improve adherence and "buy-in" for players to engage in the game for longer periods in their lives.

12.3 Study Design

In this section we briefly review the major components of the game, *SpaPlay* and the design of the study.

12.3.1 SpaPlay: The Game and Core Design Principles

Three years ago we formed a collaboration with the game company IgnitePlay. This collaboration was formed to develop and evaluate a social game environment called *SpaPlay* [28]. *SpaPlay* is an online social media environment, where players build and run a virtual "health spa resort." The growth and success of the virtual spa is tied to health-based activities that players undertake in real life. Examples of activities include choosing a healthy snack, including vegetables in a diet, climbing stairs and walking. Real-life activities are subdivided into quests, which are longer chain of activities (e.g., get down one stop before your destination and walk to work, for 4 days in a week) and sparks, which are short and immediate activities (e.g., step away from your desk and stretch for 5 min). Further, the game also has an on-line community of fellow players that can collaborate on mutual activities or compete against each other. All player activities are tracked.

SpaPlay was built under the theoretical principles of Self-Determination Theory (SDT). SDT postulates that human motivation is largely guided by three basic psychological needs: autonomy, competence, and relatedness (29–31). To reflect these principles, *SpaPlay* fosters healthy eating and physical activity through empowering players to manage their day-to-day quests (autonomy), rewards regularity and self-initiated challenges in game quests (competence), and incorporates activities that necessitate intrinsic motivation in day-to-day tasks (relatedness). Further, the game also incorporates some of the motivators deemed critical in Social Cognitive Theories (SCT) for health-behavior change, through

Fig. 12.1 Screenshots of the spa island in the game

appraisal feedback, affirmation, and just-in-time instrumental support [32]. Below we briefly discuss some of the game features.

12.3.2 The Virtual Island

Spa Play is a virtual spa game (see Fig. 12.1), in which players maintain a virtual island or a health spa. In order to maintain the rating of the spa, players do certain routine island-related activities, such as cleaning the running tracks, harvesting fruits from the trees, in addition to accruing points to unlock more game content by doing real-life physical activities and making healthy eating choices. The game play consists of maintaining this virtual island by doing *sparks* or *quests*, which reward the player with points that affects player leveling, provides currency to unlock new game content and improves the resort's overall star-rating. In addition, players accrue points to unlock game content by doing real-life activities related to exercise and healthy eating required by sparks and quests in the game. Table 12.1 presents a description of activities and their intended purpose.

The following presents a short description of each of the gaming activities that can be done by a player in the virtual island, each one of these activities is linked to a game design principle that is used to increase player retention and enhance behavior change.

12.3.3 Sparks

Sparks (see Fig. 12.2) can be thought of as real-time actions in the game that entail doing activities in short bursts, some of which are related to exercise, eating and drinking, and others that are related to tasks in the game world, such as solving a word puzzle. The design intent was to encourage players to develop fondness towards some of the gaming activities, in short bursts, while adding *playfulness* to ordinary or day-to-day physical activities, such as walking till the next bus stop, taking an extra flight of stairs etc.

Table 12.1 Implemented motivational components of Spa play

Motivation tactic	Player actions	Impact on the game
Positive reinforcement	Health activities completed in quests and sparks (described in further detail below) mini games played Spa maintenance activities done, such as cleaning virtual environment	In-game rewards (experience points XP, increase in Spa rating, unlocking of areas and activities) out-of-game rewards (coupons to stores)
Negative reinforcement	Spa is neglected when a participant doesn't login for a while or hasn't done sparks or quests	Decrease in Spa rating
Intrinsic motivation/autonomy	Ability to select ways to earn rewards through games, virtual world cleaning, variety of quests and sparks that include many eating or physical exercise activities	Different rewards traded in for new game content
Visual feedback/competence	Choose from several visualizations of comparative performance of participants' progress against their friends or community Customize of game content (see below)	Changes in the appearance of the Spa, customized visualizations for showing performance
Social activities/relatedness	Ability to add friends and messages	Increase in cooperative and competitive activities

Fig. 12.2 Spark and quest interfaces

12.3.4 Quests

Quests are a thematic grouping of several tasks that typically take somewhere between a few days to a week to be completed. Example quests include, beginner training for biking, or planning a healthy meal outside with a friend. Quests take

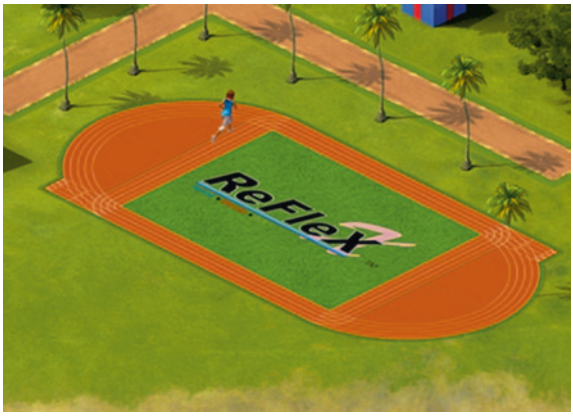

Fig. 12.3 Avatar on running track in the game in response to data from pedometer

longer than sparks to complete, while they also reward more experience points. Players can track progress of their quests. Unlike, other similar commercial adventure or role-playing games (e.g. *World of Warcraft* or *Runescape*) quests in *Spa Play* cannot be shared. However, quest sharing is feigned through providing feedback on players' progress, showing quests that have been completed by their peers t and through offering options to finish a quest with a friend for earning additional experience points. Both *spark*s and quests are recurrent, repetitive activities that reward players with experience points to unlock new content for the island that improves the aesthetics of players' resort and its rating. Upon logging into the game, the game shows interesting statistical snapshots pertinent to player activity and progress in the game, such as showing how many *spark*s and quests they did the past week, each day, sparks done recently, and so on so forth. In short, the game is designed such that players may find motivation in being able to track what they did in the game [21, 33], while also finding the virtual island to be an appealing and persistent space to spend time in, maintain it and improve its aesthetics and rating (for example, see Figs. 12.2 and 12.3).

12.3.5 Player Profile Visualization and Real-Time Feedback from Activity Sensors

The game provides an elaborate interface for players to monitor their activity in the game. Several representations for feedback were designed as extrinsic rewards for intrinsically appealing activities. For instance, in-game material rewards are earned through completion of real-life activities. Continued feedbacks are also featured in forms of meaningful comparisons, using in-game material reward in addition to conventional charts or graphs (see Fig. 12.4). In all, the user profile visualizations sought to design a playful experience in self-monitoring and goal tracking activities. In addition, certain in-game events are triggered and driven by real-time data gathered by activity sensors. For instance, Fig. 12.3 is an image of an in-game running

Fig. 12.4 Player screenshots that show virtual rewards like *rainbow*, *flowers* used to decorate the island. The *chart* shows player progress in game in relation to other players

track with an NPC running. The amount of pedometer activity tracked by external activity sensors makes in-game NPCs to populate and run on the running track in the game—again, one of the many examples of the way in which the design is such that real-life activity improves the aesthetic appeal of the island; something akin to other similar social games, like *Farmville*, except that in the case of *SpaPlay*, rewards are earned mostly through doing exercise and eating nutritious food.

12.3.6 Social Play

Several studies also show that individuals' decisions about health, eating and exercising are influenced by their friendship-based and social networks [7, 22, 34, 35]. Thus, Spa Play incorporates friendship-networks through providing visualizations for player progress and tracking of individuals' and their peers' quests. For future development, the game seeks to leverage players' affiliation to their social and friendship circle in the game and their frequency of socialization (i.e. quests done with friends, use of visualization for comparisons, etc.) in making individually profiled recommendation for sparks and quests. Spa Play provides incentives for adding friends through different game mechanics. For instance, competition is promoted by providing comparative statistical visualization, while completing quest with a friend earns more rewards, thereby encouraging collaborative play (outside of the game). *SpaPlay* is not a multiplayer gaming platform; however, it provides multi-player in-game interfaces for interactions with other players via real-time chat and visualization of activities of players and their in-game social networks.

12.3.7 Participant Recruitment and Interviewing Methods

In spring of 2013, we designed and conducted a 45-day study to investigate acceptance of the health game—*SpaPlay*. The objectives of the pilot was to investigate how players perceived the game, which game design features and gameplay

mechanics resonated the most with players, and to what extent did the game remain successful in relating to participants' daily regimen related to nutrition and physical activity. 18 undergraduate students participated in the study. Following an informed consent, participants filled out a baseline questionnaire that assessed their levels of physical activity, gaming and eating behaviors. All participants received instructions on accessing the game and were encouraged to play on a daily basis for a month. In-person interviews were conducted, once a week. Because of the semester break and scheduling difficulties, the study ran for the total period of 45 days. 16 out of 18 (88.88 %) participants played videogames at least 4–5 days a week.

6 out of 18 (22.22 %), reported exercising at a high intensity (i.e. breathing fast and cannot keep up with conversations; e.g. running, biking, playing soccer etc.) everyday or at least 4–5 times a week, while 10 of them (55.55 %) reported exercising hardly ever (or once a week). 2 out of 18 reported eating 3–6 servings of fruits and vegetables everyday, while the remaining (16 participants or 88.88 %) said they consumed 1 serving of fruits or vegetables everyday. In short, most the 18 participants (with a very few exceptions) seem to show an overall lack of attention to healthy eating and exercising routines in their daily regimen.

12.3.8 Game telemetry and Individualized In-Person Interviews

All players' interaction with the game was recorded in real time and is referred to as "game telemetry" [36]. We collected game telemetry data, which are player logs indicating player actions that are time-stamped (i.e. what players did or clicked and when it occured). These logs gave us indicators for what players did over time, including their login and out, the number and frequency of activities they did when they were logged in, number of quests and sparks they completed so on and so forth. The game telemetry was queried and the gameplay data was visualized for basic gaming activities, such as player leveling patterns, or quest completion times and frequencies (see Fig. 12.5). Such data, sometimes, gives a clearer sense of play patterns and activities, however, as mentioned by many researchers in El-Nasr et al. [36] it does not give us an indication of why players engage in certain activities and why they did not. In order to obtain a better context for the in-game telemetry data, we also conducted weekly 15-20 minute interviews with the participants of the study.

12.3.9 Telemetry-Based Individualized Interviews

A unique aspect in the methodology we used was formative and recurrent interviews that were customized for each player, weekly. Participants were interviewed after each week of game play. In this interview, the researcher asked them

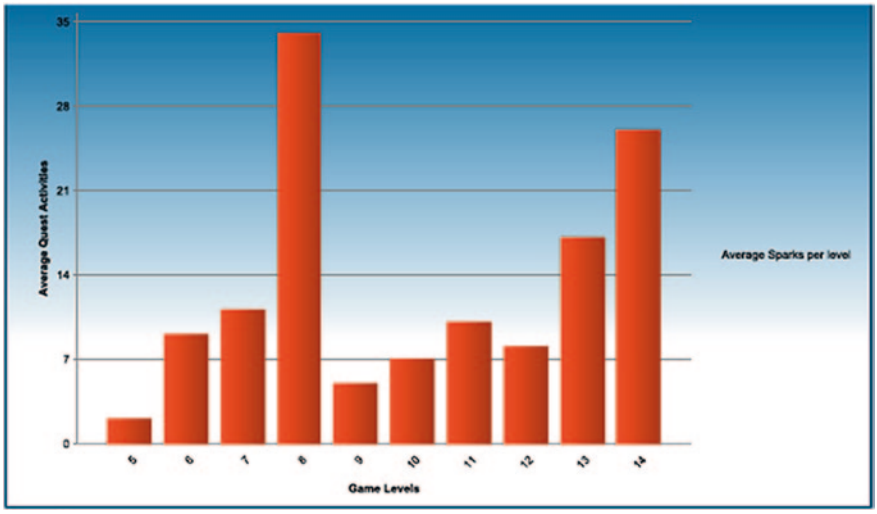

Fig. 12.5 Average number of quest activities amounting to XP at each level for all 18 players

about their impressions of the game. Our objective is to understand how useful or impactful players perceived the game metrics, and thus we sought recurrent in-depth game and play style characterizations in players descriptions of the game [37]. We used gameplay telemetry data that was visualized dynamically after each session to give us a clear indication of some of the play patterns. This data was then used to customize the interview questions for each player. We used three kinds of game-play characteristics to customize the interviews—player's leveling-up patterns, player's quest completion frequencies, and player's *spark* activity frequency. Interview questions were then modified according to how steep or progressive player's levelling-up has been, so as to encourage player responses that were relatable to their style of play and enthusiasm for the game. For instance, in cases where the player showed steady progression, some of the questions that were asked included: "do you think the game encourages you to explore new things or try new activities? How? If not, why?" Alternatively, players whose progression indicated steep increase in certain quests were questioned about the said spark or quest that they did most. For instance, questions such as, "what did you like about the spark—'use one slice of bread for sandwich'?" prompted participants to narrate what they perceived of healthy eating.

12.4 Findings

Overall, the key objectives of the study were to examine if the rewarding mechanics worked, to what extent did the game mechanics provide enough of an incentive for players to care about persisting in non-gaming activities, such

as exercise or eating and, whether players were more keen on lingering in the virtual space, playing puzzles and other recreational games in the virtual spa. By doing so, we sought to provide prototypical caricatures of play in *SpaPlay* that helped determine the salient game metrics that are being captured by the telemetry, what they mean and how we might be able to study them in a larger scale (i.e. for future implementations of building automated interfaces that will infer simple patterns of play in a large set of data to help refine design). The findings section is divided into three broad categories based upon the gameplay mechanics and game features that are core to *SpaPlay*—Quests, Sparks and Perceptions about Game Island. Under each group, we report on quantitative findings from the game telemetry and complement it with emergent interview themes to help interpret what these findings mean.

12.4.1 Patterns Observed within Quests Completed by Participants

Using game telemetry data, the average of quest activities for all players was charted at each level. Figure 12.5 shows the distribution of experience points earned cumulatively at each level, totaled for all the 18 players in the study. As we can note, the experience points earned at earlier levels (like level 7 or 8) is higher and for latter levels the experience points tapered down. We inferred that the longer the players stayed in the game they seemed to level mostly through sparks, and explore fewer quests. A comparative distribution is presented in Fig. 12.6 showing leveling pattern with respect to sparks. As can be seen, and also explained again, players in the latter levels (like 13 or 15) earned most points through short-activities, or *sparks*, instead of longer, more planned *questing*.

In total, the average quest completion for all the players was found to be 18.8 (s.d. = 9.67, n = 505). Table 12.2 shows the breakdown of quests related to eating, physical activity and quests based on activities tending to the virtual island (like clearing the trash, harvesting, etc.).

Distribution of all the 505 quest-related activities completed by the players are listed in Table 12.2, grouped under food-related, physical activity-related or game-related. Food and physical activity related are self-explanatory. Game related quests were the ones that entailed completing certain tasks pertinent to the virtual island. Some examples of game-related quests include, “level till 7 to unlock banana trees”, “harvest bananas”, “visit the yoga studio”, “find and visit the community lounge” and so on. Players spent a significant amount of time doing recurrent game activities that impacted their resort rating.

In addition, quest completion break down indicated that food-related quests were less frequently completed. Upon excerpting the interviews, we found that customization of quests based upon participant profile is crucial for player adherence to quests. Because the participants in this study were undergraduates, completing food related quests, such as following food recipes (e.g. Make

Table 12.2 Quest distribution

Quest related to	Number of times completed
Food	100 (19.8 %)
Physical activity	202 (40.0 %)
Game island	203 (40.19 %)

Cauliflower Mash) required more preparation, and hence were less likely to be picked up by the participants. At the same time quests that required minor adaptations with participants' lifestyles were more frequently picked up. Some of these quests include "Tame the Sugar Monster" quest that entails drinking water instead of sugary drinks for a week or "Eating out Healthy Portions" quest that entails eating half of a standard restaurant portion for a meal or packing ½ of it for later for a week.

12.4.2 Patterns Observed within Sparks Completed by Participants

Similarly, using game telemetry data, the average of spark activities for all players was charted at each level (see Fig. 12.6). The experience point distribution show that players completed fewer sparks in earlier levels, but mostly sparks in latter levels, as sparks became the most favored activity. We confirmed this through interviews as well.

Overall, sparks remained more popular than the quests. Sparks were found to be done at an average of 54.04 times (s.d. 70, range 0–80), and within 1 s.d. point from the mean, the 2 most popular sparks related to physical activity were "Lifting weights for 5 min", "Walk 10 min or walk with a friend" and "Ankle Rolls repeat 5 times". A more detailed break down of activity distribution along sparks has been included as an appendix (Appendix 1) at the end of the document. Similarly, the food related sparks were "Use 1 Slice of Bread for Sandwich" and "Eat ¼ Less for One Meal" and the 2 most popular sparks related to the game island were "Harvest bananas" and "Picking up Trash". On the other hand, sparks that rewarded playing mini games, such as puzzle games were less popular when compared to recurrent game-world activities, such as keeping your resort clean. In addition, we also found that game experience points from quests tapered as players progressed to higher levels, while experience points from sparks spiked as players progressed to higher levels in the game. In short, by comparing distributions from players *questing* and *sparking* activities (compare charts in Figs. 12.5 and 12.6), and through interviews we concluded that exploration in the earlier levels with quests or planned activities, like following a healthy recipe and preparing a new dish, tapered down to short-burst activities, like taking the stairs every now and then.

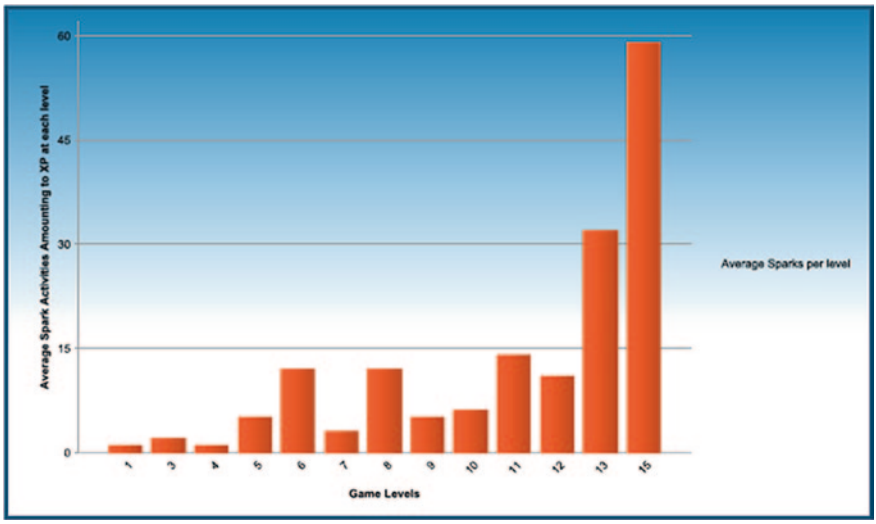

Fig. 12.6 Average number of spark activities amounting to XP at each level for all 18 players

12.4.3 Distribution of Player Game Activity

We also plotted frequency of player activity for each day of the study Figs. 12.7, 12.8 and 12.9 depict the distribution of *quests*, *sparks* and a comparison between the two respectively. As can be seen below the patterns of spark and quest distribution remain similar, while the levels of sparks remain higher than quests as can be seen in the line chart in Fig. 12.9.

This finding aligns with the leveling pattern for players (charts in Figs. 12.5 and 12.6), i.e. for the most part players tended to do more sparks, instead of planned quests, which suggested that after gaining a certain level of comfort with the game, players were less inclined to explore or continue doing goal-oriented tasks in the game. In other words, as players leveled higher, they seemed to repeat activities they normally tended to do and simply use the game as a checklist to level up with experience points accumulated through activities they did normally outside of the game.

12.4.4 Emergent Themes from Interviews and How they Explain Patterns from Game Telemetry

12.4.4.1 Importance of Being 'Honest' in the Game

One of the unanimous observations about the game made by the participants was the fact that the game relies on an "*honor code*". 17 out of 18 players ascribed to the fact that because this game is based on an honor-system and it felt like

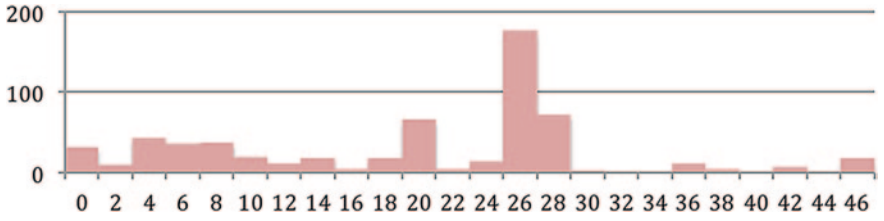

Fig. 12.7 Frequency of Quests for all players (n = 18) for each day of the activity

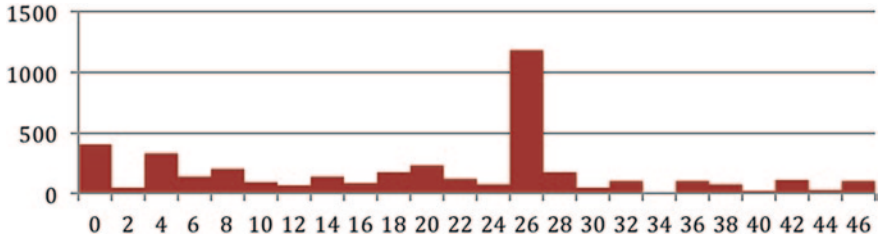

Fig. 12.8 Frequency of Sparks for all players (n = 18) for each day of the activity

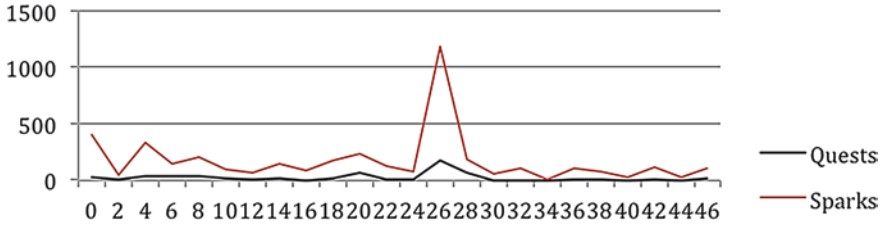

Fig. 12.9 Distribution of Sparks and Quests during the length of the study

cheating if they merely leveled-up in the game without actually doing the physical or food related activities, and instead, doing the island related activities, like cleaning the resort, harvesting the fruits etc to level-up. For instance, in the following excerpt, participant-005 uses the word 'honest' to describe his commitment to the game play.

> Participant-005: "I've been on the game at least once every day I think. I've done some of the activities, but sometimes they feel all redundant. But because, uh, I tried to keep myself **honest**—actually follow what they said to do in sparks, I tried to go on and update regularly"

12.4.4.2 Players Repeated only Those Tasks in Game that Fit Their Existing Routine

While the game was designed as a real-time activity tracker, with most of the activity *sparks* expected to be completed by the players when they were logged into the game, participants in the study used the game as an end-of-the-day

checklist, checking from the choice of *sparks* in the game to denote that they had completed these activities during the day. As a result, the use of *quests* became less useful for the players. Consolvo et al. [21], note that in efficacy of use or the *stickiness* of a pervasive health technology tends to highly improve when users are empowered to set their own goals, track them and receive feedback on the progress they make. In other words, goal setting seems to be an important trigger for motivation in health games. However, through this study we found that *routinizing* seem to take precedence over planning and setting long-term goal. For instance, in the following excerpt the participant describes why and how repetitive tasks were useful, especially when they were aligned with his existing routine despite finding some of them somewhat redundant.

> Interviewer: What would you say that is most appealing to you in this game?
>
> Participant-005: I think that is a really good idea. Just because it is really hard to measure actually doing progressive healthy things, so the fact that they [the game] actually have a delimiter for doing x-amount of healthy things is a great idea.
>
> I've done some of the activities, but then some of them seem to get redundant. I did them in a way that I could incorporate them into my **daily routine** better. So I picked the stairs one a lot because I live on the 4th floor. Going from the lowest one to the top one is like, almost impossible. But because there is this spark, I've tended to take them more.

Similarly, another player tried to incorporate the *sparks* as a way to continue some of their existing practices. In a way the game seemed to make players pay attention to the health-related choices they were making everyday. For instance in the following the player explains how she would play the game at the end of the day, spending time in the virtual island, tending to island-related activities and "check off" activities she may have done during the day. This helped her stick with her existing routine, while increasing her awareness about those activities during the day.

> Interviewer: Could you walk me through what you'd start doing when you log in the game?
>
> Participant-004: Yeah. So I log in, gather the coins and experience points you get for cleaning the resort and harvesting the banana trees; I'd get my runners [refers to the NPCs in the game] going and then I'll log any sparks that I did that day and then I'll usually play around for 15–20 min with the mini-games, like the word-runner puzzle game.
>
> Interviewer: When do you typically log in?
>
> Participant-004: I report the sparks at the end of the day. I can't log in during the middle of the day and so I go in at the end of the day. And they end up being the same ones every day. Because typically in the morning I'll take the bus to work, but like every day I'm able to check off the "get of one stop earlier one". That's something I did with my old job. Actually at that job I used get off like half a mile early and walk the rest of the way. Because that is something that I just kept up with in this job, everyday I can check off this spark.

In addition, existing routine far-outweighed the novelty in a spark or quest content. For instance in the following exchange, participant-002 reveals why he was interested in doing the sparks that he did.

> Interviewer: Was there a favorite spark you had, that you ran across? or one that may be you felt is missing?
>
> Participant-002: I wouldn't say that I found missing. some of the ones I like are the ones that just like—"you don't necessarily need to eat more or less of whatever, or

> exercise more or less of whatever". It's just, uhm, doing the same things you would do in a different way. Like, "eating dinner with a smaller plate", or "eating with your non-dominant hand" that kinds thing. That's just sort of like keeping up with your normal routine, but in a different way.

In this above exchange, participant-002 reveals points to an aspect of the game he particularly relates to positively, which is the game encourages small changes that are possibly an improvement on what one may normally follow as a part of their existing routine.

In comparison participant-004 in the following exchange finds the recipe-based quests that require more planning would work really well when they aligned to her weekly grocery shopping patterns.

> Participant-004: There are some quests that require, like more preparation on my part, which I haven't looked into and I would like to. Like some of the quests have to do with going out to eat, or cooking a certain way. But I can't complete those, because I haven't gone grocery shopping. But if I actually grocery shop, I would really want to start making these changes.

12.4.4.3 Player Perception on Rewarding Mechanisms

The game also seemed to impact player motivation through a negative reinforcement schedule. For instance, if the player logs in less frequently, the resort rating drops, and also poorly affects the aesthetic of the island—the island accumulates trash in certain parts, for instance. Some of these game mechanics that were recurrent and repetitive, but impacted negatively if the player failed to continue to do them seem to be a big motivator for the player to continue to come back. In one of the participant's own words—

> So, I think right now I am at level 12. I like where you kind of pick up trash to clean up your park, and I got the banana trees. I like that now there is more content [in the game], more of an incentive for me to log on more often and check. 'cause if I don't clean the trash up my resort rating drops to like 1–2 star or something

12.5 Discussion

In this chapter, we provide a detailed overview of the design considerations and some of the strategies that went into devising the reward mechanisms and activities that can sufficiently "infiltrate" players lifestyle [21]. Through a month and a half study investigating the game's acceptance, we noted several salient findings regarding efficacy of the design of reward systems in *SpaPlay*, overall patterns of activity in the game and player motivation to continue playing *SpaPlay.* First, in terms of game mechanics, both *quests* and *sparks* seemed to remain fairly relatable to participants. As the findings suggest, rewards for repetitive activities was something that was of value to players in this study.

Players' propensity to set goals—something that several other studies on ubiquitous technologies for health have also argued about—is an important metric for success of pervasive technologies, albeit this is a complex aspect of design. In *SpaPlay*, because the game actions for leveling up are much open-ended, players were more likely to repeat actions that seemed to align with their existing routine. However, the activity patterns did indicate that soon, players become comfortable with a narrower set of routines and continue to use those as their primary actions in the game to level up or progress in the game. As has been accounted for earlier, in the initial levels of the game, players accumulated most of the experience points from questing activities that required more prior planning, whereas, in comparison to later levels, most of the leveling was through sparks or short-burst, instantaneous activities. This led us to infer that players start exploring elaborate quests, but once they find a narrow set of activities they find suited to their lifestyle, use them as the primary means to progress in the game.

Second, we also found that recurrent *grinding* activities, such as keeping the resort clean, and experience points that kept opening new game content to improve the aesthetics of the virtual island were strong motivators for players to continue to log in their daily eating choices and physical activities. The game in its current state remains limited in its capacity to incentivize "exploration", or give players the extra push to do new activities.

Third, we also found that adherence to games like *SpaPlay* is more likely to improve if the content of the game lends to adoption into the daily fabric of participants' life, and hence, could greatly benefit from *adaptive messaging* or profile-based game content [38, 39]. For instance, findings from the current work indicate that an open-ended gaming environment remains well suited for catering to a spectrum of participant profiles, offering participants with choices they could stick to in their routine. However, this means improving personalization and customizability of game content. For instance, one of the findings from the breakdown of quest content is that this particular group of participants completed the food-related quests which required more effort with much less frequency, e.g., recipe based quests. Nonetheless, participants did seem to be interested in doing recipe related quests if they had been more aligned with their living style, such as leaving longer time frame for completion so that they had time to prepare. In short, while we found that the quest content in *SpaPlay* were relatable to the players and had the potential to generate player interest, varying and adding new quests also makes the game a moving target—complex system with inter-related and changing variables. Thus, an instrumented game provided both researchers and designers an interface to experiment with inventive approaches that can continue to influence player activities outside of the game [40].

Finally, open-ended gaming systems for health, like *SpaPlay,* face a complex design challenge in terms of customizability. As can be seen from the findings reported in this chapter, players tended to repurpose the game to suit their existing needs. What this implies is that while the game has a promise to bring about and

strengthen a sense of awareness towards day-to-day healthy routines, we also want to be cautious of the risk of monotony (e.g. players sticking to sparks instead of elaborate quests, at higher levels). In some ways, success for games like *SpaPlay* is contingent upon the "buy-in" that the players can relate to [41] in order to feel encouraged to look at the "other" healthy things they could be doing in the game. Players described their participation in terms of "reporting back to the game" and "keeping oneself honest". Such findings seem to suggest that while experimental techniques play a role in evaluating the health benefits from participation in health games in the immediate run, much like testing a feature or the impact of a technology, theory-driven approaches are needed to better depict longitudinal health-behavior change [11]. As [42] has, elsewhere, argued that there is a need for a health lifestyle theory and that when it comes to health behavior change, structural dimensions of daily lifestyle significantly impact health outcomes. When designing sustainable technologies for longitudinal health benefits, it is critical that "collective patterns of health-related behavior based on choices from options available to people" ([42], p. 55) be studied so as to leverage technology to influence some of these patterns. Our study, thus far, seems to suggest that open ended and flexible platforms, like *SpaPlay* have the potential to give designers the tools necessary to progressively modify design metrics so as to suit players' collective patterns of health-related behavior.

12.6 Conclusions and Implications for Future Work

Research in health and personal health management have changed in crucial ways, particularly moving away from a diagnostic and an interventionist models to designing formative, feedback-oriented and longitudinal models for long-term health behavior change. When it comes to designing tools to sustain player adherence in activities related to health, it is important that we understand how and to what extent rewards and incentives in the game are *persuasive* and compelling to entice players in adhering to the game over time; in the case of *SpaPlay* adherence constitutes performing sparks and quests related to physical activity and eating. In conclusion, some of the implications for future work involve refining the design metrics that can improve adherence in ways that can push players to go beyond their existing lifestyle choices. In addition, because the work presented in this chapter is largely descriptive, our ongoing efforts are in the direction of designing tools, like visual querying interface to observe players' collective health-behavior, which can facilitate decision-making at the designers end to include or leave out certain game content.

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