Leveraging Play in Health-Based Games to Promote Sustained Behavior Change in Healthy Eating and Exercise

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ABSTRACT

Games have increasingly become a prominent medium in the area of personal health and are uniquely positioned to empower and engage individuals in managing their own health. However, an important area of challenge in this, still nascent, field of study is the lack of empirical studies of games developed specifically to promote health and examining their effects on an individual's motivation to change and on health-behavior outcomes. In this paper, we present key findings from an exploratory research study investigating players' motivation and adoption of a health-based social media and game environment entitled — *Spa Play™*. We used a mixed methods approach leveraging game telemetry and interview methods to investigate acceptability of the game. Overall, our findings indicate that *Spa Play™* was accepted by all players and had a potential to integrate into players' lives and motivate a health behavior change.

Keywords

Game Analytics, Player Motivation, Health-based games, Behavior Change, Social Network Analysis

BACKGROUND

Obesity trends and prevalence of chronic ailments related to unhealthy weight gain have been on the rise over the last two decades. The Center for Disease Control and the United States department of health and human services report that obesity and unhealthy weight gain have continued to increase since the late 1980s and that percentages for obesity have gone up among all age groups between 1988-1994 and 2009-2012. Over that time period, childhood obesity increased from 7% to 12%, adolescent obesity increased from 11% to 18%, and grade 1 obesity among adults increased from 14% to 20% (Sebelius, Frieden, & Sondik, 2011). Reports on obesity attribute these rising trends to longitudinal and persistent patterns of inactivity and sedentary living of individuals, reporting that over 50% of adults above 18 years of age meet neither the aerobic activity nor the muscle

strengthening physical activity federal guidelines. The percent of inactive adults among 40-70 year olds further increases to over 70%. It is no surprise that obesity-related health care costs, estimated to average around $147 billion annually (Finkelstein et al. 2009), continue to burden the United States' annual healthcare budget. Many of the health problems related to obesity manifest as long-term effects of poor lifestyle choices. As such, much of the recent focus of research in the field of health care has been geared towards determining holistic approaches for studying and designing sustainable socio-technical systems that can potentially motivate individuals to make healthy lifestyle choices in the long term (Atem, Sharma, & Anderson, 2011; Loureiro & Nagya, 2006; John, Loewenstein, & Volpp, 2012).

Games have risen to prominence in recent years as effective and compelling media to motivate individuals to adopt healthier lifestyles. Research and design of games and interactive media targets several of these complex and highly interconnected health challenges from technological and theoretical sides. Games have become ubiquitous in the field of health, in terms of sheer popularity and social presence. Pew's 2011 study reports that the percentage of individuals using health phone applications and games for health on smart phones tripled in a year, going from 9% to 29% between 2010 and 2011, and continues to grow at a rapid pace. Games continue to transform individuals' dispositions and appeal towards health management. Increasingly, studies point that people value play, social interaction, and engagement as being key to their participation in any meaningful transformation in health-related behaviors. Several empirical and theoretical research studies have argued that through designed rewards and choices, games have the potential to motivate players to meaningfully engage in recurrent physical activities and healthy eating practices

Objectives and Research Questions

In this paper, we present key findings from a research study investigating participation, player motivation, and player adherence in a health-based social media and game environment — *Spa Play™* that was specifically designed to promote healthy eating and physical activity. 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. In this study, we adopt a mixed-methods approach to investigate acceptability of the game among a sample of young players and adherence to daily play routine. As a novel approach, qualitative in-person interviews were individualized based on weekly real-time game telemetry data. Data from interviews and real-time game play records were combined to investigate the success of individual game components, their integration into participants' lives, and their impact on health behavior. In addition, these data served as an important source for improving upon some of the existing features in the game. 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 — in what ways do the rewards in the game work? 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 and health?

GAMES AND HEALTH BEHAVIOR CHANGE

There is a wide range of games that are designed to promote healthy behaviors. Some of these include exergames, or games that incorporate motion-sensing devices that help to track movement and thereby, motivate players to exert themselves physically. In these games, users usually see a simulated virtual representation of themselves (Avatar) or part of themselves (tracked limbs) while they are asked to perform a task by moving their body. Such games are intuitive and suitable for users with not much prior gaming experience. The Nintendo Wii Fit, for example, facilitates diet and exercise tracking on a game console. The Wii Sports includes physical movement as part of gameplay. The Zumba game uses Kinect and dance to motivate exercise. Other products, such as My Weight Loss Coach (Nintendo, 2008) and the DS game Pokémon HeartGold (Nintendo, 2010), use activity-tracking devices, such as pedometers, to promote real-life physical activities. Studies about exergames show that through avatar representation and visual display of ongoing real-time activity on screen, players are motivated to engage in physical activity for a longer play session (Song, Peng & Lee, 2011; Dawes, et al., 2011; O'Donovan & Hussey, 2012). Such studies examine the immediate response of players to the game and evaluate physical exertion in a short study session. For instance, Song, Peng & Lee (2011) found that players with a more negative body image responded more positively to their avatars on screen and persisted in longer play sessions when compared to the players that had a more positive body image. Such studies are useful for refinement of the technological sophistication of videogames. They also help to build consoles that address player's needs for entertainment. However, little is known about the impact of such games on behavior change beyond single play sessions and generalizability of acquired play skills into real life. .

Alternatively, some of the other research studies have adopted a broader outlook on health-behavior change by defining the game environment beyond consoles. Some of these studies have sought to empower individuals with relevant information regarding health via compelling game narratives or content. For instance, Gillis (2003) studied the impact of a game in improving acceptance of healthy foods by kids. Similarly, Aoki, Ohta, & Masuda (2004) studied increases in awareness about diabetes through designing informational content in a game. Finally, Baranowski et al. (2003) developed DIAB to promote awareness about different kinds of food through games, engaging players in compelling narratives in favor of better and healthy nutritional choices. Several of these studies have sought to leverage rewards to incentivize some of the activities that individuals tended to do more of when presented a different technology either to monitor their activity through devices, like mobile activity trackers (Arteaga, Kudeki, & Woodworth, 2009) or through providing small goals with progressive rewards mechanisms (Consolvo, McDonald, & Landay, 2009).

However, rewards in health games are complex mechanisms that entail a more nuanced understanding of individuals' motivations and perceptions about health (Bogost, 2007). Evaluating the efficacy of design in health games may be exceedingly limiting if behavior change is tackled within a narrower notion of intervention (ie: food acceptance by kids, diabetes awareness, etc.) (Klasnja, Consolvo & Pratt, 2009; & Kientz, 2010). Arguing along these lines, more recent initiatives in research with games and health have approached health-behavior change through holistic models examining one's overall lifestyle. These studies conceptualize behavior change as being an ongoing and a life-long process for personal health improvement. Several motivators have found to be particularly useful in explaining how effective rewards can be built into health games. For

instance, Consolvo et al. (2009) argue that goal-setting capabilities are crucial in influencing player adherence to recurrent physical activities over time. In an exploratory usability study of a mobile health app (application), UbiFit, Consolvo, et al. (2009) argue that while goal-setting may be an incentive to players, the "buy-in" for these goals emerges from a range of game-play mechanisms related to tracking and monitoring of goals, including varying forms of feedback for performance (participatory and individualized), different forms of goal tracking (self-initiated and goals tracked by personal trainer), and determining the right balance between goal time frames with individuals' existing routine. In addition to user experience, games and similar mobile ubiquitous apps for health necessitate capturing of data that is both situational and contextual, while also being auto-tracked through devices (Forehlich, Chen, Consolvo, Harrison & Landay, 2007).

This paper seeks to extend these contemporary conceptualizations of health-behavior change with mobile and ubiquitous devices. Aside from a few recent studies that have been enumerated above, studies on evaluating efficacy of design through holistic approaches are still limited. There is still a need for more in-depth research that conceptualizes health behavior change beyond interventions and, instead, characterizes how player motivation and adherence might affect behavior change in the long term. This paper aims to meet some of these goals through exploring how players interface with certain design and rewarding metrics, and describing some of the "buy-ins" and rewards that motivate participants to engage in a continuous game play.

RESEARCH DESIGN

In this section, we provide the context and data for this paper stemming from an ongoing longitudinal study of a social gaming platform — *Spa Play™* that is designed to motivate players to adopt nutritional eating habits and a exercise behavior. In this game, players build and run a virtual health spa resort (see figure-1). Success in the game depends on the healthy activities that players perform in real life, such as walking or climbing a flight of stairs. These healthy activities are tracked through devices and fed back as inputs to the virtual world, enabling players to unlock certain game content. The long-term goal of this project is to design a game-based social space that motivates players to self-regulate their behaviors related to health and food intake.

Context —Spa Play™ a game for health

Spa Play™ is an online health-based social media and game platform that was developed to facilitate players' behavior change in regards to eating habits and exercise. In this game, players build and run a virtual "health spa resort," and players' success in the game is tied to health-based activities that they undertake in their real life, such as choosing a healthy snack or doing a physical activity. The game is playable on computers and iPads and connected to tracking data collected from player pedometers and calorie trackers that keep a log of players' real-world activities.

Core design components and play mechanics of the game

The design principles for game play mechanics in *Spa Play™* are inspired from strategies deemed effective by recent and past studies in longitudinal health behavior change. For instance, the overall design of the game aims to promote regular physical activities and healthy food habits. As such, most of game play in *Spa Play™* involves doing a range of recurrent and repetitive activities to "level up" in the game. These recurrent and repetitive activities are called *quests* or *sparks*. In the following paragraphs, we describe each of

these game play mechanics. While, none of these principles have been validated for adherence or behavior change, the intent of this paper is to present a pilot, taking a step towards testing these principles and finding possible refinements to the design of the game.

The Virtual Island

Spa Play™ is a virtual spa game (see Figure 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, and doing *sparks* or *quests*.. 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.

Figure-1: Screenshots of the spa island in the game.

Sparks

Sparks (see Figure 2) are real-time game actions that entail doing activities in short bursts, some related to exercise, eating, and drinking, while some are related to tasks in the game world, such as solving a word puzzle. The design intends 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.

Figure-2: *Spark* and *Quest* interfaces.

Quests

Quests are a thematic grouping of several tasks that typically take somewhere between a few days to a week to complete. Example *quests* include beginner training for a biking

trip or planning a healthy meal outside with a friend. *Quests* take longer than *sparks* to complete, and 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 user feedback and user analytics that show *quests* that other friends of players have completed 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, players are presented with interesting statistical snapshots pertinent to their activities and progress, such as showing how many *spark*s and *quests* and *sparks* were completed in the past week, on each day. In short, the game is designed to provide immediate activity feedback, which is intended to serve a motivational function (Consolvo, et al., 2009; Munson, et al., 2012). Individual summaries help to compare personal activities against the chosen goals and stimulate recurrent and frequent updates, which motivate players to come back. For example, figure 3, below, is a screenshot of an avatar populated and animated on the running track in the game island that is fed through from the data on number of steps the participant takes using their pedometers. While the pedometer itself keeps track of the step count, the game provides an additional representation of their movement that is less self-quantified, and more mediated through game rewards.

Figure-3: Avatar on running track in the game in
response to data from a pedometer.

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. Further, continued feedbacks are featured in forms of meaningful comparisons, using in-game material reward in addition to conventional charts or graphs as shown below in figure-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, Figure-3 is an image of an in-game running track with a non-player character (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 *Spa Play™*, rewards are earned mostly through doing real-life *quests* and *sparks*.

Figure-4: The first two images are in-game material rewards to decorate the island. The third image is a comparative chart of player progress in the game.

Social Play

Contemporary studies on health and social behavior increasingly show that when it comes to health, food, and physical activity, individuals' decisions are heavily influenced by their friendship-based and social networks (Christakis & Fowler, 2007; Debono, Ross, & Berrang-Ford, 2012; Hwang , et al., 2010; Mueller, et al., 2010). *Spa Play™* incorporates friendship-networks in progress visualization and *quest* tracking. 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* completed 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 a *quest* with a friend earns more rewards, thereby encouraging collaborative play (outside of the game). *Spa Play™* is not a multi-player 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.

Study Design: Data Collection and Analysis Methods

In the spring of 2013 (mid-Feb to March), we conducted a 45-day study in order to research how players perceived *Spa Play™* and evaluated the core game design metrics. Twenty-two undergraduate students were recruited, of which 4 dropped out after the informational survey session, due to lack of time to commit to the study. Thus, 18 participants (14 male and 4 female) played the game for the entire duration. We met with the participants approximately once every week for a 15-20 minute face-to-face interview, for a total of 4 interviews. Based on the baseline assessment, 16 out of 18 (88.9%) participants played videogames on a regular basis (at least 4-5 days a week); 6 out of 18 (22.2%), reported exercising at a high intensity (i.e. breathing fast and cannot keep up with conversations; running, biking, playing soccer, etc.) at least 4-5 times a week, while 10 (55.6%) reported exercising hardly ever (or once a week); 2 out of 18 (11.1 %) reported eating 3-6 servings of fruits and vegetables every day, while the remaining 16 participants (88.9%) consumed only 1 serving of fruit or vegetable a day. In short, majority of the sample reported an overall lack of attention to healthy eating and exercising routines in their daily regimen.

Game telemetry

To evaluate player activity and behavior over time, we used game analytics, referred to as game telemetry (Seif El-Nasr et al., 2013). Game telemetry data included real-time logs of all in-game activities . The logs indicated the time and types of in-game activities, including the time of log in and out, types and the number of *quests* and *sparks* completed, and so on. The game telemetry was queried and the game play data was visualized for basic gaming activities, such as player leveling patterns, or *quest* completion times and frequencies (see Figure-5). Such data sometimes gives a clearer sense of play patterns and activities, however, as mentioned by many researchers in Seif El-Nasr et al. (2013), it does not give us an indication of why players engaged in certain activities and why they did not. In order to provide a more complete picture of player motivation and adherence, we augment game telemetry with weekly in-depth interviews.

Interview methods and formative design

A unique aspect in the methodology we used was formative and recurrent weekly interviews that were customized for each player. In this interview, the researcher asked participants about their impressions of the game during their play that week. Our objective was 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 (Seidman, 2006). We used game-play telemetry data from previous week? 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. Particularly, we used three kinds of game-play characteristics to customize the interviews — a player's leveling patterns, a player's *quest* completion frequencies, and a player's *spark* activity frequency. Interview questions were then modified as per player's steepness in leveling or steady-paced leveling, so as to encourage player responses that were related to their play style and fervor for the game. For instance, in cases the player showed steady leveling, some of the questions asked included: "Do you think the game encourages you to explore new things or try new activities? How so? If not, why not?"

FINDINGS

Overall, the key objectives of the study were to examine if the rewarding mechanics work, 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 *Spa Play™* that helped determine the salient game metrics that are being captured by the telemetry, their meaning and tools for studying them on 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 *Spa Play™* — *Quests, Sparks,* and perceptions about the virtual island. Under each group, we report on quantitative findings from the game telemetry and complement them with emergent interview themes to add meaning and specifics to the findings.

I. Quests

Using game telemetry data, the average *quest* activities for all players was charted at each level (see Figure-5 below). Average *quest* completion for all the players was 18.8 (SD= 9.7, n=505). Table 1 below shows the break-down of *quests* related to eating, physical activity, and virtual island related *quests*.
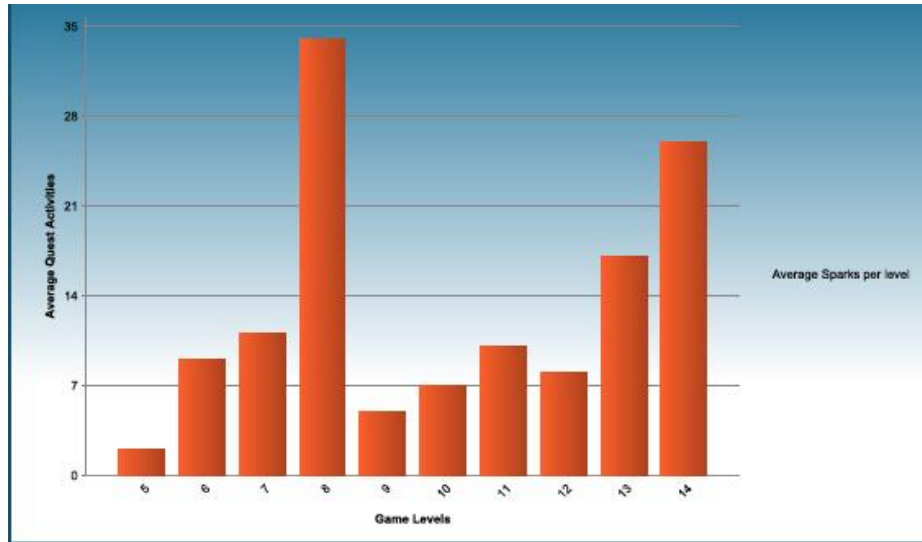

Figure-5: Average Number of *Quest* Activities Amounting to XP at each level for 18 players.

Distribution of all the 505 *quest*-related activities completed by the players are listed in the Table-1 below, grouped as 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.

Quest Related To	Number of Times Completed
Food	100 (19.8%)
Physical Activity	202 (40.0%)
Game Island	203 (40.2%)

Table-1: Quest distribution from the game telemetry data (Total N = 505)

The *quest* completion break-down indicates that food-related *quests* were completed less frequently. 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 Cauliflower Mash") required more preparation (instead of going to a

dining hall) and were less likely to be picked up by the participants. At the same time *quests* that required minor adaptations to one's lifestyle were more frequently picked up. Some of these quests included the "Tame the Sugar Monster" *quest* that entails drinking water instead of sugary drinks for a week or the "Eating out Healthy Portions" *quest* that entails eating half of a standard restaurant portion for a meal and/or packing half of it for later in the week.

II. Sparks

Similarly, using game telemetry data, the average number of the *spark* activities for all players was charted at each level (see Figure 6 below).
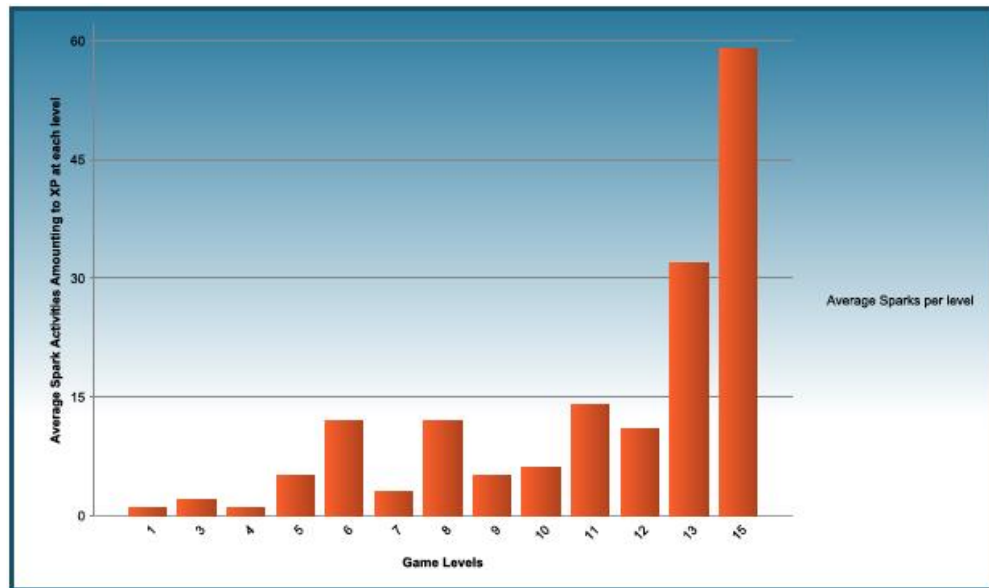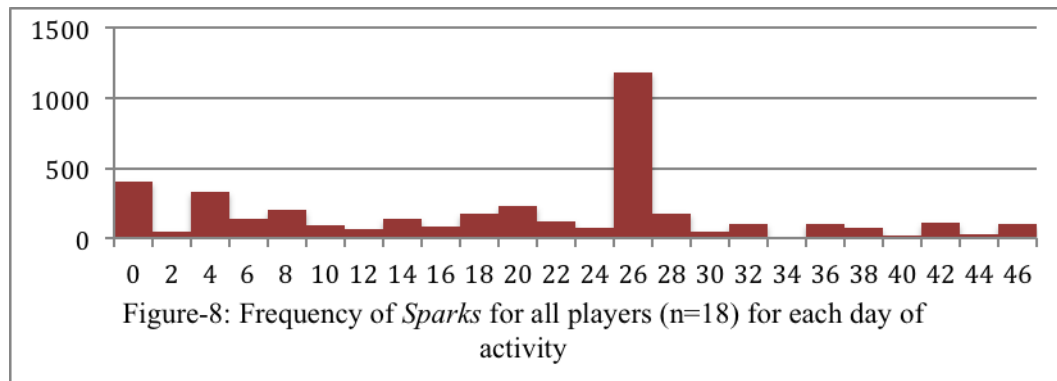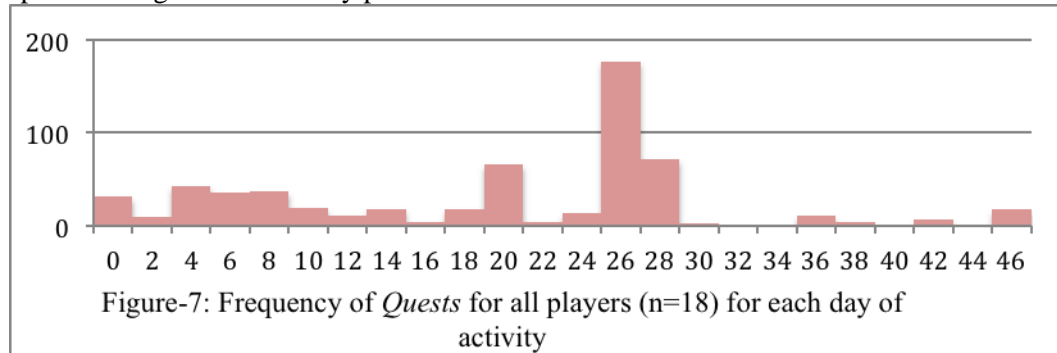

Figure-6: Average Number of Spark Activities Amounting to XP at each level for 18 players.

Sparks remained more popular than the *quests* and distribution of *spark* averages were plotted for the 18 participants. *Sparks* were completed an average of 54.0 times (SD = 70.X – decimal?, range 0-80). The 2 most popular *sparks* related to physical activity were "Lifting Weights for 5 minutes," "Walk 10 Minutes or Walk with a Friend," and "Ankle Rolls Repeat 5 Times". 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." *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* decreased as players progressed to higher levels, while experience points from *sparks* increased as players progressed to higher levels in the game, as pointed out to in figure-6 — players in higher levels gained more XP through sparks, as opposed to figure-5, that suggests that players in earlier levels accumulated points through quests.

III. Distribution of Player Game Activity

Frequency of player activities across the entire game period is summarized in Figures-7 through9. Based on Figures 7 and 8, the patterns of *spark* and *quest* distributions are comparable across the game period, with comparable peaks and valleys. Figure 9 also

demonstrates that sparks were more popular than quests, given then higher frequency of sparks during the entire study period.

Figure-7: Frequency of *Quests* for all players (n=18) for each day of activity

Figure-8: Frequency of *Sparks* for all players (n=18) for each day of activity

Further, players tended to play *spark* with more regularity (more evenly distributed across days) and continued playing *sparks* even after day 29, when most *quest* activity, on average, decreased. This suggests that, after gaining a certain level of comfort with the game, players were less inclined to explore or continue doing goal-oriented tasks (*quests*). In other words, as players leveled higher, they seemed to repeat activities they normally tended to do (*sparks*) and simply used the game as a checklist to level up with experience points accumulated through activities they did normally outside of the game.

Figure-9: *Spark* and *Quest* distribution during the length of the study
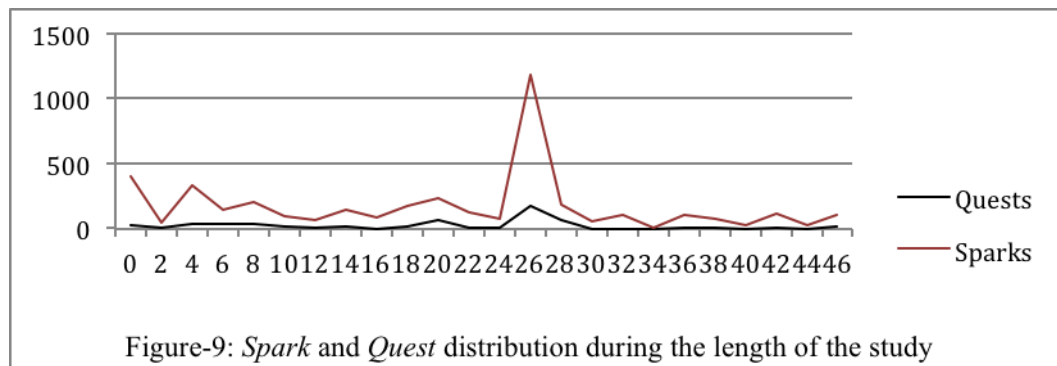
IV. Emergent themes from interviews and their contribution to understanding telemetry data

Several salient themes about play and participant perceptions about health became apparent from weekly participant interviews. These are themes are depicted in the following in-depth.

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.*" Seventeen out of 18 players ascribed to the fact that because this game is based on an honor-system and it felt like cheating if they merely leveled in the game without actually doing the physical- or food-related activities, they instead powered leveling merely through island-related actions, like cleaning the resort, harvesting the fruits, etc. 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."

Players repeated only those tasks in the 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. Goal-setting seems to be an important trigger for motivation in health games. However, through this study we found that *routinizing* seemed to take precedence over planning and setting long-term goals. 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 it 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 in to 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 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 every day. For instance, in the following, Participant-004 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 "checking 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 minutes 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 off 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, every day I can check off this *spark*."

Similarly, in relation to food-related *quests*, participants' existing routine outweighed the novelty of *quest* content. For example, in the following excerpt, one of the participants expresses that she was interested in doing some of the recipe related *quests* if they aligned with her timing of her grocery shopping.

> 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."

Player Perception on Rewarding Mechanisms
The game also seemed to impact player motivation through a negative reinforcement schedule. For instance, if the player loged in less frequently, the resort rating would drop, and the aesthetic of the island would be poorly affected (e.g., the island would accumulates trash in certain parts). Some of these game mechanics that were recurrent and repetitive, but were impacted negatively if the player failed to continue seem to be a big motivator for the player to come back. In one of the participant's own words —

> Participant-00??: "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

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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."
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DISCUSSION

Fostering lasting perseverance has been a longstanding issue with health games. As such, this study grapples with the issues of player motivation, rewards and persistent play over the course of several weeks as we examine the player acceptability of the game. Several key findings have been presented in this paper regarding design of reward systems in health games, patterns of activity and player motivation in playing *Spa Play™*. 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 studies about ubiquitous technologies for health have argued about, is an important metric for success of such technologies; albeit this is a complex design aspect. In *Spa Play™*, because the game actions for leveling up are much more open-ended, players were likely to repeat actions that seemed to align with their existing routine. However, players started getting comfortable with a narrow set of routines so as to continue leveling in the game. This is shown in the number of experience points players accumulated through more planned activities (*quests*) in earlier levels when compared to most leveling through *sparks* at higher levels. 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 continue to incentivize "exploration," or give players the extra push to do new activities.

Second, adherence to games like *Spa Play™* improves when the content of the game lends well for adoption in to the daily fabric of participants' life. In this way, participants could greatly benefit from *adaptive messaging* or profile-based game content (Gobel, Hardy, et al., 2010; Lieberman, 2009). For instance, findings from this preliminary work indicate that an open-ended gaming environment remains well suited for catering to a spectrum of participant profiles, offering participants 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 food-related *quests* that required more planning, such as following a recipe for a meal, were less frequently done by this particular group of participants because all of the 18 participants were undergraduate students. Nonetheless, participants seemed to be interested in doing recipe related *quests* if they had been more aligned with their living style, such as leaving a longer time frame for completion so that they had time to prepare. In short, while we found that the *quest* content in *Spa Play™* have potential to be relatable to players, it also makes the game a complex system of inter-related variables compelling us to think about inventive approaches that can make use game telemetry to influence player activities outside of the game.

Finally, open-ended gaming systems for health, like *Spa Play™*, face a complex design challenge in terms of customizability. As can be seen from the findings reported in this paper, players tended to repurpose the game to suit their existing needs. What this implies is that the game has a promise to create and strengthen a sense of awareness for day-to-day healthy routines, but at the same time runs into the risk of monotony (e.g. players sticking to *sparks* instead of elaborate *quests* at higher levels). In some ways, success for

games like *Spa Play™* is contingent upon the "buy-in" that the players can relate to (Bogost, 2008) in order to feel encouraged to look at the "other" healthy things they could be doing in the game. Participants 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 (Consolvo, McDonald & Landay, 2009). Elsewhere, Cockerham (2005) has 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" (p-55, Cockerham, 2005) be studied so as to leverage technology to influence some of these patterns. Thus far, our study seems to suggest that open-ended and flexible platforms like *Spa Play™* 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.

CONCLUSIONS AND IMPLICATIONS FOR FUTURE WORK

Perceptions about health and personal health management have changed in crucial ways, particularly moving away from diagnostic and interventionist models to designing formative, feedback-oriented and longitudinal models for long-term health behavior change. However, as documented throughout this study, complex and evolving models that seek to facilitate longitudinal health behavior change cannot be evaluated based on traditional interventionist models for behavior change that may seem to work well in the immediate run. 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 into repeating same tasks over time. In the case of *Spa Play™* repetitive *sparks* and *quests* related to physical activity and eating are designed for integration into real life. In conclusion, some of the implications for future work for our research 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 paper is largely descriptive, our ongoing efforts are in the direction of designing tools, like visual querying interfaces to observe players' collective health-behavior, which can facilitate decision-making at the designers end to include or leave out certain game content. It is our foresight that through this ongoing work to refine motivational metrics informed through game telemetry, compelling elements of play can be successfully leveraged to promote sustainable health behavior change, such as eating healthy or exercising.

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