Using Storytelling to Promote Family Bonding and Solidifying Family Values in Health and Physical Activity

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0. Abstract
Childhood obesity is a significant public health concern and is most common in low-income neighborhoods, where barriers to healthy living are highest. Addressing this problem requires family-focused approaches as the household environment influences behaviors in many ways. Prior HCI research work has examined how sensing technologies can help people capture and visualize data about their health-related behaviors. Yet, few systems help people reflect more fundamentally on the factors that influence behaviors such as physical activity. To address this research gap, we are examining how such reflections can be stimulated through a medium that generations of families have used for reflection and teaching: storytelling. We have studied 9 families (11 caregivers, 9 children) from the NSF funded study to assess their experiences of using activity trackers and software for physical activity data visualization. We then used what we learned from the study to design and develop the storytelling app that will help with family bonding and solidifying family values around health and physical activity.

1. Introduction
The statistics show that 17% of children and 35% adults in the United States (U.S.) are obese [1]. People that are most affected with Obesity in the U.S are those from ethnic and racial minority groups [1] and low-socioeconomic status households [2]. One of the factors that contribute to people becoming obese is lack of physical exercise [14]. People do not exercise for many reasons. Through formative interviews conducted as part of my summer research, participants described the following barriers to exercise: lack of motivation, living in unsafe neighborhoods, and not being able to afford gym memberships.

There are many health and behavioral sensors in mobile and wearable technologies that have been developed to promote people's physical activity and health in general. Examples include activity trackers from Fitbit, Samsung, and Garmin fitness bands. Human-computer Interaction (HCI) research has explored how such platforms can support physical activity. For example, researchers have developed and studied systems that support physical activity data visualization, data-driven game play [3,4], and data- grounded social support [5,6]

With all the research work that has been done, very few researchers have explored how personal health informatics tools (i.e., systems that non-health professionals interact with directly to pursue wellness) can be designed to support change in behaviour at a family level (projects by Saksono et al. and Stanley et al., [9, 6] are notable exceptions), even though the family environment plays an important role in shaping children's physical activity. A good example is parental support; it is "consistently, positively, and significantly associated with child activity" [7], with involvement, encouragement, and facilitation cited as the most important forms of support [8]. While most work has focused on helping people visualize their behaviors, less has focused on scaffolding their understandings of the factors that contribute to these behavioral patterns. If technology provides this support, it could help families to better understand how to achieve their physical activity goals.

To address the existing problem, we are conducting an NSF-funded HCI study to

understand how technology can encourage physical activity in families with young children between the ages 5-11. So far we have 11 families participating in the study. We have used the preliminary insights from the study to design a mobile application. The mobile app is exploring how storytelling technology driven by health sensor can be used for as a space for family bonding and solidifying family values in health and physical activity.

2. Related Work

Most of the HCI research on physical activity promotion has focused on leveraging health sensors to promote increased activity. HCI researchers often incorporate design focus areas such as visualization, game play [3,4], and social support [5,6]. Data visualization helps users make sense of their physical activity data (*e.g.,* information about activity levels gathered through mobile and ubiquitous sensors), through abstractions such as charts, graphs, and plain language data summaries.

Social support systems combine physical activity data with social influence and some good examples are Fitbit's leaderboard, StepStream [5], and American Horsepower Challenge [4]. Many social support systems have focused on children or adults exclusively while a small amount of research has explored the design of social support tools for parents and children [9,6].

The work that has been done on visualization systems has shown how self- monitoring through activity tracking and presentation can increase physical activity intensity awareness. However, many have questioned how these tools can support sustainable behavior change [11,3,12,4]. Health behaviour change is a process that is affected by many factors. While the short-term efficacy of self-monitoring has been reported by a vast body of research, such tools have high user drop-off rates [13]. People may go back to their old behavior of being physically inactive when self-monitoring is discontinued. People's ability to continue being physically active after they discontinue self-monitoring is often due to other support structures that they put in place when they were self-monitoring [13].

Our work is looking to help families develop more enduring support structures, such that behavior change is more sustainably supported.This project is exploring how storytelling technology driven by health sensor can be used to promote family bonding and solidify family values in health and physical activity. Solidifying family values around physical activity is one way that we can help families develop more enduring resources that encourage physical activity because children's physical activity levels and eating patterns are strongly influenced by the physical activity opportunities and foods that caregivers make available, family social support, and caregiver modeling of positive behaviors. We define caregivers as parents, grandparents, or guardians responsible for the care of children in the household.

3. Formative Study

3.1 Method

We conducted an NSF-funded study to to examine how experiential learning technologies can help people collaboratively learn from their past behaviors, identify how they can maintain and increase healthy behaviors given the barriers that exist (abstract conceptualization), test out these insights (active experimentation) and develop positive attitudes towards physical activity and healthy eating. The focus of this work is on families (e.g., caregivers and children). Health literacy (the ability to process and use health information to make healthy decisions) is important for helping caregivers to model and encourage healthy behaviors, and helping children to develop habits that prevent disease and improve their quality of life. One area of exploration in this project is digital games, as they offer a unique context for learning. The entertainment value of digital games can make education and behavior change more appealing and support the

development of skills that may transfer to the real world. In addition, health games afford a promising environment for encouraging behavioral modeling. However, prior work on health games has typically focused on game play by individuals or peer networks, not in an intergenerational family context.

In the study, participants were asked to do the following:

1)Session 1: participate in a family interview with at least one of their children aged between 5-11 years, and, optionally, another of their child's caregivers who has signed up for the study (eg. their child's mother/father or grandparent). During this session, participants completed a survey that asks them demographic questions (eg. their occupation and education level) and about their family's physical activity knowledge, attitudes, and habits. During the interview, participants were asked questions about topics like their family's physical activity and any challenges they face being physically active. They were also asked to explore the activity tracking software and describe what they think of it.

2) Fitness tracking: At the end of the interview, caregivers were given Fitbit Altas and kids were given Unicef Kid Power bands to wear. Fitbit Altas (Figure a) and Unicef Kid Power bands (Figure b) are wearable technologies that track how physically active they are (eg. how much exercise or walking they do). They were then asked to wear the activity trackers for two months. They were also asked to install Fitbit and Kid Power software on their smartphone that allows them to see graphs, charts, and other visualizations of their family's physical activity. They were asked to use the software at least once a week.

Diagrams of the Unicef Kid Power band and Fitbit Alta

(a) Unicef Kid Power band

(b) Fitbit Alta

3) Diary: Participants completed weekly surveys describing their experiences with the wellness tracking device and software. They received weekly text messages with a link to a survey.

4) Sessions 2 and 3: Interviews were conducted during and after the 2-month fitness tracking period to discuss topics such as participants' experience with the device and software and their physical activity knowledge, attitudes, and habits.

My responsibilities during the study included: creating gmail accounts for our participants, preparing fitbit and kid power bands so they can be ready for use by our participants, creating fitbit accounts on the fitbit app and kid power accounts on the kid power app, and sending surveys to our participants every week. Gmail accounts were required for the creation of both Fitbit and Kid Power accounts. I also helped with conducting the interviews.

3.2 Preliminary Insights

Data collection for the study is still going on and data analysis has just begun. The followings are my preliminary insights from the data we have collected so far: we learned different reasons for why parents want to be physically active with their kids. One of the participants said she wanted her children to be physically active because she did not want them to get sick or bullied at school for being overweight. Other participants wanted to be physically active with their kids so they can lose weight.
Participants also described various crime and safety concerns in their neighborhoods, such as shooting, sex offenders, dogs, and traffic. However, participants also mentioned that they overcome the safety barriers in physical activity by going to exercise in safe neighborhoods.

Two participants reported increased physical activity because of using the activity tracker and software.

4. Storytelling App

With what we have learned from the formative study described above, we are designing and building an app that will serve as an alternative to the current physical activity monitoring tools available commercially and in the research domain. Our goal is to create an app that better helps families reflect on their physical activity behaviors and help them achieve their physical activity goals.

4.1 Design requirements

We are creating a novel software application that uses storytelling to support physical activity. Storytelling is a recollection of past experiences that families can use to socialize and emphasize important values [Cassell & Ryokai 2001]. Therefore, storytelling can support the feeling of connectedness without the competition design element. Competition around data about oneself could have a negative impact on the parent-child relationship. Prior work has shown that competition in exergames can have a negative effect on both adults [Lin 2006] and children [MacVean 2012, Xu 2012]. Storytelling is reflective and value rich in nature [Haigh & Hardy, 2011] and therefore it can help families develop their own physical activity routines and experiences that are enjoyable and supportive for a sustainable physical activity behaviour [Troest et al 2003].

4.2 Features

Addressing these findings from prior work, we are designing and building Storywell, a smartphone application with storybooks that help families reflect on their physical activity experiences and move towards the action stage of change (Figure C). The action stage of change is the stage where families are physically active. The storybooks are composed of multiple subplots that are connected with cliffhangers, aimed to spur family interactions as well as to engage the family with the story [Lu 2015]. When a family reaches the cliffhanger of a subplot, they must select a one-week physical activity goal to continue reading the story. We designed the story in every subplots to be themed around a specific Transtheoretical Model's process of change. The story is also accompanied with a set of stage-relevant reflection questions. A set of reflection is composed of three stages. First, the system will ask the family to reflect and tell a story about their physical activity experience. Then, the

system will give a follow-up question to focus the story to a specific physical activity correlates. Finally, the system will present a concluding statement to help the family to realize the meaning of their answers. As their answers will be audio recorded, the family will accumulate qualitative answers about their experiences that are focused to physical activity. These qualitative data can be used to help them construct the support structures to maintain a sustained physical activity behavior.

The android application is composed of three sections: *Storybooks*, *Treasures,* and *Activities*. *Storybooks* shows all the story books that have been unlocked by each family. *Activities* shows the parent's and child's physical activity levels in terms of steps count, minutes in moderate/vigorous physical activity, and miles. These data are acquired from the Fitbit wristbands that are worn by the family members. *Treasures* shows the treasure items (rewards) that have been unlocked by each family while reading the story and completing the challenges. Tapping on one of the stories in the *Storybooks* will evoke the *StoryView* android activity in which the family can view and read the storybooks from. The family can monitor their progress using the *Activities* view. Once a family completes the physical activity goal, they can continue reading the story.

(C) A screenshot From the Storywell App

4.3 Implementation

The application system consists of the backend server and the Android Application.

Backend Server

The Backend server is the source of physical activity data. The server pulls physical activity data from Fitbit and provides family physical activity data in JSON format.

We developed the server using Django and Python. We used the MySQL relational database for storing the physical fitness information and user information.

After creating the storytelling database in MySQL, Django generated the tables and attributes as described in each Django app's models.py file. We then used the Django REST Framework to create REST APIs for the app. We transformed raw data from the MySQL database models into JSON format. I built the family physical activity JSON REST API that displays the weekly number of steps, distance, and calories burnt by each individual in the

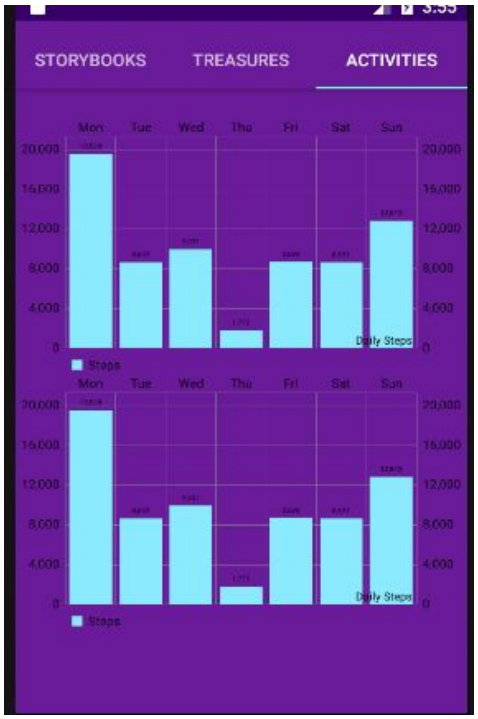
family. Below is an example of the JSON REST API for the family physical activity.


```
{
    "id": 2,
    "name": "Family One",
    "activities": [
        {
            "id": 1,
            "name": "Adult 01",
            "last_pull_time": "2017-06-12T14:39:18Z",
            "role": "P",
            "activities": [
                {
                    "date": "2017-06-01",
                    "steps": 19538,
                    "calories": 3068.98,
                    "distance": 8.37
                },
                {
                    "date": "2017-06-02",
                    "steps": 8642,
                    "calories": 2911.85,
                    "distance": 3.7
                },
                {
                    "date": "2017-06-03",
                    "steps": 9931,
                    "calories": 2506.63,
                    "distance": 4.25
                },
                {
                    "date": "2017-06-04",
                    "steps": 1772,
                    "calories": 1621.69,
                    "distance": 0.76
                },
```


Android Application

On the android app, I wrote the code for accessing JSON API data from secured URLs. I also implemented an *Activities* fragment to display the family's 7-day steps count in 2 graphs: parent and child's graph. The x-axis of the graph is the days (i.e., Sun, Mon, Tue, Wed, Thu, Fri, Sat). The y-axis is the number of steps, and the y-range for both the parent's and child's are identical. I used the MPAndroidChart Library to create the bar graphs. The graphical representation of physical fitness information will help families visualize their weekly physical activity data and hopefully motivate them to be more physically active so they can reach their physical activity goal.

Below is an example display of the family's 7-day steps count.



5. Discussion

So far we have the basic android app prototype. The goal is to have a fully functioning app and probably gamify it so it can be more exciting for our users. What is particularly challenging about designing the storytelling app is the fact that it is is going to be used by children with their parents, and therefore we have to make sure the design is one that is attractive to both parents and children.

The plan for the NSF study is to continue recruiting research participants. We currently have 9 families and the goal it to have 20.

I think the Storytelling app design is great, but for users to be constantly excited to use the app, the stories in the app have to be very exciting and entertaining. Also, the reflective prompts should not be too long and boring because otherwise people will stop using the app.

By working on this project, I got exposed to HCI research, learned android development, Django,

and how to create REST APIs. Learning these technologies was not necessarily easy, but through perseverance and hard work, I was able to accomplish what I accomplished.

6. Conclusion

Rates of overweight and obesity remain high in the United States, and innovative solutions are needed to address this significant public health concern. Our storytelling app has the potential to help low income families change behaviour from being physically inactive to being physically active and strengthen the bond between parents and children.

This project is still a work in progress. My recommendation on the project going forward is to keep adding fun features to the app that will keep our users entertained and motivated to be physically active as a family.

Acknowledgements

I would like to thank the Distributed Research Experience for Undergraduates (DREU) program team, CRA-W and all the partners for making the DREU research internship opportunity possible for me and other students in computing. I would also like to thank my mentor, Professor Andrea Parker, for welcoming me to Northeastern University and for the supervision during my internship period. Finally I would like to thank all the PhD students in the Wellness Technology Lab for the support.

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