Motivating Adolescents to be Physically Active Using a Mobile Game

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ABSTRACT

Results from the 2007-2008 National Health and Nutrition Examination Survey, indicate that an estimated 17% of adolescents aged 12-19 are obese. Obese adolescents are at risk for serious health problems during their youth and as adults. Physical activity is tightly related to lower obesity rates in youth, but it declines precipitously during early adolescence. New approaches are needed to address the problem of lack of physical activity in adolescents. In this research, we explore the use of a game that requires walking as the input mechanism to increase physical activity in teenagers. Approaching our design on a mobile platform, i.e. the iPhone OS (available on the iPhone and iPod Touch), has the advantage of providing the flexibility for the user to take this application with them and use it wherever and whenever they choose. In addition, we believe games will motivate teenagers to increase physical activity because they will make the experience fun. This belief is based on several theoretical models on motivators for adolescents and behavior adoption, i.e. Theory of Meaning Behavior and Theory of Planned Behavior. A scavenger hunt game was created in which the user has to walk a certain distance before being presented with a picture. In this picture the user is asked to search for objects starting with a specific letter. The complexity and distance increases with each level in the game. After running a focus group session on the game, we found that most teenagers said they would play this game individually or to entertain themselves on long walking distances. However, they also stated that the greater the challenge the more they would enjoy the game.

Author Keywords

Physical Activity, Theory of Planned Behavior.

ACM Classification Keywords

H5.2. [Information interfaces and presentation (e.g., HCI)]: User Interfaces---theory and methods, user-centered design.

INTRODUCTION

Obesity among adolescents aged 12-19 is a serious problem. Studies have shown that obese adolescents have a greater risk of developing serious health problems like type 2 diabetes, hypertension and cardiovascular diseases [7]. What's more, results from the 2007-2008 National Health and Nutrition Examination Survey, indicate that an estimated 17% of adolescents are obese [3].

On the other hand, it has been shown that decrease in physical activity (PA) is tightly related to the increase of obesity rates in youth [8]. The problem is that during early adolescence PA levels decrease steeply [8, 9]. Studies of some of the interventions made to increase PA in adolescence showed that only a handful have turned out to be somewhat effective [7]. Thus, new approaches are needed to address the problem of lack of PA in adolescents.

BACKGROUND INFORMATION

Understanding the factors that contribute to behavior adoption in adolescents is required when designing technology that will be motivating for adolescents [2]. The following theoretical models on motivators for adolescents and behavior adoption guide our design:

The Theory of Meaning Behavior is a theory that accounts for two types of incentives that promote behavior adoption in adolescents: first the internal motivators, motivators which have been internalized and are associated with personal rewards, i.e., positive feelings or negative feelings that occur as a result of performing a certain behavior [2, 12]. And, external motivators which are thought of as external rewards for behaviors, such as getting more pocket money for doing chores or punishment from the teacher for not doing an assignment [2, 12]. Results suggest that the internal incentives, or personal rewards, predict behavior adoption among adolescents; in other words, it was suggested that adolescents' behaviors are largely influenced by the personal meaning of these behaviors [2, 12].

The Theory of Planned Behavior (TPB) presents the concept that human behavior is also a result of three kinds of beliefs: perceived beliefs about the likely outcomes of the behavior (behavioral beliefs), beliefs of how others may perceive the behavior (normative beliefs), and beliefs of the perceived ease or difficulty of performing the behavior (control beliefs) [2, 1]. The combination of these three kinds of beliefs leads to the formation of a behavioral intention, and intention is assumed to be the immediate antecedent of the behavior [1].

GOALS

We believe games will motivate teenagers to increase physical activity because they will make the experience fun. This belief is based on several theoretical models on motivators for adolescents and behavior adoption, i.e. Theory of Meaning Behavior and Theory of Planned Behavior [2]. For this reason, we wanted to design a game that requires walking as an input mechanism to motivate teenagers to increase their physical activity and make the experience fun. More specifically, we want to make adolescents internalize the motivators to be more active.

In addition, we want to take advantage of adolescents' increased attachment to cell phones and video games [2]. By developing the game on a mobile platform, in our case, the iPhone OS (available on the iPhone and iPod Touch), and using the built-in accelerometer, we can provide the user the flexibility to take this application with them and use it wherever and whenever they choose.

This paper is structured as follows: first, we offer a description of the game designed; next, we describe the experimental method used to test the game; then, we show and discuss the results of our experiment, and finally we wrap up with our plans for future work.

GAME DESIGN

Overview of Game

The name of the game we developed for the iPhone/iPod Touch to promote PA in adolescents is *AlphaQuest*. The theme of the game is similar to the Alphabet Game's were you pick a letter of the alphabet at random, and find objects that start with that letter. In our game the user has to find objects with all the letters of the alphabet in images that will pop up on screen after he/she walks a predetermined number of steps in order to get points.

There are three modes, or distances, the player can choose to walk: beginner (1 mile), intermediate (2 miles), and challenge (3 miles). For each mode there are 6 levels, or images, with a corresponding set of letters of the alphabet: Level 1 – ABCD; Level 2 – EFGH; Level 3 – IJKL; Level 4 – MNOP; Level 5 – QRSTU; and Level 6 – VWXYZ. In each level, the image shown has objects starting with the letters corresponding to that level. For example, in Level 1 the user may find an apple, birds, clouds, a deer, etc. The images in the harder modes have more objects than in the easier modes.

Figure 1. Level 3 of beginner mode

After choosing the mode, the accelerometer starts gathering data, the steps taken by the user are added, then when the player walks the specific number of steps needed to unlock a level the following things happen: first, the accelerometer is paused, the game plays a sound alert to notify the player that he/she has unlocked another level, the image corresponding to that level pops up on the screen, the user can zoom in to take a closer look by clicking the area that he/she wants to see in more detail; then, he/she can input all the objects he/she finds to get points, and press the 'done' button when finished. When the player is done with a level, the game checks to see if the player has completed the whole game, otherwise it turns the accelerometer back on and continues adding up the number of steps until another level is unlocked.

Moreover, the way the number of steps required for a level to be unlocked is determined as follows: first, we convert the miles the player has chosen to walk into steps (1 mile = 2,500 steps), this will be the goal; next, we divide the goal by six (the number of images); then, for each multiple of that quotient, which is the product of an integer and the quotient, an image pops up corresponding to the level whose number corresponds to the integer in the product that is the multiple. For example, if a player chooses the beginner mode (1 mile)

```
goal is set to 2,500 steps
if steps % (goal/6) is equal to 0 then
      turn off accelerometer
      play sound alert
      level = steps/(goal/6)
      pop up image for level
validate answer and award points…
```

After an image pops up on the screen, the player gets the chance to input what he/she finds in the image.

Figure 2. Writing down the objects found

The way the player gets points is by writing down what he/she finds in the image. If what he/she writes down is a valid answer, i.e., the object is in the image, the user gets the number of the level times 100 points, so for level 3 the player can get up to 300 points for all the objects found. And, for non valid answers the number of the level times 5 points, so for level 6 he/she can get 30 points at least. In general, points are given as follows:

```
validate answer and award points:
      if answer is valid then
            points = points + (n*100)
      else points = points + (n*5)
print won points
```

The following figure is a schematic description of how the game is executed in general:

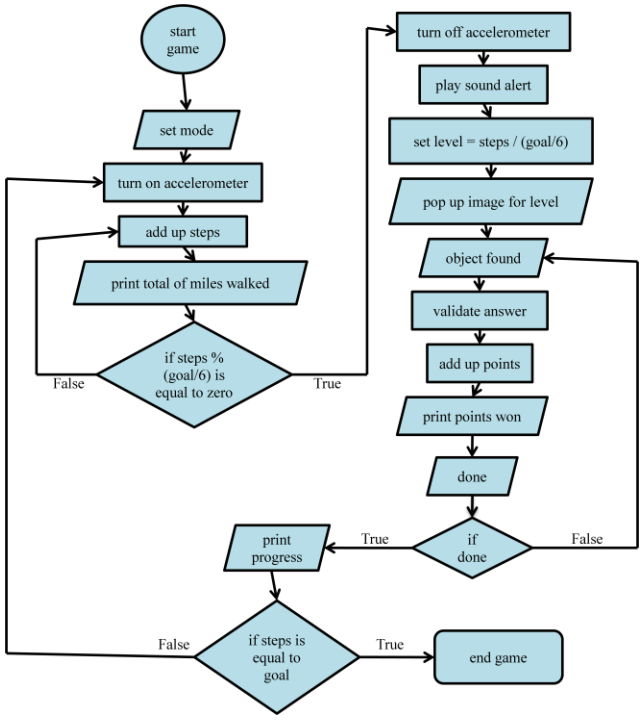

Figure 3. State diagram of game execution

Design Details

From previous works on the development of technologies to promote PA in adolescents it was found that most teenagers like games that are competitive or social, outdoors, simple to learn and with large variations [0]. Therefore, our game tries to encourage users to go outside so that they can walk a long distance. We offer variation by letting the user choose the distance he/she would like to walk, showing different images for each mode, and showing more objects on the images in the harder modes. The instructions are very simple; first the different modes are explained (easy, intermediate, challenge); next comes a description of how the game is played. At the end of the instructions it is suggested to the user that he/she play this with someone else so that he/she can have help finding the objects or have someone to compete with.

We also tried to comply with the four key requirements found in [5] for developing technology that promotes PA in adolescents: 1) give user proper credit for activities, 2) provide personal awareness of activity level, 3) support social influence, and 4) consider the practical constraints of users' lifestyles. In our game we use the iPhone's/iPod Touch's built-in accelerometer as a pedometer. We used the shake-detection algorithm used in Apple's

GLPaint, to count the steps the user takes but the player has to have the device inside his/her pocket (on the hip area) in order for this to work efficiently. In general, this proved to be reasonably accurate. In fact, using accelerometer-based activity monitors placed on the hip area has been shown to be a useful and valid way of assessing of PA [6]. Using the accelerometer's data the game shows the user the distance that he/she has walked (in terms of miles). And, as stated before the game tries to encourage the user to play with others by suggesting he/she play with others in order to facilitate finding the objects or for competition.

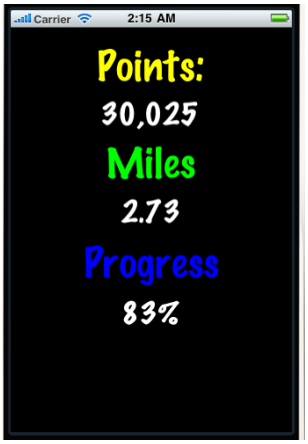

Figure 4. The game shows the user the total points won, miles walked and progress

GAME EVALUATION

To test our game we conducted a focus group in our lab with a group of three teenage girls aged 15 to 16. Two of the girls were involved in some sort of physical activity (sports, dance, etc.) and one was not. The main goals of the focus group were to learn about the game's entertainment value, explore whether or not teenagers would like to continue using the game, explore usability problems, and learn about ways to improve the game and motivation.

The way we conducted our focus group was: first, we gave a mock up presentation in which we explained the instructions and showed a demo of the game. Then, we asked the girls some question about the game. The questions that we were most interested in were:

- Would you play this game? Why?
- When and where would you play this game?
- Would you play this game with someone else? If yes, who?
- What would you add/modify to make it better and/or more motivating?
- What people or age group do you think this game is appropriate for?

RESULTS

After we were the focus group, we transcribed the audio from the focus group and built thematic networks from the girl's answers. The following figures are thematic networks that summarize the feedback we got:

Question 1: Would you play this game? Why?

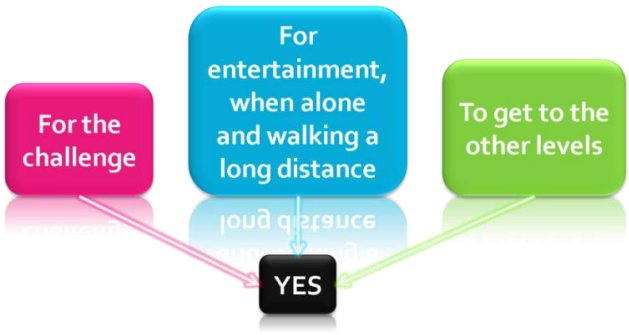

Figure 5. Thematic Network of Answers for Question 1

Question 2: What would you add/modify to make the game better or more motivating?

Figure 6. Thematic Network of Answers for Question 2

DISCUSSION AND CONCLUSIONS

We found that teenagers in general would play the game outdoors, individually, and for entertainment when walking alone a long distance. Although, all the focus group participants thought the distances were too challenging, and suggested we allow incremental progress, i.e., allow the player to save and continue the game later. Nevertheless, one participant said that some teenagers might find this a fun challenge. So, this would definitely need improving, maybe making the goals shorter distances or allowing incremental progress. What's more, we noticed that the social aspect of the game was not effective, so this is something that needs to be improved too.

On the motivational aspect we believe we got good results, because the participants said they liked the images, so they would interested in unlocking the higher levels to see the other images.

The participants also suggested we make the game more challenging by adding a timer and/or records of high scores, and an activity log that shows them how much they walked and when. They also said that they thought the game could be aimed at a wide age group, pre-teens and teens.

Even though our sample size was small and not very diverse, we believe that the feedback we got is very valuable and will help us improve our game. But, for future work it would be more insightful if we test the game on a larger and more diverse group.

In summary, teenagers would play our game, but they would like it better if it were more

challenging, the goals were shorter or it allowed incremental progress, and if it helped them keep track of their PA.

FUTURE WORK

The first thing that we would work on is finishing the game, because we only managed to finish the images for the beginner mode. Also, we would like to improve the game by making it more challenging and motivating:

- making it more social or multiplayer friendly
- adding a timer
- adding a record of high scores
- making the goals shorter distances
- adding more images
- increasing the complexity of finding the objects
- increasing the magnification capabilities
- adding an activity log that tells the player how much he/she walked and when

Finally, we would like to conduct more focus groups with larger and more diverse groups of adolescents.

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