Persuasive Mobile Exercise Companion for Teenagers with Weight Management Issues

Sonia Arteaga
University of California, Santa Cruz
1156 High Street
Santa Cruz, CA. 95064
(831) 425-1606
sarteaga@soe.ucsc.edu

ABSTRACT
Obesity is a grave problem in our society. A significant increase in prevalence within the last 20 years has resulted in greater mortality, increased stress on our healthcare system, and a decreased quality of life for people dealing with obesity and overweight issues. My dissertation concerns a mobile application that assists teenagers in leading physically active lifestyles to try and combat the risk of becoming obese or overweight as adults. I hope this research will prove to be a viable option to prevent or reduce the risk of obesity for teens so that they lead healthy lives. By reducing the risks of obesity and overweight problems, we also reduce the risk of these individuals developing debilitating diseases such as diabetes and cardiovascular diseases.

Categories and Subject Descriptors
H.1.2 [**Information Systems**]: User/Machine Systems – *human factors, software psychology*. H.5.2 [**Information Interfaces and Presentation**]: User Interfaces – *evaluation/methodology, graphical user interfaces (GUI), theory and methods, user-centered design.* J.3 [**Computer Applications**]: Life and Medical Sciences – *health.* K.4.2 [**Computers and Society**]: Social Issues.

General Terms

Design, Human Factors, Theory

Keywords
Physical Activity, Persuasive Technology, Mobile Devices, Assistive Technology, Lifestyle, Interface Design

1. INTRODUCTION

Obesity is a serious problem in the United States, due in large part to increased sedentary activities and lifestyles. An estimated 31-35% of adults are obese and 16.3% of adolescents are obese [2]. Obesity affects the quality of life of adults and is caused in part to a lack of physical activity. Obesity and overweight individuals are at greater risks of developing heart disease, diabetes, high blood pressure, and various cancers [2]. Not only does obesity affect an individual's health but also puts economic pressure on our healthcare systems.

Studying obesity among adults is just as important as studying it in children and adolescents. Furthermore, previous studies have found that if at least one of the child's parents is obese then there is an increased risk and trend for the child to also become obese [7]. Implications of such findings suggest that obesity trends and mentalities that promote lifestyles leading to

obesity can start at a young age. If healthy attitudes and practices are learned and enjoyed at a young age, then it is our hopes that teenagers will continue these healthy practices well into adulthood and can lead to healthy lives as adults.

A better understanding of the design requirements for persuasive applications for this group will be necessary in developing effective systems to assist them and motivate them to lead healthy lifestyles. Our work will use well established theories from health research and psychology to guide the design of our application. In the following, we discuss previous work in this area, the theories used to guide our system design, and propose a system that translates these theories into design elements.

2. PREVIOUS WORK

In the literature, there exist studies and applications developed that address increasing or maintaining healthy physical activity levels in individuals by using game-like approaches, friendly competition, or physical activity awareness and monitoring. In the following, we describe a few of these prior studies.

Motivation is an essential factor that can cause a person to start physical activity, increase physical activity, and continue their physical activity routines. One approach to increase motivation includes encouraging friendly competition. An example of such an application is Chic Clique. Chic Clique is a mobile application that was developed to encourage teenage girls to be more physically active by having them record their step count and share it with their friends [12].

Other approaches include physical activity based games. Neat-o-games is a collection of games used to try to encourage physical activity [4]. The game is controlled with data from an accelerometer. Accelerometer data is from step count and is thus associated with physical movement. Participants found the games to be "fun," which was a motivator for them to continue using it.

In other studies, music has been used to increase physical activity. When exercising, music can affect pace of the runner, endurance, and perception of exercise [9]. MPTrain is a system that uses heart rate and motion data to determine what song to play next on the mp3 player. The application assists the users in their running routines.

UbiFit Gardens is an application that was developed according to several theoretical guidelines including those from Cognitive Dissonance Theory and the Transtheoretical Model. Their application was targeted on the individual and creating a non-intrusive technology that would blend into the user's everyday life. Their user study was with adult participants and results showed a positive reaction to the system [3].

Most of the literature on physical activity applications were targeted towards adult users. More studies need to be conducted with teenagers to get a better understanding of their needs and to translate motivators for them into system design.

To our knowledge, little work has been done in addressing and predicting technology designs that would motivate teenagers to become or continue being physically active. The proposed research attempts to further research in this area by approaching the design of such a system from two theoretical models that will shape different aspects of system design and personality theory that will help to individualized motivational design elements of the application.

3. THEORIES USED IN OUR SYSTEM

Our proposed system was based on several theories which include: The theory of Planned Behavior, Theory of Meaning Behavior, and Personality Theory. Each of these theories are briefly described in the following.

3.1 Theory of Planned Behavior

The Theory of Planned Behavior (TPB) is a theory that is used to predict and explain behavioral intention and behavior adoption (see diagram in Fig. 1.). This theory says that behavior is affected and depends on behavior beliefs, normative beliefs, control beliefs, and intention; where each means the following [6, 5]:

1. Behavioral Beliefs: refer to the belief that a perceived outcome will occur as a result of doing the behavior and the attitudes towards the behavior
2. Normative Beliefs: refer to the individual's perception of what people he or she cares about will think about the behavior in question
3. Control Beliefs: refer to the perceived obstacles or ease of performing the behavior and their perceived capabilities and abilities to perform the behavior
4. Behavioral Intention: refers to how much a person plans to do and wants to do the behavior [8]

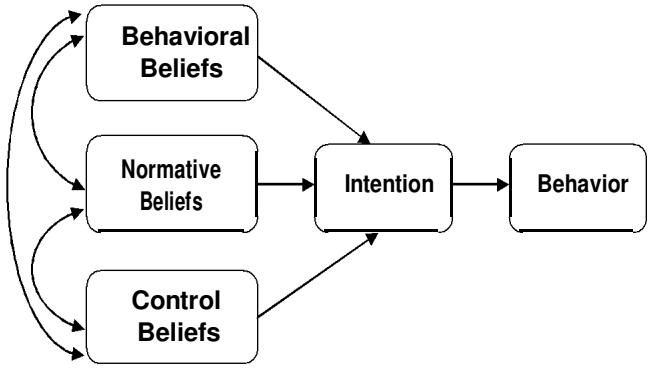

Figure 1. Model of Theory of Planned Behavior [1]

TPB has been used extensively in health-related behavior adoption studies in the past, including physical activity. In particular, some studies have also found that TPB applies over a range of population groups and they recommend it should be considered when designing health-related interventions [8].

3.2 Theory of Meaning Behavior

The Theory of Meaning Behavior (TMB) is a theory that presents two types of motivational incentives that promote behavior change. These types are called internal and external motivators [11]. External motivators can be thought of as external rewards for behaviors, such as getting a treat if you get good grades, verbal congratulations from a teacher for a job well done, or a medal if you participate in sports.

Internal motivators are motivators which have been internalized and associated with personal rewards. Personal rewards include things like feeling happy, feeling joy, and feeling

excitement as a result of doing the behavior. An example of an internalized motivator is demonstrated in the following scenario: suppose someone eats a lot of candy. This person knows that candy is bad for their teeth and health, but they continue to eat large amounts of candy. The internal motivator for such a person might be that eating candy makes him or her feel happy. This personal internal motivator of 'feeling happy' then outweighs the fact that they know candy is not good for them. Internal motivators explain why a person does a behavior without being asked to do it and are primary indicators of behavior adoption.

Previous work in the area of the Theory of Meaning Behavior showed that using this theory to formulate survey questions successfully predicted adolescent behavior 78% of the time [11]. The behavior in question for this study were eating habits during and outside of school, as well as sleeping patterns. The authors believe this theory better predicts behavior in adolescents because it takes into account an adolescent's emotional worldview. This 'emotional worldview' is the belief that adolescents do not act, behave, or take action in a 'reasonable' way. Often times, their actions and behaviors are largely due to the emotions that these behaviors encourage, and so reason is overruled by emotion.

3.3 Personality Theory

The last theory that informed our design is the Five-Factor Model of Personality. This model says there are 5 basic traits that can completely describe an individual's personality. These personality differences suggest that individuals with specific traits prefer activities that appeal to these traits. Personalizing a system for improved enjoyment can make use of personality profiles so that different interventions and persuasion styles will be more effective for people with different personality traits. The personality traits for the 5-Factor Model of personality are the following [10].

- Openness to Experience: refers to the depth, complexity, and quality of a person's mental and experiential life.
- Conscientiousness: extent and strength of impulse control.
- Extroversion: refers to the extent to which a person actively engages the world or avoids intense social experiences.
- Agreeableness: refers to an individual's interpersonal nature on a scale from compassion to antagonism.
- Neuroticism: refers to the extent to which a person experiences the world as distressing or threatening.

4. OUR SYSTEM

Our application was created for Apple's iPhone and iPod Touch. These devices were chosen because of the sensors on board and the availability of free games that require physical movement as input. Using such an approach allowed for a quick prototype of our application.

The application contained the 10 -Item version of the Big 5 personality test, which the user was asked to answer prior to using the application. An animated agent was also included that says motivational phrases. The system also presents a list of games based on the personality profile of the user. Finally, the application has the capability to log game play.

Interaction between the user and the system is as follows:

1. First the user creates a user profile which contains the 10-item personality test

2. Then the user enters the game mode
    a. Game Mode: Presents the user with a list of physical activity based games
        i. The games are chosen based on personality
    b. The user is asked to go play one of these games
3. Application exits and the user clicks on the icon for one of the games from the list
4. After playing the game, the user goes back into the application
    a. First screen presented to the user is a logging screen
        i. On this screen the user is prompted to select the amount of time they spent playing the game
5. Game mode is again presented to the user (go to step 2)

The system will also have a second component which will be a desktop application that provides a physical trainer or physical education instructor the functionality to remotely set goals for the teenager. They would also be able to provide feedback on the teenager's progress, and view the activity log for the current user.

5. THEORIES AND DESIGN

When designing the application for teenagers, we want to emphasize a fun and entertaining experience which appeals to intrinsic motivators. In this manner our design focuses on the Theory of Meaning Behavior and its finding that says intrinsic motivators are immediate predictors of behavior.

Games that require physical activity input modalities, are used as the medium to encourage the association of physical activity with "fun" and "entertaining." The idea here is that we do not want physical activity to be associated with "hard work" and "routine-like" activity.

The design element that appeals to TPB, includes the animated agent and games used. The animated agent appeals mainly to control beliefs, by providing the user with positive reinforcement in their ability to do the behaviors. Examples of the phrases spoken by the agent are:

- "You have been working really hard! Great Job!"
- "You're the best! You really are on top of things!"
- "Let's keep playing you're doing great!"

For the case of TPB, using games and choosing games that are socially acceptable, engage others, and are simple enough for the user to accomplish were chosen due to TPB's normative beliefs and behavioral beliefs. We argue that games that can be played with others and that are appropriate for the targeted population will result in positive normative beliefs. Games that are engaging and "simple" or "easy to learn and play" will improve behavior beliefs that have to do with the user's belief in their ability to play the game successfully.

Finally, we try to make the application experience as more "enjoyable" by appealing to an individual's personality traits. We argue that differing personality traits will react to different game activities more positively or negatively depending on these traits. For example, someone with higher levels of extroversion would enjoy activities where they can be in social situations than someone in the lower end of the spectrum who enjoys less social situations. In

this case, a game for someone with higher degrees of extroversion would be presented with a game that is played with many people.

6. RESEARCH PROGRESS

This research is a works in progress. Currently, we have received approval by our campus's IRB. We have also recruited teenagers to complete questionnaires and surveys that ask questions related to the tested theories (e.g., personalities, things that motivate and demotivate them to exercise, etc), recruited teenagers to participate in focus groups, and teenagers to test the prototype application. The prototype application has been completed and tested through a pilot study conducted over the summer. The results from this study have been submitted for publication.

The next phase of this research will be to revise the design of our application as needed. Then a longer larger study will need to be completed to test the effectiveness of our application in promoting long term behavior change. For this study, we need to recruit more participants and will have different versions of our system to test the validity of the different design elements, i.e. animated agents and games.

We envision that this project will contribute design requirements for applications that motivate and assist teenagers in attaining recommended physical activity levels. The application itself will encourage and assist in the adoption of long term behavior change towards a more active lifestyle which in turn should improve the adult quality of lives for teenagers. We hope our translation of theoretical choices to design elements will prove to be good predictors for long term behavioral change.

7. ACKNOWLEDGMENTS

I would like to acknowledge and thank Mo Kudeki and Adrienne Woodworth's participation and help with development of the prototype application.

8. REFERENCES

[1] Ajzen, I. 1991. The Theory of Planned Behavior. Organizational Behavior and human decision processes 50, 2 (1991), 179-211.

[2] CDC, "Center for Disease Control and Prevention: Overweight, and, Obesity,", 2009., URL= http://www.cdc.gov/obesity/index.html

[3] Consolvo, S., McDonald, D.W. and Landay, J.A. 2009. Theory-driven Design Strategies for Technologies that Support Behavior Change in Everyday Life. In Proceedings of the 27th International Conference on Human Factors in Computing Systems (Boston, MA, USA). ACM Press, New York, NY, 405-414. DOI= http://doi.acm.org/10.1145/1518701.1518766

[4] Fujiki, Y., Kazakos, K., Puri, C., Buddharaju,P., Pavlidis, I., and Levine, J. 2008. NEAT-o-Games: Blending Physical Activity and Fun in the Daily Routine. Computers in Entertainment (CIE). ACM Press, New York, NY, 21:1-21:22. DOI = http://doi.acm.org/10.1145/1371216.1371224

[5] Hardeman, W., Kinmonth, A.L., Michie, S., Stephen, S. 2009. Impact of physical activity intervention program on cognitive predictors of behavior among adults at risk of Type 2 diabetes (Pro Active randomized controlled trial). International Journal of Behavior Nutrition and Physical Activity, 6-16.

[6] Klopping, I.M., and McKinney, E. 2004. Extending the Technology Acceptance Model and the Task-Technology Fit Model to Consumer E-Commerce. Information Technology Learning and Performance Journal 22, (2004), 35-48.

[7] Martorell, R., Khan, L.K., Hughes, M.L., and Grummer-Strawn, L.M. 1998. Obesity in Latin American

Women and Children. Journal of Nutrition 128, 9 (1998), 1464-1473.

[8] Nigg,C.R., Lippke,S., and Maddock, J.E. 2009. Factorial invariance of the theory of planned behavior applied to physical activity across gender, age, and ethnic groups. Psychology of Sports and Exercise 10, 2 (2009), 219-225.

[9] Oliver, N. and Flores-Mangas, F. 2006. MPTrain: A Mobile, Music and Physiology-based Personal Trainer. In Proceedings of the 8th Conference on Human-Computer Interaction with Mobile Devices and Services (Helsinki, Finland). ACM Press, New York, NY, 21-28. DOI = http://doi.acm.org/10.1145/1152215.1152221

[10] Shiner, R., and Caspi, A. 2003. Personality differences in childhood and adolescence: measurement development and consequences. Journal of Child Psychology and Psychiatry 44, 1 (2003), 2-32.

[11] Spruijt-Metz, D. 1995. Personal incentives as determinants of adolescent health behavior: the meaning of behavior. Health Education Res. 10, 3 (1995), 355-364.

[12] Toscos,T, Faber, A., An, S. and Gandhi, M. P. 2006. Chick Clique: Persuasive Technology to Motivate Teenage Girls to Exercise. Conference on Human Factors in Computing Systems Extended Abstracts on Human Factors in Computing Systems (Montreal, Quebec, Canada). ACM Press, New York, NY, 1873-1878. DOI = http://doi.acm.org/10.1145/1125451.1125805