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Encouraging Physical Activity in Teens

Can technology help reduce barriers to physical activity in adolescent girls?

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***Abstract*—Physical activity levels of girls decline dramatically during adolescence and may be a contributor to the increasing number of obese teens in the United States. Research has shown that social support is positively correlated with physical activity levels in adolescents, particularly girls. We present the findings from a three week field study of a mobile phone application designed to create a support group for physical activity within an existing social network of adolescent girls. Our findings suggest design considerations for technologies that encourage physical activity for this user group.**

***Keywords*—persuasive technology; fitness; physical activity; activity-based applications; mobile phone.**

I. INTRODUCTION

The physical, emotional and mental health benefits of physical activity are well documented yet half of U.S. adolescents (ages 11 – 21) are not active at recommended levels, defined as 60 minutes or more of moderate intensity activity every day [12]. A recent nine year study of more than 2000 adolescent girls revealed that body mass index (BMI) increased with relative decreases in physical activity levels, showing that inactivity may be a contributor to the three fold increase in adolescent obesity during the past 20 years [5].

Levels of physical activity begin to decline during adolescence, particularly among girls [12]. The Trial of Activity for Adolescent Girls (TAAG) is a large multi-center study conducted in the U.S. that is devoted to finding ways to reduce the decline of physical activity in adolescent girls [15]. The results of this trial reveal *verbal persuasion*, *modeling*, and *social support* from family and peers help girls overcome barriers and become more physically active [15, 16], a finding supported in many other studies [1 ,4, 10]. Duncan et al. found that social support from friends, when compared with that from parents or siblings, had the strongest relationship with physical activity levels. We would like to identify ways in which mobile technology may augment the natural forms of support adolescent girls may offer each other in encouraging the uptake of physical activity.

In this paper we report the findings from a 3 week field trial of technology designed to encourage physical activity in teenage girls by leveraging the power of personal relationships. The technological intervention used in this study consisted of a mobile phone application and pedometer which work together to provide a group support system that promotes walking towards a self-established daily step goal. Entered step counts are shared within the group with text message notification of step updates. The application also allows the user to send motivating text messages to all or individual members of the group. The design process used to develop this system is described elsewhere [13].

There have been many recent studies where technology was used to leverage social influence as a means of encouraging physical activity. In fact, Consolvo et al. found supporting social influence a key design requirement for this type of technology in their study of *Houston* [1], a similar mobile phone application tested on groups of adult women. *Fish'n'Steps* [6], *Jogging Over a Distance* [8] and *Shakra* [7] also use social influence as a physical activity motivator in their designs for adults and found it to be important.

Our research is focused on indentifying the extent to which adolescent girls may use mobile technology to augment natural methods of supporting the physical activity efforts of their close friends. Our hypothesis is that *encouraging text messages, the sharing of step counts,* and the *social support of an existing social network* will all work together to motivate physical activity. The aim of the 3 week field trial was to assess whether adolescent girls would actually use the technology to support one another with encouraging text messages and determine if these text messages coupled with the sharing of step counts would promote a supportive environment. Our findings offer considerations for the design of technologies that encourage physical activity in adolescents.

In the following sections we will describe the technology and method used in the two week field study then describe our findings. We conclude by discussing the implications for the design of technologies that encourage physical activity in teens.

II. METHOD

Three groups of girls were recruited from a large middle school in the U.S. to participate in the three week study. Prior to initiating the study, Internal Review Board approval was obtained from both the university and the school corporation. Written parental consent was secured for each participant. The school's guidance counselor recruited the participants taking care to ensure that each group was comprised of girls who were good friends prior to the study. Although the application is designed for groups of up to 4 girls the groups had 3 (Groups 1 and 2) and 2 (Group 3) participants each. All the participants were 13 years old and in the seventh grade.

A. Week 1: Baseline Pedometer Readings

During the first meeting the participants were given a pedometer and instructions on use. They then completed questionnaires concerning perceived barriers to exercise, using a modified version of the *Barriers to Being Active Quiz* [9], and current levels of physical activity. They were asked to wear a pedometer every day for one week and record their steps using a paper journal to get a baseline value in order to establish a personal step goal.

B. Week 2 & 3: Field Trial of Technology

At the end of week 1, participants were given a Nokia N73, with a pre-paid phone service, running the application. Participants were asked to determine a step goal based on the week 1 step counts. Each day for the next two weeks, they were asked to keep track of the number of steps they were taking using the pedometer and to enter their step counts into the mobile phone application several times each day. The application would then send their step counts to their group, enabling each girl to compare her progress to that of her friends. In addition to propagating step counts, the application allowed participants to send text messages to each other to encourage walking. All text messages received by individual participants were logged on a web service and published daily on a secure personalized web journal. Participants were asked to review the web journal each day in order to reflect on the motivational value of the text messages they received from their friends. Their step history was also published on the web site and they were asked to reflect on their progress towards their personal step goal. The web journal was not a part of the intervention but rather a study tool to capture in-situ evaluation of how the text messages impacted the participants. Individual, semi-structured interviews were conducted at the end of the third week for more detailed feedback about the intervention.

III. FINDINGS

The supportive mechanisms we tried to create with our technical solution are next described through the eyes of the eight teenage girls who used it for two weeks. Pre-study barriers questionnaire revealed *Lack of Energy* and *Lack of Time* as the top barriers to physical activity for our participants. This finding is consistent with results of a study of over 2000 adolescent girls studied for 9 years [4] showing that the study participants experienced 'typical' barriers. Other barriers written in by participants included child care responsibilities "*I have to babysit a lot because my mom works a lot."* and concern with changes in body size "*I guess sometimes I'm still concerned that if I exercise too much I will look too bulky."*

A. Verbal Persuasion: Persuasive Text Messages

Although text message support systems have shown promise as means of motivating adherence to insulin therapy in adolescent diabetics [3] and smoking cessation [11], it is not clear that text messages could be used to motivate increased physical activity. Given the established importance of support from peers and family on teenage girls' physical activity levels we can infer text messages may be helpful [16]. The problem we found in this study was that the girls did not know how to construct motivating messages. The following quote is representative of the participants' concerns.

"I didn't know what to say to them that would make them feel motivated without making them feel like I was you know, being like 'I have more steps than you' or anything like that." <p1>

We reviewed all of the text messages that were sent between group members during the study and found there were very few that could be interpreted as motivational, most were trivial conversations and casual messages such as *"Walk 10000 steps for the Easter Bunny today."* The participant who received this message found it un-motivating *"because it was really like she was just joking."* P2 found that specific text messages such as *"We're going to meet you at the [fun raising walk] and then we're going to have lots of fun and get lots of steps"* were more motivating than general ones like *"Keep stepping!"*

When the participants were asked in post-study interviews about text message support systems –including either a system that sent messages from a health teacher or automated messages generated from a database – nearly all felt it would be *"weird"* and impersonal, *"not reaching you the way a friend would."* One approach to facilitating effective text messages may be to pre-load the content as is commonly done in e-greeting card messages. This design would empower users to efficiently create their own content.

B. Modeling: Sharing Step Counts

Sharing group step counts was done as an effort to promote modeling of healthy behavior which has been shown to have a positive relationship with activity levels in adolescent girls [2, 12,15]. The average step count for nearly all of the participants increased in the second and third weeks after the mobile phone application was introduced (Fig 1). This is self report data on a limited number of participants so the result should be interpreted carefully but it may indicate the success of our design. P8 discusses how sharing steps impacted her.

"Sometimes if I had a lot fewer steps than my friends did I would get motivated." <p8>

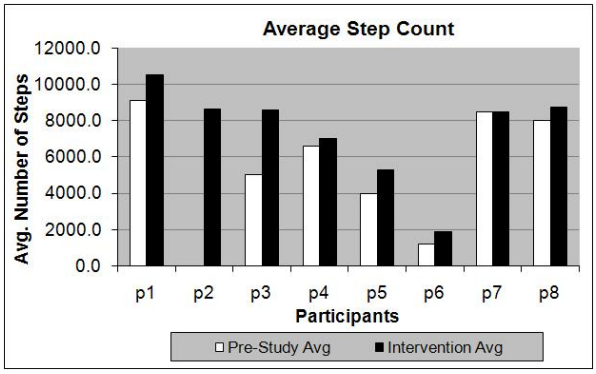

Figure 1. Average Step Count for each Participant

The application was presented to the participants as a means to support each other towards achievement of walking goals but when the technology was put to use the sharing of step counts was viewed as a competition. Competition between friends can be a fun way to create motivation for exercise but if competition is taken too far it may contribute to bad feelings and or bad behavior. The following quotations are from the three participants, all members of Group 1, explaining their response to sharing step counts during the study period. When describing her experience, P2 finds the competitive element of the application as a positive aspect.

"It gave me a chance to have a little healthy competition with myself as well as my friends too. We're not talkative after school so its nice to have that little connection …" <p2>

P2 perceived sharing step counts as a "*healthy competition"* that also kept her connected with her friends. Similarly, P8 was motivated by the competition and didn't feel it would ever be an unhealthy experience among her group.

"I can see that if we were really competitive and stuff that after a while if you just got really sick of everyone doing better than you or if someone got really braggy about it. But I don't think that would happen with us."<p8>

Although she was not worried about the competition becoming negative with her friends, she was able to imagine circumstances in which competition could become negative. P1 had stronger feelings that the application would become negative if used beyond 2 to 3 weeks, even among her group.

"I think for the [study] period of time it was fine but I think if we did it for longer it would start getting kind of cut throat even to just get more steps, lame as that sounds. But um, for a short period of time I think it's a "healthy" kind of competitive but if people were using this for a long period of time I'm not sure it would be healthy for a friendship."<p1>

Creating unhealthy competition is a serious concern when designing applications for adolescent girls given their sensitive stage of development. One way to address the issue is by removing the competitive element that occurs directly between friends and creating an individualized competition where progress in a game is shared with friends. In this way there is still modeling of healthy behavior but it may be less likely to be perceived as a direct and unpleasant competition.

C. Social Support: Group Composition

Each of the three groups involved in the study were comprised of girls who were already "best friends." Social support is an important motivator that can help reduce perceived barriers such as *Lack of Energy* and *Lack of Time* through the power of a friend's suggestion. The graphs in Figures 2 – 4 present group step counts for weeks 2 and 3 of the study when the intervention took place. Steps were entered an average of 2.6 times per day, typically in the afternoon and evening. A comparison of these three graphs reveals how the

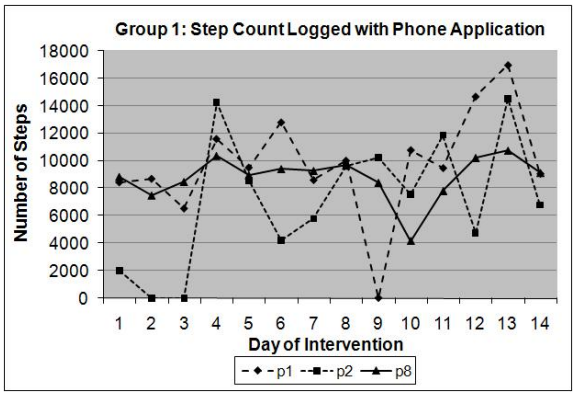

Figure 2 – Group 1 Step Count Logged with Mobile Phone

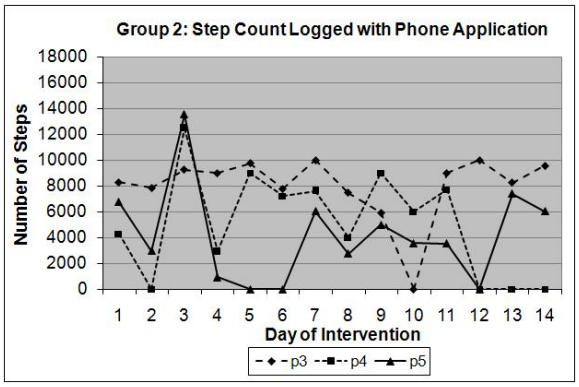

Figure 3 – Group 2 Step Count Logged with Mobile Phone

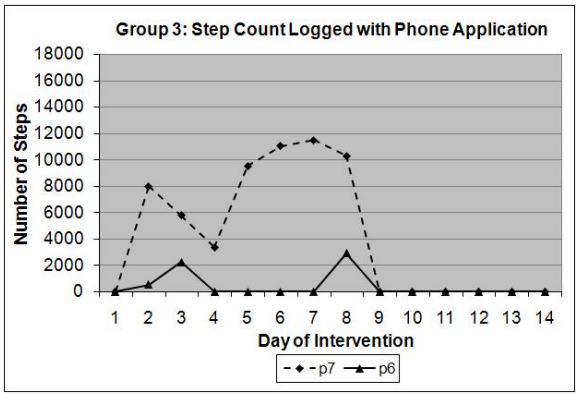

Figure 4 – Group 3 Step Count Logged with Mobile Phone

removal of social support, in this case failure to share step counts, can have an adverse affect on the use of a technology. Figure 4 indicates P6's lack of participation showing 11 days where she entered no steps at all. At the completion of the study P6 reported that she hadn't worn the pedometer during sports practices which reduced her step counts. In the post-study interview with P7, she reported that her group member's lack of participation impacted her motivation to participate and this is represented in Figure 4 which shows P7 discontinuing use of the application after 8 days of minimal input from P6. The potential negative effect of removing social support is an important design consideration when developing technology that encourages physical activity.

Large groups comprised of acquaintances or strangers were not desirable as is explained in the following quote.

"If I just compared <my steps> to everyone in class I don't think it would really much affect me at all, I don't know why I just don't think it would. I liked that I was really close friends with them because then I could be open with my steps and all and I felt more comfortable talking about it with them." <p8>

The intimacy of a small group of friends was consistently reported by participants as a benefit of the intervention. Personal fitness information is most easy to share with good friends and good friends are the ones who play a large role in motivating behavior, particularly during adolescence. One participant described the intervention as "*the same thing like with peer pressure, except its good peer pressure. Like when most of your friends do it you want to do it too."* The challenge for developers of technology to encourage physical activity is to allow for *good* peer pressure while minimizing opportunities for *bad* peer pressure.

IV. DISCUSSION

While our findings are limited by a small sample size and short field trial duration, we feel the qualitative feedback from participants offers some useful design implications for similar types of technology. Design considerations include:

1) The technology should provide scaffolding for the content of persuasive text messages that encourage physical activity. Automated messages may not be effective but should be tested given other research that has shown success with such systems.

2) Modeling is an effective method of influencing behavior change but care should be taken to avoid direct forms of competition that can be perceived negatively.

3) Social influence can have negative effects when there is no reciprocity. Systems should be designed to avoid this complication. For example, in an application like ours automated messages could be sent to prompt users to enter steps when they have failed to do so. Messages would be sent in a sensitive manner as to avoid 'nagging' the user.

4) Group composition is important for this age group. Small groups of close friends were preferred over large groups.

This study has shown how technology may play a part in reducing the barriers to physical activity experienced by adolescent girls. Although we did not specifically look at this, there was evidence that intervention may have had impact on other parts of the girls' social support system, simply through their use the application. P2 had cited in her pre-study questionnaire that one barrier she experienced was a lack of support from her family members who were not physically active. When prompted in the post-study interview about how the intervention impacted this barrier she stated the following.

"None of my family members like to exercise … that use to be the case but [my use of the application] is helping because now they're all pumped about it. I'm going to try to get more steps during the day during small breaks during the day. Just fitting walks in whenever I am just sitting around contemplating." <p2>

In addition to highlighting the positive impact to her family, P2 is describing a commitment to increasing physical activity beyond the intervention period. While this may be a byproduct of participating in the study, it may suggest that applications like these have a lasting impact, even after use is discontinued. The potential use of technology to encourage physical activity is evident in novel products such as Dance Dance Revolution, and Nintendo's Wii Sports. Continued research is required to determine if ubiquitous technology can also be effective in this population. We have provided design considerations based on our experience to inform the design of future technologies.

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