Peer Influence in a Self-Tracking Pervasive Fitness System for Adolescents: A Comparison Study

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Abstract

We describe findings from a deployment of a self-tracking pervasive fitness system for adolescents, and contrast it to a social version of the same system (StepStream). Overall, students in this study did not improve their attitudes about health and fitness, and there was no overall increase in daily physical activity. We provide evidence for two contributing factors: the specific social structure of the participant group, and the persuasive design of the system. Our results show that even a group with strong social ties will not necessarily leverage those connections for fitness without encouragement from the system. This study also provides evidence that attitude and behavior change seen in other deployments (especially the 'social' version of StepStream) are also due to these factors, and not merely the result of novelty effects or researcher bias.

Introduction

Social computing platforms hold much promise for enabling everyday health behavior change. Adolescent fitness has proven to be a particularly fertile domain for exploring these issues: daily lifestyle activity is universally applicable and tractable from an informatics perspective, and adolescents are both an important population for fitness programs and particularly receptive to peer-based solutions. However, understanding and isolating the contribution of social persuasion features can be challenging.

In our own work, we have studied peer-based adolescent fitness systems, both competitive (such as the American Horsepower Challenge, a school-based pedometer competition [1]) and collaborative, such as our own system, StepStream[2]. In this paper, we report findings from a comparison study of two versions StepStream: the 'social' version previously reported, and a 'self-tracking' version, as similar to the social version as possible but excising the social awareness and support features in the 'social' version. We sought to understand the impact a *self-tracking* system would have on students' attitudes and behaviors—without the competition mechanic used by systems like the AHPC, and without the social awareness mechanic used in other StepStream deployments. This comparison study provides evidence that attitude and behavior change seen in other deployments (especially the 'social' version of StepStream) are also due to these factors, and not merely the result of novelty effects or researcher bias. We also argue that designing for existing groups may be beneficial, and describe design challenges for this population.

Background

In recent years, the HCI and Health Informatics communities have devoted serious attention to obesity prevention interfaces and systems. Much of this work focuses on individual health goals for adults. However, adolescent fitness is an increasing area of focus. Adolescents stand to benefit greatly from early obesity prevention interventions, and researchers have had success deploying youth-focused pedometer-based fitness systems in schools and communities.

Our own StepStream system is one recent example. We designed and deployed a school-based pervasive fitness system for adolescents that focused on improving attitudes to fitness and daily step activity through peer encouragement. Over the course of a 4-week study, students wear wireless Fitbit Zip pedometers every day. Students' step-counts are collected by a wireless base station in the school and transmitted to the StepStream website. After a baseline week to establish initial activity levels, students are given access to the StepStream website for three weeks (for a combined four-week study). On the StepStream website, each student can view her own historical activity, but raw step counts are hidden from the other students. Instead, students are assigned "activity points" based on their own personal baseline from the first week. The system provides social rewards using these activity points, and students can redeem their points to play a racing game on the site. Both at home and in weekly check-in meetings in the school computer lab, students log on to the StepStream website to check their activity, play a racing game and socialize in a live chat stream. Students who have exceeded their baseline on a particular day are rewarded with a congratulatory system message.

StepStream users improved their attitudes about fitness (self-efficacy for fitness activities and sense of expertise about fitness) and increased their sense of social support for fitness (received peer social support). We measured users' attitudes and beliefs using several standard measures from the sports psychology literature The least-active students also increased their daily activity. Moreover, students in the StepStream study performed comparably in attitude and behavior change to other adolescents using more competitive or direct-comparison systems.

Method

We conducted two full deployments of StepStream: a 'self-tracking' deployment at one school—reported in this paper—and a 'social' deployment at another school, described in a previous paper [2].The 'self-tracking' deployment represents a contrast to the 'social' deployment—a different school and a different feature set—while maintaining several common elements, such as the underlying technology platform and general participant demographics.

1. System

In this study, we deployed the 'self-tracking' version of StepStream. Students wore Fitbit Zip pedometers, and used the 'self-tracking' version of the StepStream website, where they could see their own progress but not interact with each other online. We tried to make the two systems as similar as possible; both the 'social' and 'self-tracking' versions of StepStream include the same pedometer/base-station setup and were designed for school-based deployments; they even run on the same code base. However, users of the `self-tracking' version can only see their own information on the system itself, while users of the `social' version can also write and respond to social messages. Both versions include a game, but the `social' version also includes a `play-along' mechanic where users race alongside up to three of their friends.

2. Participants & Deployment

We conducted a four-week deployment with 12 Atlanta-area middle school students during the months of March and April 2013. Students wore pedometers for one week without using the website, then wore pedometers and used the website for three following weeks. As with the system design, we tried to find as similar a school and participant population as possible, ultimately selecting a demographically similar school in the same district as the 'social' deployment, and conducting both deployments simultaneously to control for other external factors such as weather.

Four boys and 8 girls participated. All students were African American (school: 98%). The median age for participating students was 13.5, and all students were in the 7th and 8th grade. As with the 'social' school, the school in this deployment served a majority-minority low-income community. Students were more overweight than average: 9 students self-reported BMIs (age-adjusted height-weight ratio) that qualified them as overweight or obese (national average: 33%[3]). Additionally, significant race-correlated health disparities exist in their local community.

We met with students as part of an existing after-school club. Students in the club complete projects in their school or community, and then document those projects and submit them to competitions. Students wore pedometers for one week without using the website, then were given access to the website for the remaining three weeks. A base station located under the teacher's desk transmitted students' step activity to the StepStream website. We met with participating students three times: a week before the deployment, at the official start of the deployment, and at the official end of the deployment.

3. Data Collection & Analysis

We evaluated the 'self-tracking' version of StepStream using the same measures as the 'social' version: pre/post surveys, focus groups, login & gameplay analysis and step data analysis. We surveyed participating students on their attitudes and perceptions to physical fitness, using the same survey instrument from the 'social' StepStream deployment. This survey instrument incorporated validated measures of self efficacy, expertise, intrinsic motivation, enjoyment, and social support for youth fitness interventions. After the deployment concluded, we conducted a focus group with all participants.

We collected login and gameplay data from the system—to see when participants used the StepStream website and when they played a game—and collected step data recorded by their pedometers and uploaded to StepStream. To analyze students' step data, we concentrated on a sub-sample of 5 students who ended the study with sufficient baseline and post-baseline data for analysis (following best practices from the youth pedometer literature [4]). The 5 students in our sub-sample were representative of the participant population in terms of BMI, ethnicity, gender, baseline activity level, and average age. We imputed missing data using the baseline average (that is, assuming no change post-baseline) and performed repeated-measures ANOVA tests for significance [4].

Findings: Fitness Attitudes & Behavior

There was no statistically significant increase in attitudes and perceptions of fitness, and participants did not increase their daily step-counts. However, the study did generate interesting findings about the effects of the existing social structures and strong social ties in the participant population, and the effect of students' competitive attitude on system use. Students' attitudes about fitness, self-reported time engaging in fitness activities, and enjoyment of physical activity were unchanged after using StepStream. Their sense of social support for fitness actually declined slightly on two measures: how likely they were to exercise together [$t(12)=1.95$, $p<.05$] and how likely they were to *offer* to exercise with friends[$t(12)=2.12$, $p<.05$]. Participants also reported being less likely to get rewards for exercise [$t(12)=2.83$, $p<.05$].

Participants did not statistically significantly improve their daily average step counts during the deployment. Participants walked an average of 5238 steps/day during the baseline week and 5822 steps/day during the three following weeks, but with a p-value of 0.12 this result was not statistically significant.

Findings: Friendship, Competition & Awareness

Participants in this study were already part of a close-knit group. In our prior work, we have studied groups of adolescents brought together for the purpose of the research. In the AHPC, schools often held lotteries for participation; in our own formative studies, teachers and principals worked together to select an applicant pool. However, the participants in this study were all part of a small, close-knit after-school club, altering the social dynamics of the deployment. These students were quite obviously 'strong ties': they knew each other by first name, chatted about many topics during our meetings, and generally behaved as a group of friends would.

The participating students and teacher were very interested in competition, but this did not lead to increased mutual awareness of each others' physical activity. The club itself is a competitive one, and during the deployment participating students presented their projects in a statewide contest. During the first meeting, the teacher tried several times to describe the 'self-tracking' deployment as a competition. However, this competitive interest did not appear to lead to more *awareness* of each other's activity. During the two meetings in which we observed students using the system, they would walk over to another student's computer and check to see the user's nickname and avatar and then try to assess which of them was getting more steps. However, these conversations did not appear to lead to further discussion or awareness of each others' activity, as evidenced by the flat social support ratings.

Students' lack of mutual awareness (with respect to physical activity) also became apparent in the post-study focus group. When we asked the students what they did to get steps, several students reported one of their biggest walking days as a group had been the day they were all together on a field trip. But when we looked at the step average for that day, it was no more active than any other day.

Discussion: Contributing Factors

Our 'self-tracking' study shows that deploying a pervasive fitness system to adolescents does not necessarily lead to improvements in attitudes and performance. This is encouraging; it means that any improvements seen in other deployments of StepStream do not come solely or even predominantly from novelty effects or excitement about participating in a high-tech deployment. As with any ecologically valid study, there are a number of contributing factors at play. After surveying possible contributing factors, we found only two with the potential to meaningfully contribute to study outcomes: participants' social dynamics and the design of the 'self-tracking' system.

1. Persuasive Design Elements & Social Dynamics

Of all the potential contributors to the attitude and behavior outcomes of the 'self-tracking' study, the lack of social awareness and competitive elements in the system design is the most likely. All the elements present in the 'self-tracking' system (Fitbit pedometers, website platform, individual progress reports) are also part of the 'social' system, and are common to other pedometer systems like the AHPC. However, the 'self-tracking' system offers no easy mechanism for data-driven social comparison, no goal-setting interface, no mechanism for peer encouragement or social support. It does not suggest ways to increase physical activity nor does it offer a mechanism by which students might schedule exercise together.

Participants in the study had a strong social cohesion prior to engaging in the research, and met frequently throughout the year. And yet their strong ties did not lead to an increase in social support for fitness, and observational learning of new fitness behaviors did not appear to occur either. This finding is somewhat surprising, because these students appeared to have high levels of mutual peer support in other facets of their lives, especially their club's projects and activities. Intuitively, one might assume that strong social bonds would naturally extend to fitness when given the opportunity.

2. Non-Salient Factors

The following factors did not appear to contribute meaningfully to participants' health attitudes and behaviors: initial attitudes & behavior patterns; willingness to engage; and the frequency of in-person meetings. Participating students' initial attitudes towards fitness and sports were not that different than students in other StepStream deployments. Students' average step counts were slightly lower than those of students in the 'social' study (5726 steps per day, compared to 6408 steps per day for the social group), but given the similarity in the two populations' attitudes towards fitness there is no reason to believe this factor would inhibit activity improvement. Indeed, students with lower baseline step counts in the 'social' study actually increased their daily averages more than those with higher baseline step counts.

We saw few signs of disengagement during the study. In fact, if pedometer retention is anything to go by, participants in this study were more engaged than any other we've conducted! Only two students lost their pedometers, and the rest of the students wore their pedometers for an average of 20 days out of 27. Participants' website use was also within expectations: students logged in an average of 4 times each, compared to 6 logins per student for the 'social' deployment. We believe the averages might actually have been equal if we had been able to conduct two additional in-person meetings.

Students in the 'self-tracking' study attended fewer study meetings than we had intended (and fewer than those in the 'social' study), which might have led to reduced engagement or efficacy of the system. We certainly found that for the 'social' configuration, regular in-person meetings were key to the system's success. However, if the 'self-tracking' meetings we did attend are anything to go by, the difference may not have been nearly as stark as one might imagine. When we observed the students using StepStream, their interaction with it was very short. They logged in, looked at their historical activity and averages, and logged out.

We also saw no evidence of significant *negative* effects of social interaction on participants' attitudes or behavior. We hypothesize that such negativity (and thus demotivation and shame) arises primarily from users' ability to make direct comparisons and to compete with each other.

Conclusion

We cannot say definitively how much each of the preceding factors affected the outcome of the study. The very things that make the deployment compelling—the 'in the wild' nature of the deployment, the small scale focus on one deployment site—also inhibit clean analysis. Certainly the small number of participants compared to the 'social' deployment reduces the statistical power of the survey and step count findings and prevents direct comparison, and no two schools are exactly alike. But the evidence we *have* collected strongly suggests that the deployment of a pervasive fitness system is not enough in itself to generate improved fitness attitudes or behaviors. Many things were equal, or as close to equal as possible. In the end, this study shows the importance of two key factors in social tools for everyday adolescent health: the scale & social connectedness of the participant population, and the presence of persuasive elements in the design of such systems.

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