Research Proposal

Group 27
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Background

Poor mobility, decreased muscle strength and poor balance have been associated with a poor prognosis in elderly subjects. In Blain (2010) balance and walking speed predicted subsequent 8-year mortality in well-functioning women aged 75 years and older, even after adjusting for risk factors such as cancer, hypertension, diabetes, depression, cognitive impairment and other factors. The study suggests that further research is needed to determine the precise mechanisms at work, and to determine whether an intervention aimed at increasing balance and gait would increase life expectancy. We propose to investigate ways to encourage older women to walk more, in the hopes that should it be demonstrated that improving balance and gait increases life expectancy then one of the simplest methods would be to increase time spent walking.

In Kamal (2013) a framework is developed for using an online social network to encourage positive health behaviour change. Older women are not as likely to be as comfortable or familiar with online social networks as younger people. Introducing them to this tool is likely to be highly beneficial and may have other psychosocial benefits, as well. Bandura (2004) lay the groundwork for this type of intervention by observing that human health is a social matter and not just an individual matter.

In Consolvo (2006) it is demonstrated that sharing step counts motivates people to stay active. We propose having our subjects wear a Fitbit (model Zip) that measures ‘total steps’ and ‘very active minutes’ and then wirelessly transmits the data to a computer.

Bickmore (2007) explores strategies for interrupting users to perform a healthy behaviour and notes that certain strategies are more or less successful with short and long term adherence. Many exercise-oriented social sites use challenges as a way to engage users and increase activity.

While we expect that simply having subjects wear a Fitbit and share the information generated with others on an online social network will have a positive effect on the number of steps taken and the number of very active minutes, we would like to go further and have subjects issue challenges to other subjects. We would like to use the principles of statistical machine learning to develop an algorithm that generates the most effective such challenges. Once developed, the algorithm can then suggest challenges for one user to send another that will result in the most benefit.

Proposed Methodology

To assess the effect of wearable technology (WT) the combination of a learning algorithm applied to social networking sites (SNS), we propose to conduct a three-factor completely randomized design experiment. Our subjects will be a pool of 600 women from ages 45 and above from random backgrounds in US or Canada who have not used WT or SNS on a regular basis. They will be randomly assigned to one of the following three groups: (a) a standard control group to which only WT is given, (b) a social media group to which both WT and SNS are given, and (c) an intervention group to which WT and an SNS system incorporating a challenge-issuing learning algorithm. Data analysis would be performed using statistical methods on fitness data collected by the WT, such as tracking changes in average steps taken or differences in average active minutes across treatments.

The standard control group (a) will have access to a digital record of their fitness data. The social media group (b) will be able to share this WT data with contacts in their network. Finally, the intervention group (c) will receive SNS feedback that includes a various challenges such as gamification of simple goals, one-on-one competition, and preference and progress interventions. Subjects will be observed over the course of 12 months and the results will be measured quantitatively by the WT as the intensity and duration of daily activity sessions.

Using a three treatment design allows us to determine if the effects suggested by Kamal (2013) holds for women over 45 by comparing treatments (a) and (b). Comparison of the results from treatments (b) and (c) allows us to quantify the fitness effect of the challenge-proposing algorithm. Finally, comparison across all three levels allows us to determine if there is a greater synergistic effect (or gestalt effect) present - that is, if the effect of the whole treatment is greater than the sum of the effects of its parts.

We intend that the learning algorithm be developed using a connectionist network. The inputs to the model would be a combination of user activity data (such as steps taken, very active minutes), and social network data (such as number of friends, best friends, sharing frequency, challenges accepted). The outputs would be fitness challenges which the user can then issue to contacts in their SNS. The fitness challenges are deemed "good" if they are attempted frequently, with high rates of successful completion. Conversely, the fitness challenges are "bad" if they have poor rates of participation and completion. We envision that the network will use the response data for previously suggested challenges to modify the weightings of its hidden units such that it proposes good challenges at a higher rate.

Bandura, A. (2004). Health promotion by social cognitive means. Health Education & Behavior : The Official Publication of the Society for Public Health Education, 31(2), 143-164. This article makes the point that human health is a social matter, not just an individual one and stresses that belief in one's efficacy to exercise control affects initiation of habit change, motivation and perseverance, the ability to recover from setbacks and maintenance.

Bickmore, T., Mauer, D., Crespo, F., & Brown, T. (2007). Persuasion, task interruption and health regimen adherence. (pp. 1-11). Berlin, Heidelberg: Springer Berlin Heidelberg. Authors explore strategies for interrupting users to perform a healthy behaviour. The degree of politeness is positively correlated with long-term adherence, but negatively correlated with short-term adherence. Empathic interruptions are superior for short and long-term adherence.

Blain, H., Carriere, I., Sourial, N., Berard, C., Favier, F., Colvez, A., & Bergman, H. (2010). Balance and walking speed predict subsequent 8-year mortality independently of current and intermediate events in well-functioning women aged 75 years and older. The Journal of Nutrition, Health & Aging, 14(7), 595-600. This paper shows that walking speed and balance predict subsequent mortality rates in older women even after controlling for other conditions. The paper does not offer a mechanism, but suggests more research and possible interventions.

Christakis, N. A., & Fowler, J. H. (2007). The spread of obesity in a large social network over 32 years. The New England Journal of Medicine, 357(4), 370-379. A study of 12,067 people showed a person's chance of becoming obese increased if he or she had a friend, sibling or spouse who became obese. Network phenomena appear to be relevant to the trait of obesity.

Consolvo, S., Everitt, K., Smith, I., & Landay, J. (2006). Design requirements for technologies that encourage physical activity. Paper presented at the SIGCHI Conference. Given that clinical studies have shown that health benefits can occur from simply increasing the number of steps one takes each day and that social support can motivate people to stay active this paper explores an app for encouraging activity by sharing step counts with friends.

Consolvo, S., Klasnja, P., McDonald, D., & Landay, J. (2009). Goal-setting considerations for persuasive technologies that encourage physical activity. Paper presented at the 1-8. This paper explores individuals' reactions to goal-setting, goal sources and goal timeframes using a persuasive technology to encourage physical activity.

Frost, J. H., & Massagli, M. P. (2008). Social uses of personal health information within PatientsLikeMe, an online patient community: What can happen when patients have access to one another's data. Journal of Medical Internet Research, 10(3), e15. This paper explores how patients with a particular condition (ALS in this case) can benefit from sharing what would otherwise be considered confidential information in an online social network site.

Kamal, Fels, Blackstock and Ho, The ABCs of Designing Social Networks for Health Behaviour Change: The VivoSpace Social Network, p. 323-348 of Kranakis, E. (2013). Advances in network analysis and its applications Springer Berlin Heidelberg. This paper develops the Appeal Belonging Commitment (ABC) Framework for participation in an online social network, with the aim of promoting health behaviour change.