

# Technological Approaches to Promoting Physical Activity

**Julie Maitland**

People-Centered Technologies Group  
National Research Council Canada  
46 Dineen Drive, Fredericton, NB, E3B 9W4  
julie.maitland@nrc-cnrc.gc.ca

**Katie A. Siek**

Wellness Innovation and Interaction Lab  
University of Colorado at Boulder  
430 UCB, Boulder, CO, 80309-0430  
ksiek@colorado.edu

## ABSTRACT

This paper reflects on the HCI community's current and potential contributions to the problem of promoting physical activity. It does so by first presenting a conceptual overview of existing research, and then draws from the findings of a study of attitudes towards health and health-related behaviour to frame a critical review of the current state of the art. In doing so, we identify an area of outstanding need and opportunity for future research: conveying the value of physical activity to those unconvinced of its importance.

## Author Keywords

physical activity, persuasive technology, low-income

## ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI):  
Miscellaneous. J.3. Life and medical sciences: Health.

## INTRODUCTION

Physical activity promotion has been a topic of interest in the HCI community for several years now. At the core of research efforts has been the development of physical activity monitoring capabilities and activity inference techniques. A second strand of research addresses the design of engaging and effective user experiences that promote participation in physical activity. As physical activity promotion matures as an application domain, it is necessary to reflect on what has been achieved so far and consider how HCI can further contribute. This work provides such reflection by presenting a conceptual overview of existing research, and then uses a study of attitudes towards health and health-related behaviour to frame a critical review of the current state of the art. In doing so, we identify an area of outstanding need and opportunity for future research: conveying the value of

© ACM, (2009). This is the author's version of the work. It is posted here by permission of ACM for your personal use. Not for redistribution. The definitive version was published in *OZCHI 2009*, {VOL#, ISS#, (23-27 November 2009)} <http://doi.acm.org/10.1145/{nnnnnn.nnnnnn}>

physical activity to those unconvinced of its importance.

## THE STATE OF THE ART

In a short paper such as this it is not possible to provide a thorough review of the ongoing work in this area; for this we refer the reader to (Consolvo et al., 2008). Instead, here we provide a conceptual overview that considers the nature of the applications being developed and their scope of impact. Here we categorise three broad genres of applications that encourage physical activity: exercise journals, shared awareness applications and exergames.

*Physical activity monitoring* is an underlying component in each of the genres, although by different means and to different ends. It is commonly combined with goal setting, feedback and social influence components—each of which are considered to be behavioural change techniques. These underlying *behavioural components* are typically employed as informed by one or more *theoretical frameworks*, such as game design theory or principles of persuasive computing. From a user's perspective the genres vary in their obvious *focus* on physical activity, and the *nature of activity promotion* that arises through use of the system.

## Exercise Journals

Keeping an exercise journal is common practice for those who are engaged in an exercise regime. Automated or manual monitoring of physical activity is used to facilitate the behavioural change technique of self-monitoring. The benefits of digital versions are obvious: they can exploit the ever-increasing sensing capabilities of purpose-built (Choudrey et al., 2008) and commodity devices (e.g., Nokia n95 and iPhone), and they can be tailored to the individual to provide interactive goal setting, feedback on progress (Consolvo et al., 2008), and comparison with others (e.g., Nike+). As with the traditional exercise journal, they are assistive: helping the individual to establish a routine and maintain ongoing motivation.

## Shared Activity Awareness Applications

In contrast to the exercise journals, which essentially digitise (and enhance) a traditional practice, these lightweight social awareness applications represent a new genre of health promotion technology. Again, automated or manual monitoring of physical activity is used to facilitate the behavioural change technique of self-monitoring. These applications are typically characterised by the tracking and

sharing of physical activity levels between pre-defined groups of users (Maitland et al., 2006), and commonly combined with goal setting (Consolvo et al., 2006) or explicit teamwork and competition (Lin et al., 2006). We refer to these applications as lightweight because of their playful nature and the relatively low demand on the user. Although physical activity is the focus of the application, it is not absolutely necessary for individual users to be fully focused on physical activity in order to share the experience with other users. These applications are facilitative: they promote physical activity by socialising monitoring and goal setting, while creating a resource for physical activity-related interaction and reflection.

### **Exergames**

The Wii Sport is an excellent example of how well designed exergames and exertion interfaces (Mueller et al., 2003) can increase the physical activity levels of previously sedentary gamers and populations not traditionally associated with computer games (Graves et al., 2007). Unlike the previous genres, these applications are designed to be a standalone experience. Here, automated monitoring is used to facilitate system interaction, i.e., rather than necessarily being the focus of the application, physical activity is a means through which to interact with the system. Mobile games promise to further enhance the potential for consequential increases in physical activity, whether developed specifically for that purpose or for leisure.

From this brief overview we can identify the following **key components** of existing approaches that are embodied in the three genres presented above: physical activity monitoring (manual, automated), theoretical framework (theories of behavioural change, persuasion, game design), behavioural components (self-monitoring, goal-setting, feedback, social influence), degree of focus on physical activity (primary, partial, incidental), and nature of activity promotion (assistive, facilitative, consequential).

### **THE STUDY**

We carried out a study of attitudes towards health and health-related behaviour within a population of low socioeconomic status. Poverty is positively correlated with physical inactivity (Brinkerhoff, 2004) and so it follows that the poor stand to benefit most from recent innovations in physical activity promotion. However, low-income communities are not traditionally considered in the design of applications to promote physical activity. It is outside the scope of this paper to discuss the socioeconomic barriers to such interventions. Rather, here we focus on addressing the context gap that currently exists between current designs and the problem of physical inactivity as perceived by this study's participants.

We carried out a focus group and interviews with primary caregivers of young families. We investigated attitudes and practices surrounding health and health-related behaviours.

The focus group and interviews were transcribed and coded during data analysis sessions, then analysed for emergent themes. A more thorough account of the motivation behind the study and the approach taken can be found in (Maitland et al., 2009).

### **Participant Overview**

We recruited 17 participants; all were women between the ages of 20 and 56 years old. The women were the primary caregivers (mother=14, grandmother=3) for between two and five children. Thirteen were single. Seven women worked full time, and two women worked part-time. Sixteen participants had access to a computer, either at home (9) or at a community centre (7). Thirteen of the participants owned mobile phones and used them daily.

### **FINDINGS**

We found a stark contrast between participants' attitudes towards their own physical activity and the physical activity of their children. Participants appreciated the value of physical activity as an intrinsic part of childhood, and encouraged children's physical play wherever possible. Yet only five participants actively engaged in purposeful exercise; most of the others acknowledged that they did not get enough physical activity but few explicitly expressed the desire or intention to become more active.

Additionally, it became apparent early on in the course of the interviews that of the two behaviours being discussed, dietary intake was of the utmost concern to the study participants. The participants were aware of the strengths and weaknesses of their families' dietary habits and were motivated to make changes, but lacked the resources needed to do so (Maitland et al., 2009). Here we present our findings that suggest external barriers to increasing physical activity levels within low-income caregivers are compounded by a low perceived value of physical activity and low investment in self.

### **Busy Inactivity**

Lack of time and exhaustion were the primary reasons given for inactivity; the majority were single parents looking after several children, some working multiple jobs. However, an additional barrier that we found was much less practical in nature: although physical activity was uniformly deemed to be an important part of childhood, the perceived benefit of physical activity for the caregivers themselves was much less evident. When children engage in physical activity it is not only beneficial to the children but it frees up time for the caregiver and tires the children, thus reducing demands on the caregiver. For the already worn out and busy caregiver, engaging in physical activity does not appear to provide any equivalent benefits.

While the participants did not express the belief that their everyday activities would improve their health, what was conveyed was a sense of disbelief that any additional exercise would make any improvement because they were already physically exhausted, *"I am pretty much on the go*

*all day. [...] I get people telling me all day, geez as much as you are running around this place, you would think you would lose a lot of weight and I think I have gotten into this routine for 24 years that I don't lose the weight, because I am very active. [The shop] is a very busy, busy place and you constantly moving and constantly running."*

### **Physical Activity as a Secondary Strategy**

The caregiver's relative indifference to physical inactivity can be explained in part by their belief that dietary intake is more important to health than physical activity, *"I think it has to do with what you eat [...] if you don't eat healthy, no matter how much you walk. Because I walk all day, I mean even at my night job, I am still cleaning offices and that and as long as I keep eating pizza, I keep eating McDonalds, and Taco Bell, I am not going to lose the weight."*

In some instances that notion had been confirmed during weight loss attempts where individuals had experienced little feedback when trying to lose weight via exercise as opposed to the 'success' that they had experienced when following crash diets. While physical activity was seen as a preventative strategy for the health of their children, for the caregivers any prospective changes were primarily remediative, in the hope of losing weight. As such, physical activity was seen as a means to an end as opposed to being an end in itself. Additionally, physical activity was viewed to be an optional feature of everyday life. Standing in contrast to the correlation between physical play and childhood, exercise was associated with 'healthy' people and seen to reflect a personality trait.

### **Lack of Investment in Self**

All of the issues described above go some way to explain the disparity between attitudes towards the importance of physical activity for children and for the caregivers themselves. Additionally, there is a well-documented tendency for caregivers to place a higher priority on looking after the health of the family rather than their own health (Mutrie et al., 2000). For example, one participant justified her daily intake of junk food because it was only her, and not her children, who ate it, *"My kids eat healthy, because my mom and dad, they help me out[...] that is why I have another part time job at night[...]I am the only one on the street so it is just easier [to eat fast food when driving from one shift to another]."* We suggest that the prioritisation of dependents' needs further reduces the perceived importance of a caregiver's physical activity levels, both in comparison to the importance of the physical activity levels of their children, and in comparison to dietary intake (which, in general, directly affects the health of the whole family).

## **DISCUSSION**

As with the majority of other studies investigating barriers to physical activity, a lack of time was the most commonly mentioned barrier. It cannot be disputed that the majority of the participants were extremely busy with limited time available to participate in leisure time activity. However,

Morris and Choi (2005) argue that those who appreciate the benefits of physical activity are more likely to 'make time'. This study sensitises us to three issues relating to the perceived value of participation: the belief that physical activity doesn't work and that dietary intake is more important, and the prioritisation of others. In order to reflect on existing approaches in light of these findings, we consider two questions: is it likely that individuals would use the applications, and do the applications address the observed (mis)conceptions regarding the limited value of participation in physical activity?

*Degree of Focus and Nature of Activity Promotion:* Exercise journals appear to be inappropriate as they demand a degree of existing engagement and a commitment to exercise that simply is not present in this population. In contrast, the lightweight social awareness applications are only partially focussed on physical activity, and so an individual may become engaged through the social aspect of the system. The social interaction afforded by such systems could potentially help individuals overcome the obstructive perspective that physical activity is something that 'other' people do. Similarly, a vested interest in physical activity is not a precursor for use of exergames. Therefore, *applications with partial or incidental focus on physical activity seem more appropriate for this population than those with a primary focus.* For similar reasons, *systems that enable facilitative and consequential activity promotion appear more suitable for those who have not yet committed to making changes.*

A potential benefit of ambient interfaces on commodity devices, such as Ubifit's glanceable interface (Consolvo et al., 2008), is that they afford gradual reflection on the information being conveyed. *Enabling gradual engagement not only reduces the initial barriers to adoption, but also fits well with stage-based theories of change that are commonly used as a theoretical basis for technological interventions.*

*Physical Activity Monitoring and Behavioural Components:* Information currently being presented typically consists of raw activity levels, progress towards goals, or comparison with peers. However, we would suggest that unless augmented with additional information that conveys the value of physical activity, it is unlikely to motivate change in those unconvinced of its importance. Although value may well be conveyed implicitly through the participation in the physical activity that is promoted by existing approaches, we suggest that *there is scope to convey value explicitly in future system designs.* Indeed, we suggest that the current trend of using personal devices is ideally suited to this task. By utilising an individual's own physical activity levels as a medium through which health messages are delivered, public health information becomes personal, thus promoting the cognitive process of self-referent encoding (Rogers et al., 1977) whereby information that is perceived to be related to the self is given cognitive priority. Furthermore, *the ability to tailor augmentations to*

*suit the context of the individual increases the potential for effect.* In addition to conveying impact on health, data could be augmented in such a way that it conveys alternative benefits that more readily resonate with the needs and values of user.

*Theoretical Framework:* Each of the theories that were highlighted in our earlier critique offer particular affordances and limitations with respect to this population. For example, game design could harness the altruistic nature of the caregivers through participation in exergames with their children. However, we should be careful of placing more demands on an already pressured caregiver. Indeed, others have argued that efforts should be made to motivate the caregiver to value and look after her own health, “promoting exercise to women as benefiting others reinforces our patriarchal culture of women’s needs being secondary to those of others” (Mutrie et al., 2000). Theories of behavioural change and persuasion appear to be well suited to address this issue, however a shift in focus is required from physical activity to self-care. Indeed, *health education theories promise to provide a sound theoretical framework for technological efforts to convey value.*

## CONCLUSION

In engaging with a population not traditionally considered in the design of physical activity promoting applications, and reflecting on the current state of the art, we have highlighted an outstanding area of need: conveying the value of physical activity to those unconvinced of its importance. This paper has addressed the issue at a conceptual level. Referring back to the key components of physical activity promotion systems that we identified in our critique of current approaches, our analysis points to the following recommendations:

- physical activity monitoring: self or automated
- theoretical framework: health education and self-referent encoding
- behavioural components: self-monitoring and tailored information provision
- degree of focus: gradual engagement (starting with partial or incidental focus)
- nature of activity promotion: informative

The next step in this research is to consider how we apply these suggestions to the design of technology that addresses the specific challenges raised by this study. Moving from an abstract notion of conveying value, we will investigate how to develop interventions that (i) disambiguate between cardiovascular activities and those that are just tiring, (ii) illustrate the relationship between diet and physical activity and convey the unique benefits of each, and (iii) convince caregivers that their own needs are worthy of attention.

It should be noted that we do not suggest that the opinions expressed by the study participants are irrational. Caregivers must address everyday survival needs before

even thinking about developmental needs (Maslow, 1943). However, the correlation between poverty and ill-health (Brinkerhoff, 2004) reminds us it is important to develop health promotion interventions for this population. Furthermore, we do not suggest that technology alone can solve this population’s problems, but that when designed appropriately it may lower *some* of the many barriers to health (Maitland et al., 2009). This paper proposes a strategy to address one aspect of a complex and multifaceted problem.

## REFERENCES

- Brinkerhoff, D., B. Essentials of Sociology. (2004). Wadsworth.
- Choudrey, T., Borriello, G., Consolvo, S. et al.: ‘The Mobile Sensing Platform: An Embedded System for Capturing and Recognizing Human Activities’, IEEE Pervasive Computing, 2008
- Consolvo, S., Everitt, K., Smith, I., et al.: ‘Design Requirements for Technologies that Encourage Physical Activity’. Proc. CHI’06, (2006)
- Consolvo, S., McDonald, D., W., Toscos, T. et al.: ‘Activity Sensing in the Wild: A Field Trial of UbiFit Garden’ Proc. CHI’08, (2008)
- Graves L, Stratton, A., and Ridgers, N.D.: Comparison of energy expenditure in adolescents when playing new generation and sedentary computer games: cross sectional study. *BMJ* 2007;335
- Lin, J., J., Mamykina, L., Lindter, S., et al.: ‘Fish’n’Steps: Encouraging Physical Activity with an Interactive Computer Game’. Proc. Ubicomp’06, (2006)
- Maitland, J., Sherwood, S., Anderson, I. et al.: ‘Increasing the Awareness of Daily Activity Levels with Pervasive Computing’. Proc. Pervasive Health’06, (2006)
- Maitland, J., Siek, K., A., and Chalmers, M.: ‘Persuasion not Required: Improving our Understanding of the Sociotechnical Context of Dietary Behavioural Change’. Proc. Pervasive Health’09, (2009)
- Maslow, A.,H.: A Theory of Human Motivation, *Psychological Review* 50(4) (1943):370-96.
- Morris, F., and Choi, P.: ‘Changing physical activity levels and exercise patterns’, in Browning, C., J., et al. (Eds.): ‘Behavioural Change: An Evidence-based Handbook for Social and Public Health’ (2005)
- Mueller, F., Agamanolis, S., and Picard, R., W.: ‘Exertion Interfaces: Sports over a Distance for Social Bonding and Fun’. Proc. CHI’03, (2003)
- Mutrie, N., and Choi, P.: ‘Is ‘fit’ a feminist issue? Dilemmas for exercise psychology.’, *Feminism and Psychology*, 2000, 10, (4), pp. 544-551
- Rogers TB, Kuiper, N.A., and Kirker, W.S.: "Self-reference and the encoding of personal information". *J Pers. Soc.Psychol.* 1977;35