Motivating physical activity at work: Using persuasive social media for competitive step counting

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ABSTRACT

Previous research has suggested that social and competitive interaction over online social networking sites could be harnessed in order to motivate behaviour change in users. This paper presents the design and in-the-wild evaluation of StepMatron, a Facebook application designed to provide social and competitive context for daily pedometer readings in order to motivate physical activity in the working environment. A study was conducted in order to determine whether interactions between users via the application more successfully motivated physical activity than simply recording daily step counts in a similar application. Ten participants (1 male), all nurses working in a UK hospital, used the application across two conditions over the course of the study. In the socially-enabled condition, participants could view each other's step data and make comparisons and comments. In the non-social condition, participants could only view their own personal step data. A significant increase in step activity was observed in the socially enabled condition. Our findings highlight the potential of social media as a means for generating positive behaviour change. They also suggest that simple mobile devices can function as an inexpensive, accessible and powerful trigger towards this behaviour change without necessitating the use of overly complex and expensive mobile applications or devices.

Categories and Subject Descriptors

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

General Terms

Design, Experimentation, Human Factors

Keywords

Persuasive technology, lifestyle, health, mobile devices, pedometers

1. INTRODUCTION

Modern lifestyles are becoming increasingly sedentary ([23],[13]). A US governmental report states 60% of Americans are not physically active on a regular basis with 25% not active at all [4]. In the UK only 11.6% of adults are classed as physically active by taking part in moderate exercise 5 times or more a week [6]. Physical exercise has also been shown to improve health conditions such as heart disease and depression [2]. Indeed, by carrying out a healthy active lifestyle provides supporting evidence as a preventative measure to such debilitating illnesses [16].

These changes in physical activity levels can be largely attributed to developments in technology. For example, we now choose to drive to the shop, take the lift instead of the stairs and sit for many hours in front of a computer screen for work, leisure and entertainment. As much as technology has enriched our society and opened up a global space of communication, it can also be argued that it has also affected our health negatively by lowering physical activity.

This paper reports on the use of a simple mobile device (SMD) – a digital pedometer and a social application - to improve physical health in a specific environment: the workplace. With the average UK working hours totalling 37 hours per week [20] and employees spending up to 60% of their waking hours at work [21] there is scope to utilise some of this non-social time to encourage more physical activity. Additionally, the workplace is often subject to enforced rules and policies which do not exist outside of the working context. As such, the workplace could be considered as an artificial or special environment which presents particular challenges when deploying mobile technologies to help increase physical activity.

In recent years a number of researchers have conducted studies to evaluate the potential of using pedometers as health interventions in the workplace (e.g. [22],[3]). Chan et al. [3] report a substantial study involving 1442 employees over a 12 week period in which pedometers were used to measure the effects of two types of motivational structures on physical activity. These two motivational structures were; health education (control group), and personal/team goal setting (intervention group).The control group were asked to complete the Centres for Disease Control and Prevention (CDC) health risk appraisal [5] and given a monthly newsletter describing the health benefits of physical exercise. Each participant in the intervention group utilised a personal paper handbook that offered guidance and incentives for use of the pedometer, and facilitated self-reporting of daily pedometer readings. Intervention participants were also divided into teams with team orientated goals. Updated posters were displayed on the walls every two weeks comparing team goals attainment. Analysis

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of the study's activity data revealed that 51% of participants in the intervention group met the US governments recommendations for *Healthy People 2010* [27] compared to 31% in the control group.

In the study reported in [3], no technology-enabled feedback other than the pedometer display was utilised in either the control or intervention groups. Thus, the feedback presented to participants was indirect, infrequent and over a long period of time. The current paper suggests that offering users more direct and frequent online feedback, as well as the ability to view and interact with the progress of fellow participants, could lead to both a more enjoyable experience for the user and more positive gains in recorded physical activity.

It has recently been suggested that certain technologies can function as triggers for positive behaviour change [10]. In the current study, it was hypothesised that the SMD could function as a reminder that the participant was engaging in a socially competitive activity. Essentially, viewing the simple digital read-out on the pedometer could function as a trigger for the social pressure elicited by the competitive social network application.

In this study we leveraged an extremely popular [8] contemporary online social network (OSN) - Facebook - in combination with SMD's in order to engage participants in a timely and playfully competitive manner with their step activity. The intention was to demonstrate the value of using an online social application to record data, display feedback and facilitate on-topic discussion, thus eliminating the need for the user to wear anything other than a cheap off-the-shelf pedometer. We are engaged in a number of studies in which we are evaluating the viability of using social platforms *in general* to motivate and encourage positive behavioural change. For instance, this approach has been used successfully in raising awareness of the ecological impact of energy use in the home [12].

We designed and developed the Facebook application Step Matron using the Facebook API [9] and then evaluated it through a user study. The user study followed a within subjects design with each participant taking part in two conditions or social modes. In condition A, Step Matron was socially enabled, for example participants could see their friends' step data as well as their own; in condition B the Step Matron application was manipulated so that there were no social features available and so participants could only see their own personal step activity. Our hypothesis was that participants would be more active when using the socially enabled condition of Step Matron when compared to the non-social condition.

2. Experimental Method

2.1 Participants

Ten registered nurses (nine females and one male) were recruited through a personal contact to trial Step Matron. All of the nurses were employed within the same hospital ward and personally knew each other as friends. Additional criteria for recruitment were that they must have been regular users of Facebook for the past 12 months and that all participants must be on each other's friends list on Facebook.

2.2 Design

In order to examine whether the social interaction element of the application was necessary over just recording and displaying feedback, we created two conditions; socially-enabled and non-social. In the socially-enabled condition, participants could view each other's step data and make comparisons and comments. In the non-social condition, participants could only view their own personal step data. The independent variable was therefore Step Matron's interaction mode, either social or non-social. The dependent variable was the number of steps taken by each participant, with a total step count being recorded in each condition for each participant.

The experiment's conditions were counterbalanced to avoid ordering effects. This was done by creating two groups quasi-randomly, each group containing 5 participants. Group 1 started in the social condition, group 2 in the non-social condition and the condition that each participant experienced was switched halfway through the experiment. Thus, each participant experienced both conditions, and order effects were controlled for as carefully as possible.

2.3 Materials

In order to generate activity data that we could use within the Step Matron application we used a commercial off-the-shelf pedometer – the 'Silva Ex3 plus' [25] as shown in figure 1.

Figure 1. Silva Ex3 Plus Pedometer used in study

The Silva pedometer was selected after a comparative usability evaluation on three commercially available digital pedometers – the Silva device, the Oregon PE830 and the pedometer system supplied with the Nintendo DS My Health Coach game. The quality of the end-user's interaction was the focus of the usability research undertaken with the experience of using the pedometers to carry out two main tasks analysed. Two usability research methods were used; CELLO [7], an expert-based heuristic method and the NASA TLX (Task Load Index) method where non-experts assess task difficulty [18]. For the CELLO evaluation three usability experts were recruited to provide a group heuristic evaluation. For the NASA TLX evaluation we recruited three participants (1 female). By using the two differing evaluation methods we were able to compile and interpret usability issues on each of the pedometers tested.

The pedometer with the lowest number of recorded minor to moderate usability problems was selected to ensure the study would run without any technical issues from the participants perspective. An overview of the occurrences of problems found for each heuristic guideline in the CELLO evaluation is shown in table 1. Based on our usability results we chose the Silva Ex3 pedometer for inclusion in the study.

Table 1. Occurrence of heuristic based usability problems

Heuristic Guideline	Nintendo DS 'My Health Coach'	Silva Ex3 Connect	Oregon PE830
Visibility of System Status	0	0	2
Match between system and the real world	3	0	1
User control and freedom	0	0	0
Consistency and standards	2	1	0
Error prevention	1	1	1
Recognition rather than recall	1	1	1
Flexibility and efficiency of use	2	2	2
Aesthetic and minimalist design	0	1	3
Help users recognise , diagnose and recover from errors	0	0	0
Help and documentation	0	0	0

In the study conducted here, participants manually self-reported their step count data as a task in the Step Matron software. Step Matron then offered users the ability to compare their step data with other users and also to post comments on their peers' activity. Each time a participant entered their step count it was automatically posted to their Facebook profile news feed. This approach enabled all of the participant's friends on Facebook to see how they were actively engaging in physical activity and offered those friends the opportunity to post comments on the participants' progress. Additionally, personalised Facebook notifications were sent to each of the participants in the study who had all added Step Matron to their Facebook profile, as shown in figure 2.

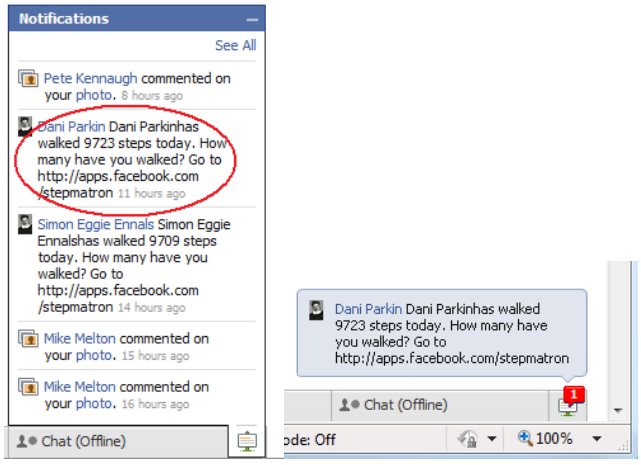

Figure 2. Notifications to other participants who are using Step Matron

A rankings interface displayed the total step count for each participant in a table format with the highest total step count placed at the top of the table. Each participant in the table was selectable for a breakdown of their previous 7 day step count and for personal messaging. . At the bottom of the rankings table a *public* comments board was available for posting messages viewable by all. The rankings table provided the competitive attribute of Step Matron - as well as providing an opportunity for social interaction to take place, centred on step activity. The ranking interface is displayed in figure 3.

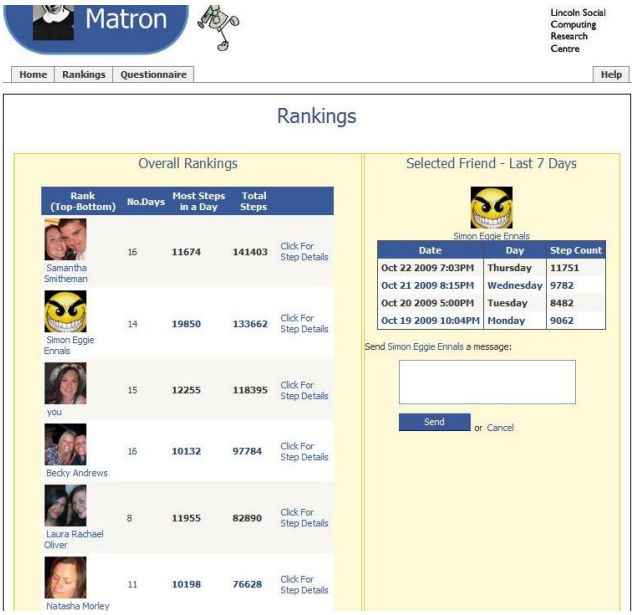

Figure 3. Step Matron Rankings interface

Other goal-driven features were implemented such as displaying who had walked the 'most steps in one day' on the rankings interface with a star rating. This provided the participants with a mini-goal to work towards which supplemented the goal of attaining highest total step count. An overall group measurement was incorporated which showed the total number of steps taken by all participants with the equivalent mileage walked. These goals and group measurements are shown in figure 5.

Submitted step data from the participants was stored in an MS SQL database, with all data stored anonymously. The Google analytics service was also used to record the number of Facebook application page views for each of Step Matron's interfaces.

2.4 Procedure

Each participant gave their informed consent and undertook the experiment by carrying a Silva Ex3 pedometer during working hours and entering their step data into Step Matron after each working shift was completed. The experiment took place over a period of 21 days with each participant submitting 5 working days of step activity in each condition. Half of the participants started in the social condition with the other half starting in the non-social condition. Once all participants in each group had submitted 5 working days of step data they were sent an email and notification through Facebook informing them of the changeover

of conditions. Step Matron was then reprogrammed to perform in the alternative conditions with the relevant participants. Crucially, in order to deter participants from over-reporting step-count data, all participants were briefed at the beginning of the study that the pedometers stored historical activity, and that this would allow researchers at the end of the study to validate the accuracy of all self-reports.

2.5 Results

The steps recorded for each participant in both conditions are summarised in figure 4. Analysis found that 9/10 participants walked more steps in the social condition than in the non-social condition, with mean step ratings of 42004.4 and 38132.1 for social and non-social conditions respectively.

A Wilcoxon statistical test for repeated measures of non-parametric data showed that the total number of steps taken was significantly higher when participants used the social condition ($Z = -2.5$, $N=10$, $p=0.013$).

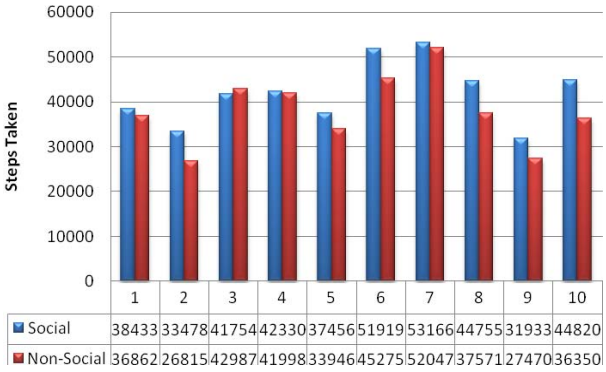

Figure 4. Participant step activity in each condition

Additional data collected from Google Analytics provided an insight into how often the participants across both conditions logged on to Step Matron. In the 21 days of the experiment, there were 1142 pages views, with 224 unique visits to the Step Matron application, equalling 5 page views per visit. The average time spent during each visit was 6 minutes 11 seconds, highlighting that users of the application were willing to spend some of their own time in interacting with Step Matron. Additionally, the users spent an average of 1 minute 46 seconds on the step input interface (viewing personal steps activity), but spent almost a minute longer when interacting with the rankings interface (viewing and comparing others step activity) at 2 minutes 37 seconds. It may be assumed that participants enjoyed the rankings interface due to its social and game like properties – a league table and comments board. Indeed, previous research into multi-player exertion games has found that social play is an important element in engaging users [17].

3. Discussion

This paper has described the design, deployment and evaluation of a system that utilises a Facebook application to extend and support an SMD in persuading participants to increase physical activity in the workplace. Participants recorded a significantly higher number of steps in the social condition than in the non-social condition. This finding suggests that social interaction over an online social network, such as viewing each others step counts, comparing own usage to that of peers, and commenting on each others progress, can help motivate participants to increase physical activity in the workplace.

Another demonstration of the value and importance of social interactions in the current study is demonstrated by the finding that participants viewed the rankings and comments board for a longer period of time than when interacting with their own personal step data. There were a number of social and collective features on the rankings interface such as the comments board and total number of steps taken with distance travelled collectively (see figure 5). An improvement in leveraging these features further could have borrowed from the team based game '*The Horsepower Challenge'* from Humana Games [15]. This game allows students from various schools to collectively use their step activity to compete against other schools. One of the game features is an online virtual school bus for travelling around the world to reach and learn about famous landmarks. Each school can only travel as far as their collective step count. This would introduce a strong socially orientated team element fuelling competition and potentially raising activity levels.

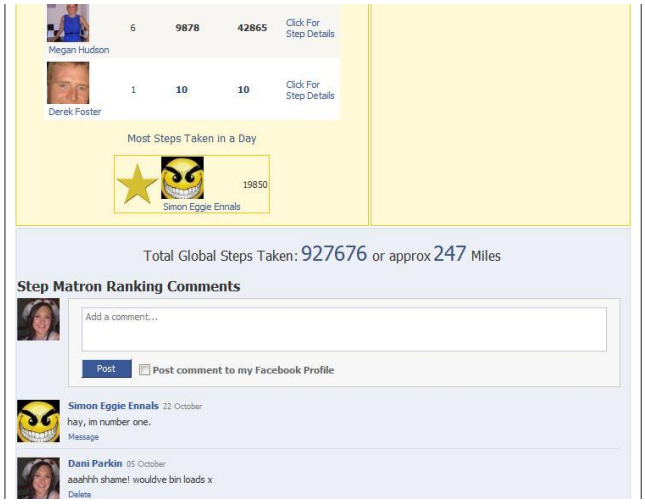

Figure 5. Step Matron's collective counters and comments board

The comments feature of the rankings interface allowed participants in this study to engage in playful chat - or *banter* - based around their activity levels.

Participant comments indicated pleasure in the competitive aspect such as "*ooooh im number 1 so far :-)*" and "*hay, im number one. not bad for a lazy arse hole like me lol*". Team motivation was also present, "*we have walked 7 miles between us not bad eh? X*". Congratulating other participants on their activity levels was also evident with, "*hahaha well done [name omitted]!!*"

Interestingly, a comment was made that moved the context of the physical activity from the workplace out into the personal social space, "*was out dancing fri night, can you imagine how many steps that would have been!!!*" with a response showing empathy over the 'lost' steps, "*aaahhh shame! Wouldve bin loads x*". It

may be possible for positive intervention behaviours to extend into the participants personal lives thereby promoting a healthier lifestyle overall.

We can see from the user generated comments that participants were engaged in disclosure of information on their own activity and were also open to reciprocity from others. A provocative element was noticeably present with a few participants playfully congratulating themselves on being number 1 in the rankings.

The current study suggests that SMDs can function as successful triggers for positive behaviour change, when delivered as part of a larger programme. Specifically, the conclusion drawn above was that the social and competitive interactions occasioned by the social version of the Step Matron Facebook application motivated participants to become more physically active during work. However, it is difficult to understand the process through which this competition was maintained, as participants did not have access to the Facebook application during working hours. Rather, participants only had access to a simple digital read-out of their daily step-count from the pedometer during working hours. Thus, it is apparent that the competitive activities occasioned by the Facebook application were not only in action while participants used the application, but also throughout the rest of the day; and that the SMD functioned as a trigger for these competitive activities.

It is equally valid to consider the converse of the above; that social network applications can serve as a powerful context that allows participants to understand quantitative behavioural measures as more than mere numbers. For example, when participants in the current study occasionally viewed their step-counts while working, it is possible that these were considered not purely as the number of steps taken, but as steps closer to beating their friend, steps closer to winning, or as a performance that needed to change in order to achieve equality with fellow participants. Without the competitive Facebook application, this would not have been possible.

The distinction between the two explanations provided above is too subtle to be teased out from results in the current study, but may be an interesting avenue for future research. However, what is apparent from the current study is that the carefully considered combination of two simple technological elements can be effective in motivating behaviour change. This finding could prove valuable when designing the architecture of future persuasive technology, as it suggests that complex applications on complex devices are not necessary to motivate real behaviour change in users.

The domains of behavioural and social psychology may offer explanations of the motivating factors exhibited in participants using Step Matron. The desire to belong and willingness to adapt behaviour to follow what others are doing has been seen as a fundamental motivator [1]. Social norms such as peer pressure have also been seen as a means of changing behaviour to align with the ideals or beliefs of groups [24]. Computers have, for example, been shown to help people overcome their fear of public speaking [26]. Recent work on persuasive technology has argued that reciprocal interaction through instant messaging and "pokes" can be effective strategies for persuasion [28]. Whilst there is insufficient space to give a full account of the psychological theories of social motivation, effecting behavioural change through computer mediated social applications seems promising.

There are some parallels to be drawn with this study and the successful Nintendo DS game 'Walk-With-Me' which sold 26,000 copies in its first week of release in Japan alone [14] . The game also employs a simple pedometer more rudimentary in design than the pedometer used in this study which acts as a trigger within a larger programme for motivating physical activity. In 'Walk-With-Me' the pedometer has no digital readout but provides simple feedback from an LED that flashes green if a goal has been attained and red if not. This feedback triggers the player to upload their step activity to the DS system. In contrast with the online social networked application presented in the current paper, Walk-With-Me uses a game environment in addition to social attributes to motivate users to increase physical activity. The game environment facilitates social competition and the creation of mini goals to motivate an increase in physical activity. It is possible that the combination of social networking activities available in Step Matron with the goal-setting and game-like activities in Walk-With-Me could produce even more valuable gains in physical activity, while maintaining the requirement for only the most basic mobile devices.

Figure 5: Nintendo's walk-with-me simple pedometer

As pointed out in recent work in the persuasive technologies domain, behavioural change is no easy feat and more often than not technological endeavours fail to make an impression on the target users [11]. It has been suggested that one of the main reasons for this is that designers of persuasive technologies often set goals that are too difficult for users to attain and work towards, ultimately they give up trying. Effectively, the results of this study indicate that the participants themselves provide motivational goals for each other by introducing playful social competition by going head to head with peers, all facilitated in the first instance by viewing a SMD's display.

4. Conclusion

The quantitative and qualitative analysis of the data collected from participants in this study suggest that social applications such as Step Matron may be able to play a role in increasing physical activity in a fun and enjoyable way.

Although the paper describes a relatively small scale study, it provides encouraging results and presents scope for a scalable implementation in a larger workplace investigation. In particular, there is potential to improve the design of the experiment by empowering teams of participants as well as the individuals

directly. Future work direction would likely include game like mini-goals for both the individual and team orientations.

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6. REFERENCES

[1] Baumeister, R.F., and Leary, M.R., (1995) The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin* 117:497–529.

[2] Bravata, D.M., *et al* (2008). Using pedometers to increase physical activity and improve health: A systematic review. *JAMA, 298*(19), 2296-2304

[3] Catherine B. Chan, Daniel A. J. Ryan and Catrine Tudor-Locke, (2004) Health benefits of a pedometer-based physical activity intervention In *sedentary workers Preventive Medicine*, Volume 39, Issue 6, Pages 1215-1222

[4] CDC, (1999) *Physical Activity and Health – A Report of the Surgeon General*, available from http://www.cdc.gov/nccdphp/sgr/index.htm

[5] CDC, (2010) *Centers for Disease Control and Prevention*, available from http://www.cdc.gov/nccdphp/dnpao/hwi/programdesign/health_risk_appraisals.htm

[6] Department of Health (2008) *Health Profile of England 2008 : Department of Health – Publications*, available from http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsStatistics/DH_093465

[7] EMMU, (1999) Cello: Evaluation by Inspection, available from http://www.ucc.ie/hfrg/emmus/methods/cello.html

[8] Facebook, (2009) *Facebook | Statistics* , available from http://www.facebook.com/press/info.php?statistics

[9] Facebook, (2010) *Facebook Developers* ,available from http://developers.facebook.com/

[10] Fogg, B. (2009) A behavior model for persuasive design. In *Proceedings of the 4th international Conference on Persuasive Technology* (Claremont, California, April 26 - 29).

[11] Fogg, B. (2009) Three possible futures for persuasive technology. In *Proceedings of the 4th international Conference on Persuasive Technology* (Claremont, California, April 26 - 29).

[12] Foster, D., Blythe, M., Cairns, P., and Lawson, S. (2010) Competitive carbon counting: can social networking sites make saving energy more enjoyable? In *Proceedings of the 28th of the international Conference Extended Abstracts on Human Factors in Computing Systems* (Atlanta, Georgia, USA, April 10 - 15).

[13] G. Norman, M. Zabinski, M. Adams, D. Rosenberg, A. Yaroch, and A. Atienza (2007) A Review of eHealth Interventions for Physical Activity and Dietary Behavior Change, *American Journal of Preventive Medicine*, Volume 33, Issue 4, Pages 336-345

[14] GoNintendo, (2010) *GoNintendo - Japanese software sales - Oct. 27th to Nov. 2nd*, available from http://gonintendo.com/viewstory.php?id=61980

[15] Humana, (2008) *Humana Games for Health – solutions – Horsepower Challenge*, available from http://humanagames.com/#/solutions/hpchallenge/

[16] Miller T.D, Balady, G.J., and Fletcher G.F., (1997) Exercise and its role in the prevention and rehabilitation of cardiovascular disease. *Ann Behav Med*.;19(3):220-229

[17] Mueller, F. *et al* (2009) Design influence on social play in distributed exertion games. In *Proceedings of the 27th international Conference on Human Factors in Computing Systems* (Boston, MA, USA, April 04 - 09).

[18] NASA TLX, (2009) *NASA TLX Homepage*, available from http://humansystems.arc.nasa.gov/groups/TLX

[19] National England, (2009) *National Step-O-Meter Programme (NSP) | Walking the way to health* available from http://www.whi.org.uk/details.asp?key=2032|0|2EC7485896907|p|748|0

[20] ONS, (2009) *Labour Market Statistics*, available from http://www.statistics.gov.uk/pdfdir/lmsuk1009.pdf, [accessed 10/10/2009]

[21] Peersman G, Harden A, and Oliver S. (1998) *Effectiveness of Health Promotion Interventions in the Workplace: A Review*. London: HEA

[22] R. Dishman, D. DeJoy, M. Wilson, and R. Vandenberg (2009) Move to Improve, A Randomized Workplace Trial to Increase Physical Activity *American Journal of Preventive Medicine*, Volume 36, Issue 2, Pages 133-141

[23] S.Rajaratnam, J.Arendt (2001) Health in a 24-h society, *The Lancet*, Volume 358, Issue 9286, Pages 999-1005

[24] Schultz, P.W., Nolan, J.M., Cialdini, R.B., Goldsteing, N.J., and Griskevicius, V., (2007) The Constructive, Destructive and Reconstructive Power of Social Norms. *Psychological Science*, 18:429-434.

[25] Silva, (2009) *Pedometers – Silva5*, available from http://www.silva.se/en/Products/Exercise-4-life/Pedometers/

[26] Slater, M., Pertaub, D-P., and Steed, A., (2002) An Experiment on Public Speaking Anxiety in Response to Three Different Types of Virtual Audience. *Presence* 11, 1:68-78

[27] USDHHS, (2010) *Healthy People 2010*, available from http://www.healthypeople.gov/

[28] Weiksner, G. M., Fogg, B. J., and Liu, X. (2008) Six Patterns for Persuasion in Online Social Networks. In *Proceedings of the 3rd international Conference on Persuasive Technology* (Oulu, Finland, June 04 - 06)