EAI Endorsed Transactions
on Ambient system
Research Article ICST.ORG

iFlit: an ambient display to induce cognitive dissonance and behaviour change

R.Maimone[1,*], I.Zavala[2], E. Quintana[2], J.Favela[2], M.Tentori[2], O. Mayora [1]

[1]CREATE-NET, via alla Cascata 56/D, Trento, Italy
[2]CICESE, Carretera Ensenada-Tijuana 3918, Ensenada, Mexico

Abstract

In this paper, we explore how persuasive ambient displays could induce cognitive dissonance to promote positive behaviour change among graduate students. We developed iFlit –an interactive and collective ambient display that enables a group of students to reflect on their burnout level, and sleeping and activity habits. iFlit shows a garden with birds representing students monitored behaviour. Birds move according to users' activity level, and the garden's background changes according to each user's sleeping habits. Users match peers perceived burnout, and sleep and activity habits to induce cognitive dissonance. We argue such displays are more efficient than personal devices to empower individuals' self-reflection due their capabilities for enabling a playful interaction with their personal data.

Keywords: ambient display, dissonance cognitive, perception change, behaviour change.

Received on 27 November 2013, accepted on 10 January 2014 , published on 04 March 2014

doi: 10.4108/amsys.1.3.e2

1. Introduction

Cognitive dissonance is a psychological state that appears in a person experiencing simultaneously two or more conflicting cognitions such as thoughts, emotions, or intended behaviours. When individuals are motivated to reduce or eliminate dissonance, they tend to change their behaviour or beliefs [1]. In other cases people can reduce the presence of dissonance by avoiding specific conflicting information or situations that may produce or reinforce the dissonance. In contrast, the increase of cognitive dissonance may trigger the questioning of owns beliefs and therefore can be used as a way to intervene towards rising personal self-awareness.

Recent research projects are focusing on increasing the awareness of people mental and physical state by enabling individuals to collect and share personal data related to their behaviour, habits, and thoughts. As an example, persuasive ambient displays are used to provide individuals with continuous awareness of this myriad of personal data increasing self-reflection and increasing the opportunities for individuals to experience cognitive dissonance [10]. Furthermore, strategies derived from cognitive science theories are mostly used when designing such persuasive ambient displays, in particular theories based on the social influence on people's behaviour as the Presentation of Self-[9] and Cognitive Dissonance Theory [3]. The first describes how individuals attempt to manage the impressions they want others to have of them, while the second describes how individuals manage the discomfort experienced when two or more conflicts cognitions are present.

In this paper, we explore how cognitive dissonance could be used to persuade positive behaviour changes in individuals' lifestyles through the design of a persuasive ambient display. We studied the impact of cognitive dissonance among graduate students as they experience poor lifestyle habits resulting from their sense of responsibility, and inability to complete academic tasks and excessive workload. A moderate level of physical activities can improve cardiovascular functions, reduce the risk of diabetes and obesity; and also impacts sleep quality and mental wellbeing. Recent studies showed that sleep plays an important role in learning processes and

* Corresponding author. Email:rosa.maimone@create-net.org

memory consolidation [13] and is fundamental in school achievement and academic performance [7, 8]. Daytime habits, sleep routine, lifestyle and many emotional issues, have resulted in sleep disorders and insomnia cases[12] . Psychological and physical fatigues also have a strong impact on sleep efficiency.
Taking into account this evidence, we designed a persuasive ambient display (iFlit) that monitors students' physical activity, sleep quality, and burnout as predictors for determining when a user is following a healthy lifestyle and how others perceived users wellbeing. iFlit design is based on serious game approach enabling direct interaction of users with the display, comparison and collaboration among users, and rewards represented by environment animations targeting increase of user engagement. The rest of this paper includes a description of related work, of the development of the system, and concludes with future research plans.

2. Related Works

The Ubicomp and HCI communities have explored the design and evaluation of innovative technologies to motivate people to change their perception and/or behaviour. An example of technologies using cognitive dissonance for behaviour change was proposed by Dickerson et al [15]. In their experiments, the authors showed that people were motivated to save water when reflecting on their own data regarding shower usage. Awareness about discrepancy among their behaviour perception and their real behaviour have aroused mild feelings of hypocrisies and motivated them to change their attitudes to eliminate this situation.
Other studies show how cognitive dissonance is not only induced by the comparison with his-self or self-esteem but demonstrate that social behaviour also strongly influence behaviour change.
Carkenord and Bullington [4] showed how it is possible to induce cognitive dissonance among students comparing their attitudes and behaviours on a variety of social issues.
One of the strategies most often used in persuading behaviour change is to share personal information on social networks, and compare data monitored by devices with the same data of friends.
BinCam[2], a social persuasive system aiming to motivate reflection and behavioural change in food waste and recycling habits of young adults, using a smartphone installed on the underside of the bin that take pictures to the food waste and upload them to Facebook. Results of this study showed how social influence can be considered as a source of change and can help increase people' attitudes and awareness.

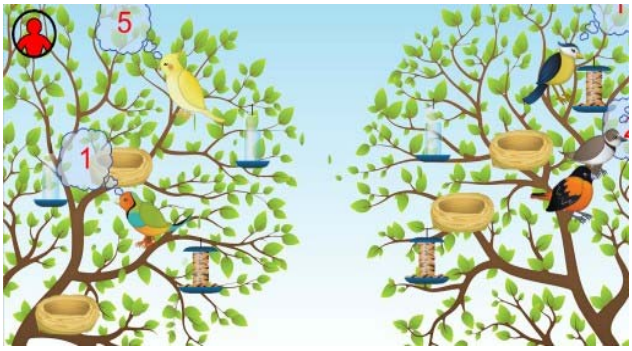

Figure 1. Ambient application showing the birds representing users and their activity level – data gathered from the smartphone

Breakway[3] is an aesthetic and lifelike ambient display encouraging people whose job requires them to sit for long periods of time to take breaks more frequently.
It consists in a small sculpture placed on the desk whose shape and movement reflect the form of the human body; an upright position reflecting the body's refreshed pose, and a slouching position reflecting the body' s pose after sitting for a long time.
Similar projects are used to inform users about their impact of their everyday activity on their living ecosystem, as Coralog [5] and Wattsup [6].
Videogames are an important expressive medium and means of persuasion. Bogost [16] argues that games, thanks to their rule-based representations and interactions (procedural rhetoric), induce the player to think how and why it works and , analyzing game situations, encourage him to reflect on his choices. In some cases, games can support social and cultural positions and also potentially leading to significant long-term behaviour change.
Our work is motivated also by extensive research about benefits derived by the increase of a moderate level of physical activity [14]. Physical activity can help people improve their quality of sleep and therefore to improve cognitive state and eventually academic performance [7].
In iFlit we want to explore the use of social and collective feedback on a public ambient display to induce cognitive dissonance as a trigger for increasing self awareness of people in an aggregated way.

3. Developing iFlit

We followed a user-centered design methodology to design and develop iFlit –an interactive and collective ambient display that enables a group of users to reflect on their burnout level, sleeping and physical activity habits. IFlit interface shows a metaphor consisting on a garden with birds representing users (Figure 1).
Virtual characters representing birds were designed to provide continuous peripheral awareness while being friendly/affable. Birds move according to users' activity

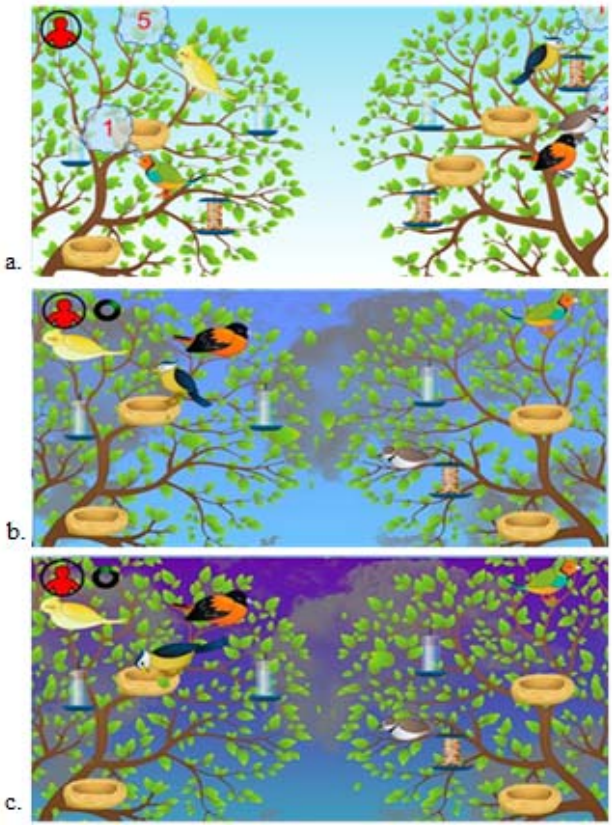

Figure 2. The three different levels of students sleep efficiency daily average: a) clear and sunny sky corresponds to a medium-high value of sleep efficiency average, b) cloudy sky represents a medium-low value of efficiency average, c) the sky become dark when the sleep efficiency average is very low.

level, and the garden's background changes according to each user's sleeping habits. (Figure 2). Attachment to the virtual pet allows a user to be engaged in the game and to avoid negative reinforcements reflected on the pet, as a consequence a user might be more motivated to the change behaviour [13].

A user reports burnout level answering surveys based on the Workload TLX and the Maslach Burnout Inventory Survey on a mobile phone

The smartphone's accelerometer running SensIT is used to automatically detect individuals sleeping quality and overall activity level.

SensIt is an Android application that runs in the background and is constantly sensing the user's physical activity (activity counts, Figure 3). Sensed data is stored locally and then synchronized whenever a Wi-Fi connection becomes available. iCAT is a RESTful web service used by SensIt and iFlit to upload sensed data and query users' activity-related information respectively. iCAT computes energy expenditure and sleep quality from users' activity counts.

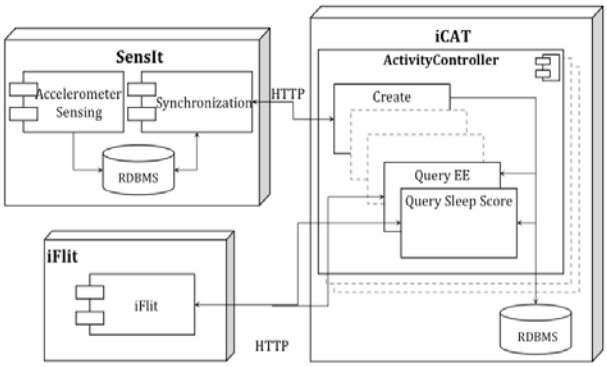

Figure 3. Architecture of iFlit System

The smartphone's app uploads the user's information to the cloud which is periodically queried by iFlit and presented later in the form of charts (Figure 4). If the users want to know about the information gathered, the system also provides a natural user interface for consulting it implementing a gesture based navigation. We use the Microsoft Kinect sensor to capture the user presence and the navigation commands. For example if the user steps in front of the system, the interface acknowledges this and provides some feedback like wind movement. The users can select a particular character representing a user's information using the hand tracking position and later move through the interface. Figure 5 shows the user interface of iFlit in which the user data can be explored.

Different strategies are used to induce cognitive dissonance in students through iFlit, namely i) social influence, and ii) self monitoring to increase the awareness of their habits and behaviour. In this regard, the social influence is provided by the comparison among users' data and by applying the Perception of the Others concept.

Providing the average values (denoted in the system as "promedio") for each behavioral factor in the user's daily chart (such as burned calories, sleep hours and stress/fatigue level) we aimed not only to create a competitiveness among students but also to stimulate the collaboration among them in order to improve the iFlit environment.

With the respect to the implementation of our concept "Perception of The Others", each user can express the opinion about the behaviour of all his/her colleagues and at the same time a user can be informed about the perception of his own/heron behaviour as perceived by the others in the group.

The iFlit ambient display provides a simple game which features the behavioural data and each user is encouraged to play it (Figure 5 shows a screenshot of this game). The game engages a user to select a face of his/her colleague and to associate it to the data which in his/her opinion corresponds to a selected person.

We deployed the display in a meeting room where students often gather to study either alone or independently.

Figure 4. User data displayed when a user gestures are recognized.

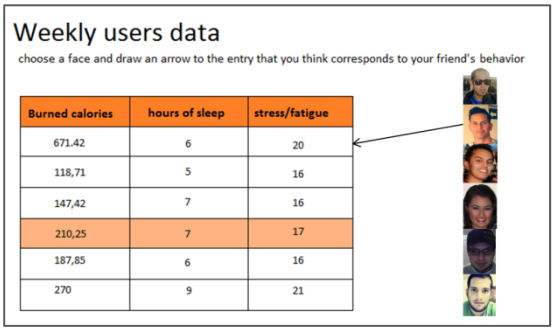

Figure 5. Playing with Perception of the Others.

4. Conclusions

We presented the design and development of iFlit. Awareness about students' stress and fatigue was also induced through a visual report on iFlit. We are currently gathering data from accelerometer about physical activity and sleep efficiency, and we are analyzing data about burnout. We intend to observe the interaction of the students with the iFlit and to analyze their behaviour for a period of 6 weeks.

Results from this pilot study will help us improve strategies to induce dissonance and verify our hypothesis related to the efficiency of a collective social feedback on public monitor to motivate a small community to adopt a healthy lifestyle.

5. References

[1] Jafarinaimi, N., Forlizzi et al."Breakaway: an ambient display designed to change human behavior," Proceedings CHI "05, 1945-8.

[2] A. Thiembe, R.Comber et al. We"ve bin watching you": designing for reflection and social persuasion to promote sustainable lifestyles. CHI2012, 2337-2346.

[3] Festinger, L. A Theory of Cognitive Dissonance. Stanford, CA: Stanford University Press, (1957). Schwartz, M. *Guidelines for Bias-Free Writing*. Indiana University Press, Bloomington, IN, USA, 1995.

[4] David M. Carkenord, J. Bullington. "Bringing Cognitive Dissonance to the ClassroomTeaching of Psychology". February 1993 20:41-43.

[5] T. Kim, H.Hong, B. Magerko. Coralog: use-aware visualization connecting human micro-activities to environmental change". Proceedings CHI EA „09 CHI09, 4303-4308.

[6] D. Foster, S. Lawson et al. Wattsup? : motivating reductions in domestic energy consumption using social networks. Proceeding NordiCHI „10, 178-187.

[7] G. Cuccio, M. Ferrara, L.de Gennaro. Sleep loss, learning capacity and academic performance. Sleep Medicine Reviews (2006), 323–337.

[8] K.T.Potkin, W.E. Bunney. Sleep Improves Memory: The Effect of Sleep on Long Term Memory in Early Adolescence. www.plos.org

[9] Goffman, E. The Presentation of Self in EverydayLife. New York, NY, USA: Doubleday Anchor, (1959).

[10] Kenneth G. DeBono, Ashley E. Edmonds.Cognitive Dissonance and self-monitoring: a matter of context? Motivation and Emotion , Volume 13, Issue 4 , pp 259-270

[11] P. Marquet. The role of sleep in learning and memory. Science 294, 1048 (2001).

[12] A. C. Heath, L.I. Eaves, K.M. Kirk and N.G. Martin. Effects of lifestyle, personality, symptoms of anxiety and depression, and genetic predisposition on subjective sleep disturbance and sleep pattern. Twin Research (1998) 1, 176–188

[13] J.J. Lin, L. Mamykina, S.Lindtner et al. Fish'n'Steps: encouraging physical activity with an interactive computer game. UbiComp'06 Proceedings. pp261-278.

[14] F.K. Panedo, J.R. Dahn(2005). Exercise and well- being: a review of mental and physical health benefits associated with physical activity. Current Opinion in Psychiatry, 18, *189–193*

[15] C.A. Dickerson, R. Tibodehau, E. Aronson, D. Myller. Using Cognitive Dissonance to Encourage Water Conservation. Journal of Applied Social Psychology, 1992,22, 11, pp. 841 -854.

[16] I. Bogost. Persuasive games. The expressive power of Videogames. MIT Press, 2010