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Table of Contents

Improving Therapeutic Exercise Devices for People with Rheumatoid Arthritis: A Research Method Combining Cultural Probes and Persuasive Design Theory

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Abstract: Persuasive Design engages a number of theories and strategies for influencing people towards desired target behaviors. To ensure the effectiveness of these strategies, detailed contextual information about the user group is required to guide and appropriate persuasive design theory to specific applications. This paper presents an innovative application of the photographic 'cultural probe' and 'photo-elicitation' research methods - used as part of a research study which aims to improve therapeutic exercise devices for people with Rheumatoid Arthritis (RA).

Keywords: Persuasive Design, Technology, Design for health, Rheumatoid Arthritis, Qualitative Research, Photo-elicitation, Successful Aging.

1   Introduction

Exercise therapies help to maintain functional ability in patients with RA. Pinch grip, overall grip strength and hand dexterity are the three hand functions most widely recognized as having the greatest impact on functional ability and quality of life. Therapeutic exercise devices are available to help maintain these functions, however, many patients struggle to engage with such equipment long-term. This is reportedly due to fatigue, fear of injury, pain, or patients' own beliefs. This study explores the potential of 'Persuasive Design' to improve patient engagement with therapeutic exercise devices. To achieve this we ask the following key question:

> What designable factors, specific to RA, should be considered alongside existing persuasive design theories, to inform the development of therapeutic exercise interventions which also support patients' daily-life needs?

To achieve this, detailed information about the objects, environments and behaviors already present within the lives of people living with RA, is required to guide and appropriate persuasive design theory to specific applications. A multi-phase, photographic 'cultural Probe' and 'photo-elicitation', study was developed.

1.1 Why Rheumatoid Arthritis?

Rheumatoid arthritis is a chronic autoimmune disorder affecting approximately 1% of the working age population. The costs of RA to those who live with the condition, their families and to the economy, are very high. In 2000 there were 1.9 million GP consultations for inflammatory arthritis and around 46,000 hospital admissions in the UK alone. From 1999 to 2000 the loss of working time and subsequent cost to society and to the economy was 9.4m working days, representing £833m in lost production. [1] The cost to the NHS of managing RA, and complications such as osteoporosis, is an estimated £240 million a year. The National Audit Office (NAO) estimates the total annual cost of treating RA and its additional complications, including sick leave and work-related disability, to be £1.8 billion. [2]

1.2 Persuasive Design

Developed from Behavior Change theory 'Persuasive Design' engages a number of socio-psychological and design theories to influence people towards desired target behaviors.

Within this study Persuasive Design is defined as: an area of design research which seeks to change a person's attitude or behavior, through physical objects or environments, to facilitate and support concordance with healthcare recommendations.

The diagram below is a prototype behavior model, developed as part of this study, to locate the role of design in facilitating behavior change. The model identifies 'designed objects and environments' as the principle agent facilitating therapeutic exercise behavior; the 'bilinear' pathways identify both 'intentional' (considered & planned) and 'non intentional' (unconsidered & unplanned) actions, 'trigger factors' (timely reminder/facilitator) and the 'biopsychosocial' - biological (ability), psychological (attitude) and social, factors affecting our ability and willingness to engage with target behaviors. This is a cyclical and multidirectional model.
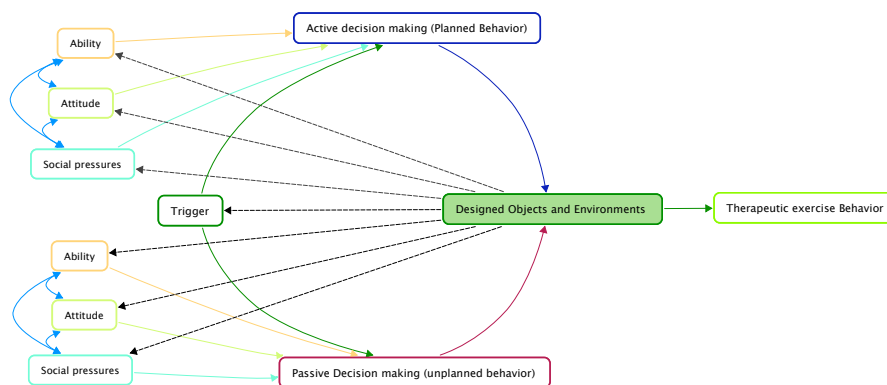
Fig 1. Prototype behavior change model for therapeutic exercise devices

2 Contextual Evidence Research Study

2.1 Study Design & Procedure

Photographic 'Cultural Probe' and 'Photo-elicitation' methods were adopted as part of a multi-phase focus group study. The Cultural Probe method invites participants to engage with 'novel interaction techniques' [3] designed to provoke inspirational responses and provide qualitative data that illustrates the lives and memories of participants. Participants were asked to take 27 photographs of objects they use everyday and the places they visit most regularly. Images provide detailed contextual information about daily life activities and the limitations of currently available treatments. Participant generated images were then used as conversational triggers within the 'photo-elicitation' exercise. Photo Elicitation is used to facilitate deeper discussion; photographs, drawings and artifacts can be used to trigger, unlock and identify personal narratives, social contexts and emotional elements within a respondent group [4]. Each focus group session was recorded, transcribed and analyzed for emergent and reoccurring themes. This information is then analyzed to identify opportunities for persuasive design interventions.

2.2 Results

Analysis for this study is ongoing. Preliminary findings have been identified using an 'Interpretive' model of analysis:

- **Existing devices have been developed to solve problems too narrowly conceived**. For example, many patients use their wrist splints to swim, play tennis, cycle and generally pursue the interests they had before onset of RA. Existing devices have not been developed to support these activities, instead, the design of most existing devices have been limited to functional effectiveness. Furthermore, many existing devices are considered by many to convey a design language of 'illness'. This adds further psychological and social strain to individuals already having to deal with the affects of ill health.
- **The Patient Journey**. Evidence suggests that the length of time an individual has lived with RA has an affect on the nature of their concerns these can be broadly mapped between short, medium and long-term issues. Interventions should take these factors into account - tailoring recommendations to timely needs and assisting individuals to transition from one phase to the next.
- **Personal Technologies**. (mobile phones and computers) were prevalent throughout the lives of all who participated in this study. They were popular regardless of age, gender, disease activity level or personal interest. Although not always considered to be desirable, evidence identifies a growing dependency on both mobile phones and computers. This prevalence presents significant opportunities for therapeutic interventions. Personal technologies could be used to provide context aware, timely triggers, detailed monitoring and social motivations.

3 Conclusions

- **Design Interventions.** Preliminary analysis suggests that existing responsibilities and activities provide opportunities within existing behaviors to introduce therapeutic interventions. Personal hobbies and interests offer powerful intrinsic incentives which could be harnessed to overcome physical challenges introduced as part of therapeutic exercise interventions. Persuasive design strategies could be adopted to raise awareness of RA within society through 'ambassador products' - objects that promote understanding and recognition of the needs of others.
- **Persuasive Design model.** Almost all interactions that we have throughout our day, both socially and professionally, are mediated by the designed objects and environments that surround us. Design not only facilitates many of these interactions it can also shape and influence our attitudes, abilities and our willingness to engage with particular behaviors and activities. The persuasive design model presented here identifies the importance of 'design' in affecting behavior towards healthy change.
- **Research Methods Used.** The research methods used within this study are an effective method for gaining detailed information identifying the real-life needs of users. The interactive nature of these methods provides the opportunity for patients to identify and report their needs, concerns and experiences in ways that could not be achieved by other means.

3.1 Future Work

This study provides a methodological foundation from which future studies can be built. Planned next steps within this study will take place in two areas:

Firstly, the study will develop a series of design criteria for improving user engagement with therapeutic exercise devices for people with RA. Secondly, the study will develop a series of interactive, conceptual, prototype devices to further extend our understanding of the research. Multiple pieces will be produced to examine the methods and application of this research. Beyond this, the intention is to develop commercial, product outcomes, and to apply our research findings to other conditions requiring physical therapy or physical rehabilitation.

4 Bibliography

1. Department of Health.: The Musculoskeletal Services Framework – A joint responsibility: doing it differently. pg36 (2006)
2. National Audit Office.: Services for People With Rheumatoid Arthritis. The Stationery Office. pg5 (2009)
3. Gaver, Bill, Tony Dunne, and Elena Pacenti.: Design: Cultural Probes. Interactions 6, no. 1, pp 21-29. (1999)
4. Prosser, J., and A. Loxley.: Introducing Visual Methods. ESRC National Centre for Research Methods (2008)

Air Pollution in Everyday Life: toward Design of Persuasive Urban Air Quality Services

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Abstract. To study the effects of air pollution on everyday life, a qualitative study was conducted assessing urban Finnish families' experiences regarding air quality variation. This paper sums the findings of the study. Opportunities are identified for the design of persuasive mobile services aiming to tackle the negative psychological and physiological effects of urban air pollution.

1   Introduction

In the coming decades, urban areas will be responsible for the overall population growth, while drawing in some of the rural population [1]. Growth of urban areas will not occur without challenges. Air pollution is a global phenomenon, affecting urban populations, in particular [2]. Pope et al. [3] showed that changes in life expectancy were associated with differential changes in particulate air pollution that occurred in the United States during the 1980´s and 1990´s. Reductions in air pollution accounted for as much as 15% of the overall increase in life expectancy in the cities studied. Poor air quality affects also psychological wellbeing. A study assessing healthy individuals living in a polluted and non-polluted region of Bavaria pointed out area-related effects of sulfur dioxide on mood, stress and ability to concentrate [4].

This paper explores the potential of designing air quality services from a persuasive [5] perspective. We highlight two enablers for such approach. First, advances in wireless sensor networks will enable the generation of near real-time view of the geographic spread of air pollution. E.g., project OpenSense [6] aims to obtain a micro level understanding of the spatio-temporal variation of air pollutants, based on data collected with sensors placed on top of trams and buses. Second, as mobile phones are carried around ubiquitously, air quality information can be adapted to the routines of the users, inferred through continuously sensed mobile data [7]. Using these two enablers, an air quality service could highlight locations and routes encountered frequently by a given individual, along which air quality levels are particularly poor. Such information could convince the user of the importance of avoiding certain areas of the city.

Kim & Paulos [8] showed that when users were given mobile tools to measure indoor air quality variation in their homes, and to access the measured levels through a mobile phone interface, they were in certain cases able to identify the cause of the deteriorated air quality. This, in turn, led to behavioral changes. While [8] highlights the *potential* of air quality services, more research is needed to understand the *actual* needs. This type of approach can inspire the design of persuasive air quality services.

The present study adopted a user centric design approach to study urban air quality variation. The next section describes the method of the qualitative study and summarizes the findings. Section 3 lists opportunities around design of persuasive air quality services, identified based on the outcomes of the user research.

2   Effects of air quality variation on everyday life

Family as a social unit is interesting from the point of view of air quality services. Parents of families are likely to be concerned not only for their own wellbeing but also for that of their children. Six Helsinki based families were selected for the study. The following screening criteria were used: health (presence vs. absence of allergies and asthma among family members), location of home (centre vs. peripheral), and commute methods used (car vs. public transport). Variation along these three dimensions was sought when selecting the sample. The participants were given a diary, which was intended to be used to record air quality related observations using text and photographs, over the period of approximately ten days. The participants were subsequently asked to ideate an air quality service based on the observations made. The final interviews focused on the material created by the families.

2.1   Summary of findings

Families living in the capital region, even healthy ones, were affected by low air quality. Pollution had an adverse effect on wellbeing: polluted commute journeys as well as always ongoing construction work were mentioned by all participants. Also seasonal factors, such as road dust in the spring and heat spells during the summer, contributed negatively to the perception of Helsinki as a clean city. The families located in the most polluted areas found visual cues of pollution from their homes, such as dirt on the window panes. The two families living in the worst affected parts of Helsinki considered moving to a cleaner area. All of the families expressed a preference to spend their freetime in clean, rural environments.

Low air quality in Helsinki region was seen as unfortunate yet unavoidable. Especially when it comes to commuting to work or school, there was little freedom as to which route to select. All of the participants acknowledged the negative health effects of air pollution. Despite this, there were several gaps in knowledge pertaining to air pollution. Most interviewees were unable to name the pollutants. They were not able to specify the exact health impacts of the specific pollutants, and furthermore, they were unaware of how to protect themselves during a period of low air quality.

The participants were at ease ideating services tackling air pollution. Several expressed a preference for combined presentation of weather and air quality

information. This may be influenced by the fact that online weather services showing realtime information are relatively mainstream in Finland. Ideas were expressed pertaining to mobile services highlighting polluted (or clean) personal routes or locations. For instance, the service could provide a list of the cleanest parks in one's city. Preferences were also expressed for effortless access to air quality information while on the go.

3 Design opportunities and conclusions

The findings led to identification of 3 opportunities for design of persuasive mobile communication features conveying air quality information. The opportunities could facilitate perceptual and behavioral changes, resulting in increased wellbeing. The opportunities are: (1) positive focus, (2) personalization; (3) active role of users.

Positive focus. Participants acknowledged the adverse health effects of air pollution. Preferences were expressed to receive air quality alerts. However, emphasizing the negative aspects of air pollution may not necessarily result in a positive overall effect. Threshold for behavior change can in fact be lower when in a positive mood [9]. Hence, an opportunity emerges, namely one related to the service emphasizing the fresh and clean contexts, as opposed to the polluted ones. The ideas of some of the participants fall in line with this opportunity. It was suggested that recommendations for clean parks and jogging routes could be generated, essentially shifting the emphasis on the positive aspects of the city.

Personalization. The participants stated that air quality information is conveyed in a coarse grained manner to the citizens. Relatively few monitoring stations measure air quality variation for any given city and the pollution levels communicated in conjunction with weather reports were perceived to be general. The novel measurement techniques [6] can yield a high granularity representation of air quality variation, however, making it possible to offer personalized data relating, e.g., to air quality associated with the usual routes of any given individual. Preference for this type of information was expressed by the participants, both from a real-time, as well as from historical points of view. Yet another form of personalization would be to summarize the mobility patterns of the individual and suggest changes to them, with the aim of reducing that particular person´s exposure to contexts of low air quality.

Active role of users. Previous research indicates that air pollution can become a neglected background characteristic of urban environments [10]. In line with this, participants of this study thought that not much can be done to effect one's exposure to air pollution, mostly because the everyday routines are spatially and chronologically fixed. To overcome such helpless mindset, the air quality service could underline the possibility of the user taking on an active role in reducing one's exposure to air pollution. Given the constraints imposed by the everyday life, this effect could be achieved by suggesting minor changes in the geo-routines of the individual, while allowing the overall pattern to remain the same. For instance, changing the bus stop used during a commute journey to one associated with a smaller level of pollution could result in a decrease in exposure to poor air quality. Users could also be reminded that they can personally contribute to reductions in

urban pollution by taking certain actions. One participant suggested that the measurement results associated with the sensor boxes could be conveyed directly to people nearby. Displays placed on top of buses could feedback the present air quality level. The displays would serve as a "collective conscious" reminding nearby drivers that the emissions from their vehicles are contributing to the air quality level.

To sum, health effects of air pollution were readily acknowledged. Despite this, the notion of air pollution remained at an abstract level. Most participants were not able to name the common pollutants and there was low awareness of how protect oneself during a period of bad air quality. The participants also felt that not much can be done to avoid exposure to pollution during the time constrained everyday life. It could hence be concluded that mobile air quality services have several challenges to address. Carefully designed persuasive service features could make air quality information more approachable and usable for urban dwellers and result in an increased wellbeing. The opportunities discussed in the present paper are a useful start. In the future, the topic should be studied across a wider range of use segments, as well as geographic regions.

4 Acknowledgements

5 References

1. United Nations, Department of Economic and Social Affairs, Population Division: World Urbanization Prospects, the 2009 Revision: Highlights. New York (2010)
2. Soubbotina, T.: Beyond Economic Growth: An Introduction to Sustainable Development. The World Bank, Washington D.C. (2004)
3. Pope, C.A., Ezzati, M. and Dockery, D.W.: Fine-Particulate Air Pollution and Life Expectancy in the United States. N Engl J Med. 360, 376-386 (1981)
4. Bullinger, M.: Psychological effects of air pollution on healthy residents: A time-series approach. J. Environmental Psychology. 9(2), 103-118 (1989)
5. Fogg, B.J.: Persuasive Technology. Morgan Kaufmann Publishers, San Francisco (2003)
6. Aberer, K., Sathe, S., Chakraborty, D., Martinoli, A., Barrenetxea, G., Faltings, B. and Thiele, L.: OpenSense: open community driven sensing of environment. Proceedings of the 2010 ACM SIGSPATIAL International Workshop on GeoStreaming (2010)
7. Blom, J., Gatica-Perez, D., and Kiukkonen, N.: People-Centric Mobile Sensing with a Pragmatic Twist: from Behavioral Data Points to Active User Involvement. Proceedings of MobileHCI (2011)
8. Kim, S. and Paulos, E.: inAir: Measuring and Visualizing Indoor Air Quality. Proceedings of Ubicomp (2009)
9. Schwarz, N., Bless, H. and Bohner, G.: Mood and Persuasion: Affective States Influence the Processing of Persuasive Communications. Advances in Experimental Social Psychology. 24, 161-199 (1991)
10. Evans, G. and Cohen, S.: Environmental Stress. In: Evans, G. & Cohen, S. (eds.) Environmental Stress, pp.571 – 610. Wiley, New York (1987)

Ambient Persuasive Guiding Measures: Influencing pedestrian walking behaviour at bottlenecks in the London Underground

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Abstract. This paper presents solutions for particular problems commuters encounter during the walking phase of their journey in public transport facilities. Commuters get obstructed or have collisions at bottleneck situations making their walking inefficient and stressful. The notion presented in this paper is to reinforce existing infrastructures with embedded *ambient persuasive technologies* acting as *psychological guiding measures* to enhance pedestrian flow.

Keywords: Ambient persuasive technologies, psychological guiding measures, avoidance maneuver, anamorphic graphics.

1   Introduction

In 2010/11 the London Underground carried a record number of 1.1 billion passengers per year [1] and it is projected to grow to 1.5 billion by 2020 [2].

This constantly growing number of passengers imposes a great impact on the operational system of the London Underground. This increasing passenger flow will require improvements to infrastructure and information design in transport facilities not just to improve the efficiency of pedestrian flow, but also the quality of travelling through the setting, i.e. with less stress and more comfort.

An interrupted pedestrian flow (as people obstruct or even collide with each other), for example at blind corners, has an impact on the overall commuter flow and individual stress levels. These areas act as bottlenecks, which together with other delays in the overall journey are trigger points for causing stress and frustration.

The following study aims to develop *ambient persuasive technologies* [3, 4, 5] embedded into the environment, which act *as psychological guiding measures* [6] for a more effective *self-organisation* to improve the pedestrian flow and the quality of walking. It is argued that persuasive power is most efficient if applied as an ambient intervention; embedded in the built environment aiming to make suggestions at the right moment and place, without causing irritation to the users involved [3, 4, 7].

2   Ambient Persuasive Guiding Measures

The goal of this study is to develop ambient persuasive technologies (APT) acting as psychological guiding measures (PGM), which provide commuters with the required support at the right time, in an unobtrusive, non-coercive way for a more managed pedestrian flow. We have designed several such measures:

Anamorphic Graphics. This is the notion of using anamorphic graphics to assist pedestrians to organise themselves more efficiently at bottlenecks by strategically placing illusions of physical barriers to change their walking behaviour. These anamorphic graphics, although actually flat and static, appear to be dynamic as they morph into different 3D shapes depending on the viewing angle (Figure 2). They are designed to morph into the intended form right at the moment and place the graphic is needed most. For example, an illusion of 3 triangular divider protruding from the wall aiming to change

commuters' behaviour to walk as close as possible around corners from one side – based on the notion of *cutting corners* [8] – to minimise collision avoidances.

Parallax Motion Display. This PGM is concerned with the potential of dynamic, responsive information. The notion of *responsive graphics* is based on the principle of the zoetrope. This is a rotating cylinder with vertical slits and a series of images on its inside, which produce the illusion of motion, when viewed in quick succession through the slits. However, in this study the animation can be seen on a linear display, generated through body movement, rather than a rotating device. The notion is that motion displays, which are self-generated through body movement, draw more attention than static graphics. Also, due to the fact that the graphics apparent movement is actually generated by the pedestrian's movement, it provides a certain interactivity and playfulness which might make it more likely to be accepted and followed as guidance instructions.

Digital Hagioscope. This APT is concerned with the enhanced perception for collision avoidance around narrow corners or walls. It is based on the notion of a hagioscope, which is an architectural wall opening, mainly found in churches, allowing a direct view of the altar, if for example obstructed by a wall. The concept is, that instead of constructing an opening in the structure of a corner, which might affect stability, two LCD screens receiving signals from appropriately positioned cameras are installed showing the view of the opposite side, giving an illusion of transparency at the edge of the corner to prevent collisions.

Platform Distribution Display. This APT is concerned with the distribution of commuters on a platform. Data about how many passengers are in the individual train carriages is collected, using video detection and sensors (kinect) to estimate the capacity of each carriage of the in-coming train. This information will be displayed on the LED screens, currently used on the London Underground to indicate the time of the next arriving train, allowing commuters to distribute themselves on the platform accordingly to where the least crowed carriage will stop. An alternative solution might be to use ambient lighting to direct people to the desired area where the least crowded carriage will be.

3   Experiments

This paper focuses on the first, most basic set of *ambient persuasive guiding measures* – anamorphic graphics designed with the intention to *nudge* [9] pedestrian's walking behaviour in a subtle way at corners to minimise collisions and avoidance maneuvers. The notion of influencing people's path at a corner derives from the fact that straight, head-on walking lanes allow people an optimised monitoring the oncoming person and to display their intentions in order to avoid each other. However, a corner will prevent monitoring the entire field, limiting the ability to scan oncoming pedestrians, thus increasing the likelihood of being involved in a collision [10, 11]. Hence, in order to reduce the chances of this happening it is necessary to investigate ways to improve this area, using measures that allow people an earlier *body scan* [12, 13] at points where the view is limited or reduced - without having to construct new architectural elements, but instead augment the existing infrastructure.

The initial experiments were designed to find out whether the proposed PGM's are actually able to influence the way people walk around corners. The study was conducted over a duration of 5 days. In total 22 participants (10 female, 12 male) took part. The experiments focused on 5 interventions: 2-D Line, 2-D Curve, 3-D illusion (wall), 3-D illusion (floor), 3-D object (floor) all designed to influence people's walking behaviour at about 1.2 metres before the actual corner (see Figure 1). The closer a person is to the wall to which he/she will turn at this point, the less he/she can see whether someone is coming from the other side, increasing the likelihood of a collision or sudden avoidance

maneuver. Hence, each additional centimeter way from the wall will allow the pedestrian to see further around the corner to allow making appropriate path choices.
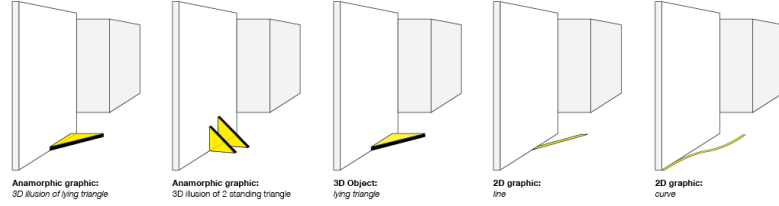
Fig. 1. Illustration of the 5 main interventions situated at a corner.

All experiments were designed to investigate how interactants perceive, comprehend and react to non-verbal, floor-based signals. The experiments were conducted in a controlled setting at the Pedestrian Accessibility and Movement Environment Laboratory (PAMELA) in collaboration with University College London, UK (UCL) [14]. PAMELA is a controlled multisensory research facility providing a platform consisting of 60 configurable modules (1.2m x 1.2m) that can be adjusted to simulate different environmental conditions. For the experiment an artificial corridor environment was built made out of an unroofed 2m (h) x 1.2m (w) x 2cm (t) honeycomb cardboard panels.

4   Methodology

A combination of video ethnography (observations and video-analysis of the footage) and a post-questionnaire to assess participant's attitudes was used creating a qualitative and quantitative approach.

Latin Square. During the experiments 2-4 participants, coming from each side are asked to walk through the artificial corridor to simulate a pedestrian counter flow. The participants were divided into groups (A, B and C). Each group underwent the same set of experiments, but in a different order to avoid possible bias. The Latin square method was used to rotate the layout of the setting as well as what intervention the group of participants would encounter first in order to avoid people learning the route.

Video observations. A video ethnographic approach is commonly used in the field of behavioral studies and was adapted to this study. 8 cameras were used to observe people's walking behaviours around corners, i.e. how they approach, manoeuvre and perceive corners. Overhead cameras were used to capture any potential trajectory change. Horizontal views were used to observe certain hot spots where potential avoidance maneuvers are likely to occur. This allowed documenting the experiment from various positions allowing a thorough retrospective analysis of the study.

Post-Questionnaire. After completing the experiments each participant was asked to fill in a short questionnaire to acquire more information regarding the effectiveness of the interventions on people's attitude towards walking in public transport facilities.

Video Analysis. The video analysis software ELAN was used in order to make observations and annotations at the moment the action occurred, making it possible to determine subtle behaviour and trajectory changes more easily. The 0.4m x 0.4m tiles of 1.2m x 1.2m modules were used as a grid to measure the deviation of the participants.

5   Results

The initial findings were expected to yield insight into the perception, reaction and effectiveness of (analogue) PGM's to provide viable data for the main study. The study presents the average trajectory deviation for each intervention (in cm), i.e. the amount of

space people have been shifted away from the wall measured from their original position and to what extent the design was effective (see Figure 2). For example, if the original position of a person was 40cm away from the wall to which he/she would turn, the use of a 3-D illusion would shift a person, on average 20cm further, which means 60cm away from the wall compared to no intervention.

Intervention	Average Deviation	Effectiveness	P-value
2-D Line [N= 17]	4 cm	41%	0.0123
2-D Curve [N=32]	15 cm	84%	0.0001
3-D illusion (wall) [N=25]	20 cm	84%	0.0001
3-D illusion (floor) [N=22]	20 cm	82%	0.0001
3-D object [N=22]	24 cm	91%	0.0001

Fig.2. Average deviation of each intervention including their effectiveness to influence people's walking behaviour around corners.

The findings showed that 91% of people changed their paths to avoid the 3-D object (9% stepped over it). In comparison 82% of people changed their paths to avoid the illusion of the same object. Hence, this shows that an illusion of a physical object placed at a corner can influence people's walking behaviour to almost the same extent, but without the risk of creating a trip hazard for people coming from the opposite side.

References

1. TfL: Annual Report and Statement of Accounts, <http://www.tfl.gov.uk/assets/downloads/corporate/tfl-annual-report-2010-11-final-interactive.pdf>

2. Railway-technology: London Underground Major Regeneration Scheme, <http://www.railway-technology.com/projects/london/>

3. Davis, J.: Towards Participatory Design of Ambient Persuasive. In: Persuasive 2008, <http://www.pervasive2008.org/Papers/Workshop/w2-03.pdf> (2008)

4. Mathew, A.P.: Using the Environment as an Interactive Interface to Motivate Positive Behavior Change in a Subway Station. In: CHI'05 Extended Abstracts on Human Factors in Computing Systems, pp. 1637--1640 (2005)

5. Rogers, Y., Hazlewood, W.R., Marshall, P., Dalton, N., Hertrich, S.: Ambient Influence: Can Twinkly Lights Lure and Abstract Representations Trigger Behavioral Change? In: UbiComp'10 (2010)

6. Helbing, D., Molnar, P., Farkas I.J., Bolay, K.: Self-organizing pedestrian movement. Environment and Planning B: Planning and Design, Vol.28, No.3, pp. 361--383 (2001)

7. Fogg, B.J.: Persuasive Technology: Using Computers to Change What We Think and Do. Morgan Kaufmann, San Francisco (2003)

8. Kovacs, L.B., Galle, P.: The logic of walking in urban plaza. Environment and Planning B: Planning and Design, Vol.21, No.2, pp. 159--177(1993)

9. Thaler, R.H., Sunstein, C.R.: Nudge: improving decisions about health, wealth and happiness. Penguin (2009)

10. Rymill, S.J., Dodgson, N.A.: Psychologically-Based Vision and Attention for the Simulation of Human Behaviour. ACM (2005)

11. Yokoyama, M., Okano, Y., Fukushima, S., Furukawa, M., Kajimoto, H.: The Device of Visual Stimuli for Pedestrian Clash Avoidance Using Peripheral Vision. In: Augmented Human 2011, Tokyo (2011)

12. Collett, P., Marsh, P.: Patterns of Public Behaviour: Collision Avoidance on a Pedestrian Crossing. Semiotica, Vol. 12, No. 4, pp. 281--300 (1974)

13. Goffman, E.: Relations in Public. Microstudies of the Public Order. New York, Harper and Row (1971)

14. PAMELA, <http://www2.cege.ucl.ac.uk/cts/arg/pamela2/laboratory/>

Ethical Considerations in Designing Adaptive Persuasive Games

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Abstract. In this poster, we describe an ongoing project concerning the development of an Adaptive Treatment Game (ATG) for treating Post Traumatic Stress Disorder. The ATG uses biofeedback and computer game technology to enable multiple treatment techniques and goals. We examine how a multidisciplinary approach shaped the prototype and we discuss the ethical implications of creating a self-adaptive, semi-autonomous treatment game.

Introduction. Post Traumatic Stress Disorder (PTSD) can be a severely disabling syndrome. It is sometimes developed after exposure to extreme stress in situations that include experiencing or witnessing mortal danger or extreme terror. Research into the efficacy of different treatments for PTSD has been ongoing since the 1980's and a variety of treatment approaches have been identified [2, 8]. One of the most recent developments in treatment approaches is the use of Virtual Reality Therapy (VR-T). Studies of the efficacy of VR-T are cautiously positive, though more research is needed [9].

Meanwhile, advances in affective computing have enabled the creation of systems that use psychophysiological and behavioral data to reliably infer emotions experienced by users, including stress and anxiety [5, 10, 11]. Drawing together threads of earlier research initiatives, we have reason to believe that including ludic and diegetic aspects in VR-T universes will enhance their efficacy, along with their ability to promote attitude and behavior change. To explore this hypothesis, we are developing a prototype of a multi mode Adaptive Treatment Game (ATG) that brings together three Cognitive Behavioral Treatment techniques in one coherent game universe. The ATG prototype will be completed and undergo clinical testing in Spring 2012.

The ATG prototype. The multidisciplinary team behind the ATG included multiple game designers and developers, computer game, affective computing and artificial intelligence researchers and three PTSD therapists (two psychologists and a psychiatrist) with decades of treatment experience between them. Based on the recommendations and experience of the therapists, Relaxation Training (RT), Stress Inoculation Training (SIT) and Exposure Therapy (ET) were chosen as the treatment approaches at the outset of the project. As such,

our tool is multi modal, in that it supports these three treatment types. Avenues of adaptive persuasive design that were outlined by Fogg almost a decade ago [3] have now been used in a plethora of tools and products as discussed by Kaptein et al. [7] and Kaptein and Eckles [6]. Drawing on persuasive design strategies, including *tunnelling*, *tailoring*, and *conditioning* [3], we designed a treatment tool that uses adaptive biofeedback technology to learn an individual patient's response patterns and adjust the presented stimuli relative to reaction data from previous treatment sessions [11]. In addition, the tool uses game design to create a convincing, seamless world. The three modes of the ATG are displayed in Figure 1.

| Relaxation Training | Stress Inoculation Training | Exposure Therapy |
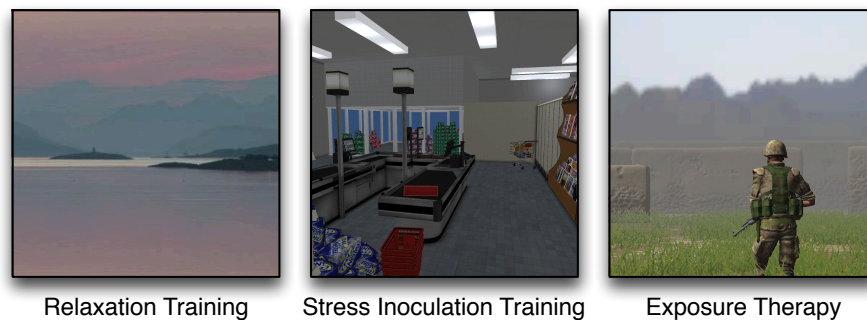
Fig. 1. Screenshots from the three modes of ATG

We decided to create our own development method in order to support the multidisciplinary collaboration process and structure the contributions from the different areas of expertise. Since we wanted to create a game that could be used in real world psychological practice, we needed to ensure that the ATG was feasible, useful and safe outside the laboratory. To solve this task, we started by forming a hierarchy of design concerns, in the following priority: *functional design, treatment design, technology design, and game design*. This *design hierarchy* was used to resolve any design conflicts - e.g. treatment design concerns would always take precedence over game design concerns.

Discussion. A design incorporating input from many sources of reference must become an amalgam of priorities from all the different fields, which are not necessarily compatible. This means that hard decisions and prioritization was necessary in order to make the different constituents of the ATG fit together.

It resulted in an underdeveloped game design, since this was at the lowest tier of the design hierarchy. It might have been fruitful to give game design a higher priority, or to abandon the idea of prioritized concerns altogether to ultimately make a more compelling tool.

However, we believe that the most interesting and pressing questions that the ATG raises, fall under the area of ethical persuasive design. Making any

form of semi-autonomous system that interacts with patients in clinical settings entails a major ethical responsibility on the part of the designers of the system, as does the construction of any piece of persuasive technology. The responsibility of imbuing the system with these adaptive properties is not whisked away by providing the therapist as a safety measure; the constructors of the system still carry a responsibility for its subsequent effects on end users [4]. Berdichevsky and Neuenschwander [1] describe in their decision tree for ethical evaluation of persuasive technologies that a system designer's work is ethical if her system's outcome is intended and good, but she is not responsible if an undesirable outcome is unintended and not reasonably predicable. In the case of adaptive persuasive technology it becomes more difficult to imagine all possible use scenarios and thus all the possible unintended side-effects. This blurs the line of reasonable predictability as also Kaptein and Eckles point out in their treatment of persuasive profiles [6]. Indeed, using adaptivity and profiling might put an even greater responsibility on the designer. In our case, we identified the following risks:

Black-boxing of the ATG's inner workings could make the links between experience and evaluation opaque to the patient and the therapist. This may in term result in alienation from the platform and demotivate the patient from engaging with the ATG more than once. The answer to this was exposing the evaluations of the system to the therapist as well as the patient, making the ATG a tool that the two use in an egalitarian and transparent manner.

Objectification of the patient to a level where the ATG's evaluations take precedence over phenomenological experience. A special responsibility lies with the therapist to emphasize the experience of the patient as valid.

Erroneous profiling where short-comings of the applied AI lead to misclassifications and possible misinterpretations of the patient's reactions to certain stimuli, potentially leading to the exposure of the patient to unduly stressful or completely inappropriate stimuli. This is handled by the fact that the therapist may always override the system.

Second-order conditioning where fear reactions to cues in the virtual environment are not extinguished, but rather generalized, making hitherto unproblematic elements of experience into cues eliciting stress and/or anxiety. This risk is handled in conjunction by the therapist and the ATG.

Re-traumatization could be considered the worst-case consequence of the combination of erroneous profiling and second-order conditioning. If the ATG presented a patient with a wrongly graded, too intense, stimulus, it could set off a fully fledged anxiety attack or a flashback. The consequence could be conditioning adverse responses to the therapy situation itself and have destructive consequences for the therapeutic alliance. To minimize this risk, the stimuli in the ATG undergo testing with expert therapists, users drawn from the general public and as well as veteran cohorts, and carefully selected PTSD patients.

Conclusion and Future Work. With the ATG, we designed and built a prototype that points to a new way of applying virtual reality for PTSD in

particular, but perhaps also cognitive behavioral therapy in general. While we have yet to investigate the efficacy of the ATG as a treatment tool (it will undergo clinical trials in Spring 2012) the process of making the prototype yielded a number of valuable insights.

Bringing a hierarchical set of concerns into an iterative design process turned out to be limiting. With this approach some areas of a project may receive too little attention or be inappropriately bounded by concerns with higher priority. This was partially the case with game design in our project and it remains an open question whether the ATG would be a better tool if game design had been allowed to influence functional or treatment design.

Our research and development efforts so far suggest that adaptive and goal-directed VR-T tools can make psychological therapy not only more engaging, but also more effective at treating debilitating anxiety disorders. It shows that making adaptive and profiling tools raises important ethical questions with responsibilities for the designers and creators – and that handling these challenges is worth the effort, when it allows us to make future cognitive behavioral therapy a more personal, immersive and effective experience.

References

1. Berdichevsky, D., Neuenschwander, E.: Toward an ethics of persuasive technology. Communications of the ACM 42(5), 51–58 (1999)
2. Foa, E.B., Keane, T.M., Friedman, M.J., Cohen, J.A.: Effective treatments for PTSD, practice guidelines from the International Society for Traumatic Stress Studies. New York: Guilford Press, second edn. (2009)
3. Fogg, B.: Persuasive Technology Persuasive Technology. Using Computers to Change What We Think and Do. San Francisco: Morgan Kaufmann Publishers (2003)
4. Friedman, B., Kahn Jr, P.: Human values, ethics, and design. In: The human-computer interaction handbook. pp. 1177–1201. L. Erlbaum Associates Inc. (2002)
5. Haag, A., Goronzy, S., Schaich, P., Williams, J.: Emotion recognition using bio-sensors: First steps towards an automatic system. Affective Dialogue Systems pp. 36–48 (2004)
6. Kaptein, M., Eckles, D.: Selecting effective means to any end: Futures and ethics of persuasion profiling. Persuasive technology pp. 82–93 (2010)
7. Kaptein, M., Markopoulos, P., de Ruyter, B., Aarts, E.: Can you be persuaded? individual differences in susceptibility to persuasion. Human-Computer Interaction–INTERACT 2009 pp. 115–118 (2009)
8. Nemeroff, C., Bremner, J., Foa, E., Mayberg, H., North, C., Stein, M.: Posttraumatic stress disorder: a state-of-the-science review. Journal of Psychiatric Research 40(1), 1–21 (2006)
9. Parsons, T., Rizzo, A.: Affective outcomes of virtual reality exposure therapy for anxiety and specific phobias: a meta-analysis. Journal of Behavior Therapy and Experimental Psychiatry 39(3), 250–261 (2008)
10. Picard, R.: Affective Computing. MIT Press, second edn. (2000)
11. Popović, S., Horvat, M., Kukolja, D., Dropuljić, B., Ćosić, K.: Stress inoculation training supported by physiology-driven adaptive virtual reality stimulation. electronic form only:: NE (2009)

Evaluation of Persuasive Design Features in a Prototype of a Tobacco Cessation Website[*]

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Abstract. Tobacco smoking rates are higher in the lesbian, gay, bisexual, transgender, and questioning (LGBTQ) community when compared to mainstream groups. There is an increased interest in designing and implementing online cessation programs tailored for this community. This work-in-progress contributes to our understanding of issues for supporting online tobacco cessation by reporting findings from the evaluation of design features included in a paper prototype developed for a proposed LGBTQ health and wellness website.

Keywords: online tobacco cessation, LGBTQ, persuasive technologies

1 Introduction

Research evidence indicates a high frequency of tobacco use among individuals in the lesbian, gay, bisexual, transgender, and questioning (LGBTQ) community [1, 3]. As such, there is an interest in designing and implementing effective tobacco cessation programs specifically targeting this audience [1]. In fact, evidence exists to support the notion that members of the LGBTQ community prefer tailored cessation programs that are sensitive to their unique identity and culture [6, 7].

Despite the emerging literature on this issue, little guidance exists to inform the design of persuasive technologies intended to encourage tobacco cessation in the LGBTQ community. To address this knowledge gap we conducted an evaluation of persuasive features in paper prototypes for a LGBTQ health and wellness web site. Specific questions addressed in our study:

1. How does the target audience react to persuasive design features derived from the Functional Triad Framework [3]?
2. How do tobacco users at different stages of change in the Transtheoretical Behavior Change Model [5] react to the site?

2   Theoretical Underpinnings

To address these questions, we drew upon theory from both human-computer interaction (HCI) and behavior change. Specific frameworks and models informing our study include: the Functional Triad Framework [2] and the Transtheoretical Model for Behavior Change [5].

- The Functional Triad Framework [3], served to guide specific persuasive features included in the website prototypes. This framework suggests that computers, including Web based designs, can influence behavior as tools, media, and social actors. Given the goals of the proposed site, we chose to focus our design suggestions and analysis on the computers as a tool and social actor aspects of the framework.
- The Transtheoretical Model, or Stages of Change Model [5], allowed us to examine how individuals at different psychological stages of change interact with a website designed to influence their behavior. This type of feedback provides important information to guide future iterations of the proposed website.

3   Methodology

3.1   Prototype Development

The study was conducted with paper prototypes of three pages from a larger website promoting health and wellness in the LGBTQ community. Pages evaluated included the home page, a page devoted to LGBTQ specific smoking cessation topics, and a page with prominent online smoking cessation programs. Specific persuasive design features, derived from the Functional Triad Framework [3], included:

- user testimonials to facilitate self-efficacy and provide models for target behaviors.
- inclusive graphics and design elements relevant to the target audience.
- decision making aids such as thumbnails of linked sites, text descriptions, and social information. (e.g. 300 people liked this)

3.2   Participants

We recruited 5 members of the LGBTQ community to participate in the study - three female, one male, and one genderqueer. The participants had a mean age of 32 years with a range of 19-47 years. With regard to sexual orientation, two identified as lesbi-

an, one gay, one bisexual, and one queer. Four were current smokers and one had quit within the last six months. According to responses to the Smoking Stages of Change Questionnaire [6], two had no intention to quit (Precontemplation Stage); two stated an intention to quit within the next six months (Contemplation Stage); and one indicated quitting in the last six months (Action Stage). The site owners provided a $20 incentive for participation[1].

3.3 Data collection and analysis

We used semi-structured interviews to collect data. The interviews lasted approximately 30 minutes and involved participants evaluating each page of the paper prototype. All interviews were audio recorded and transcribed for analysis. Data were analyzed qualitatively using a structured thematic analysis process proposed by Patton [4]. After initial independent data analysis, the researchers collaborated to identify a consistent coding scheme. The researchers then applied this coding scheme and met periodically to evaluate and adjust their consistency.

4   Preliminary Findings, Limitations, and Future Research

Participants responded in a variety of ways, both positively and negatively, to the persuasive design features included in the paper prototypes. Specific themes identified from the interviews included:

- *Testimonials:* All five participants noted the potential value of including testimonials as part of the site. For example, one participant noted that the stories have the potential to "humanize" an otherwise clinical topic. However, after reading the sample testimonial two of the five participants cautioned that the tone needed to feel authentic and include specific information in order to be impactful.
- *Content Organized to Trigger Decision Making:* All participants generally spoke positively about content included to trigger decision-making. Three of the five participants specifically indicated that the visual preview of each resource was an important initial criteria used to determine whether or not to "click through." All participants discussed the use of the text descriptions for each site as a secondary line of information when reviewing the options presented on the page. In addition, four of the five participants indicated that the popularity information in the mockups might be helpful in deciding which resource to attend to first. One participant felt that since the information was on a health website, relevance should be refereed by a qualified individual not other users. Two participants cautioned that the "like" button might imply that the user had to sign-up or reveal his/her identity.
- *Inclusiveness Images, Messages, and Design Elements:* All respondents commented positively on the tailored nature of the prototype graphics. Participants specifically referenced that the use of diverse images of gay and lesbian couples gave a

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sense of inclusiveness. However, participants voiced concern about the use of images that may stereotype the LGBTQ community or may have been too casual.

This study also offers some preliminary data to support the claim that individuals at different stages of change may view websites differently. Below are themes unique to participants at two of the stages of behavior change included in the study. Since there was only one participant at the action stage, convergence on major themes could not be identified and reported.

- *Precontemplation Stage (no intention to quit smoking):* The two participants at this stage indicated a sense of skepticism toward the site. For example, both participants expressed a sense of skepticism as to whether or not "a website could really make them stop smoking." Further, both participants were skeptical of the unseen "man" who wants them to stop smoking.
- *Contemplation Stage (intention to quit smoking in the next six months):* The two participants at this stage expressed concerns about some of the site content. For instance, both participants seemed more sensitive to pointed messages on the dangers of smoking. Additionally, both participants demonstrated a keen awareness of the criteria they would use to select a cessation resource.

These observations, while limited by a very small sample size and the use of paper prototypes, may point to important implications for the design of persuasive websites, particularly smoking cessation resources. For instance, the findings may support the implementation of creative ways to tailor sites to a user's unique psychological needs. Future exploration of these issues on this site and others of a similar nature may be fruitful to the field of persuasive technologies for health-related issues.

5   References

1. Gay and Lesbian Medical Association.
   `http://www.glma.org/index.cfm?fuseaction=feature.showFeature`
   `&FeatureID=138&d:\CFusionMX7\verity\Data\dummy.txt`
2. Fogg, B. J., Cuellar, G., Danielson, D.: Motivating, influencing, and persuading users: An introduction to captology. In: Sears, A., Jacko, J.A. (eds). Human Computer Interaction Fundamentals. pp. 109-122. CRC Press, Boca Raton (2002)
3. McElroy, J. A., Everett, K. D., Zaniletti, I.: An examination of smoking behavior and opinions about smoke-free environments in a large sample of sexual and gender minority community members. Nicotine & Tobacco Research, 13, 6, pp. 440-448 (2011)
4. Patton, M.Q.: Qualitative Research & Evaluation Methods, 3rd Edition. Sage Publications, Inc.: Thousand Oaks (2002)
5. Prochaska, J. O., DiClemente, C. C.: Stages and processes of self-change of smoking: toward an integrative model of change. Journal of Consulting and Clinical Psychology, 51, 3, pp. 390-395 (1983)
6. Remafedi, G., Carol, H.: Preventing tobacco use among lesbian, gay, bisexual, and transgender youths. Nicotine & Tobacco Research, 7, 2, pp. 249-256 (2005)
7. Schwappach, D.L.B. Queer quit: Gay smokers' perspectives on a culturally specific smoking cessation service. Health Expectations, 12, 4, pp. 383-395 (2009)

Using Persuasive Social Medias to Support and Motivate Prosthesis Carriers

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Abstract. In this paper we present some initial ideas and reflections regarding the use of social networks as a mean to facilitate amputees using prostheses in their daily lives. We therefore combine perspectives from Persuasive Technology with the principles used to motivate patients with prosthesis to complete their rehabilitation. These prosthesis carriers (PCs) experience several challenges in their everyday life, such as exclusion from a group, why the prosthesis inadequacy demotivates the PCs approach to social interaction with others. The idea is to design a persuasive technology that supports, helps and motivates these PCs to deal and comprehend with, not only their psychological issues and worries, but also some of the more fatal consequences there are if they stop using their prosthesis. We thereby hope that the PCs will support, reward and motivate each other through interaction, recognition and self-monitoring.

Keywords: Persuasion Technology, MIP, prosthesis, social media, network

1 Introduction

Every year, thousands get amputated due to numerous causes of trauma and other conditions. These interventions can have fatal consequences for a person's quality of life [1]. Also amputees often experience depressive core symptoms such as; blame, lack of joy, decreased pleasure or interest and increased fatigue also depressive accompanying symptoms; low self-esteem, guilt, self-blame, difficulty concentrating, agitation, sleep disturbances, appetite and weight change [1,2]. These people incur serious disabilities, and therefore have a higher risk of experiencing serious loss of life quality and happiness [1].

People with acquired amputations and congenital limb absence are most likely to experience great trauma as a result of losing a leg or an arm, which creates challenges in their everyday life [3,4]. They are therefore offered prostheses to restore or imbue some of the function and/or cosmetics as part of their rehabilitation [1,3,4,5]. Adapting a mechanical body part is furthermore likely to be a challenge because of the reduced mobility. Many amputees, at some time, experience a feeling of being different or excluded from others non-amputees. But having a strong collective identity helps them feel like they belong in a group [6]. Furthermore a collective identity can provide a profound sense of fellowship with other people and thus help to satisfy a basic

human need to experience themselves as part of a social community. By gathering the PCs, the risk of feeling different or excluded reduces remarkably in such an environment, which may strengthen their quality of life [1,10]. The patients can also benefit from this experience and thereby get the strength to support, motivate and help other PCs in a similar situation [1,6,10]. To motivate PCs, we find a need of success and reward [7,8], which sports and competition hopefully can provide. Furthermore, the PCs must be motivated to work individually with the prosthesis so that they achieve body and prosthesis control [5,9], with the hopes of creating a natural and acceptable body movement [9]. Again sports and workouts can be the solution.

2 Consideration of a social media

We find it interesting to develop a network where sharing experiences, independent of time and place is possible, so that physically challenged from all over the world can interact, share information and communicate. We thereby hope to motivate a large number of people at one time - Mass Interpersonal Persuasion (MIP) [11]. MIP brings together interpersonal persuasion and mass media, and is thereby able to persuade a large number of people to change attitude or behavior. MIP uses social influence and competition, which is what we expect to incorporate in the social network. Furthermore we see it as advantageous to consider previous experiences, for example our work in HANDS SPo[1] [12] as well as successful social platforms such as Facebook (FB). Other open source platforms are to be considered, to delineate the right platform for a PC-network; there is need of further investigation of social media platforms, which is a part of our future research. Our immediate expectations and assumptions on these platforms is for example that MIP needs a massive social graph, whereby FB is a valuable choice. Also we expect most of the PCs to already have a functioning profile at FB and we find that most users check their account several times a day. FB makes it easy for users to find PC-friends, which will increase social interaction. Therefore we have an idea of creating a new website or platform for this PC-network, where users login and find friends at FB and apply them to the PC-network.

Here we find the need for ethical reflections and considerations important. Users of a social network must consider what kind of information they choose to share with others about their privacy as well as who has the rights over their public accessible and personal information available on the Internet. These ethical considerations must be clearly specified and discussed. Likewise, the pros and cons of either, using an already existing social network as FB versus creating a new social network must be considered. The possibility of becoming a part of the social network is primarily an offer for PCs living with the aforementioned physical and psychological challenges. Although there are several benefits for choosing FB we must on the contrary ensure that we reserve the rights to keep the PCs log-data private.

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[1] Helping Autism-diagnosed teenagers Navigate and Develop Socially. Sharing Point (SPo) a group at FB, where young autistics share experiences and learn about sarcasm.

Another important motivation factor is independence and natural movement with the prosthesis [5,9]. Competition and exercise releases endorphins and therefore hopefully can become a successful persuasive strategy [1,7] like team sports; football or running teams. By exercising or playing sports the PCs will be able to focus on opportunities rather than limitations, and they may get positive experience and feel of their bodies. However the PCs may risk finding it demotivating to train alone, due to lack of competition and social contact. The solution might be to practice with others through an interactive network such as Endomondo or NikePlus as a supplement to the PC-network. Here participants can share goals, distances, etc. and hereby interact and compete, independent of time and space.

Designers often have a specific intention with the design of a technology, and the intention is often more complex than 'wanting to motivate patients to use their prosthesis', and so the users intention towards applying a specific technology must to some extent be motivated by exogenous factors [1]. For the social network to help motivate the users to interact and share information and experiences, credibility is required. This is the same type of credibility and persuasion that has made FB so popular – recommendations, affiliation, opinion makers and social acceptance [7]. If friends use the site, communicate and share information, pictures, running routes, experiences and goals with each other, an unity is created.

3   A social network

Through the PC-network users will be able to manage and monitor their own actions and performances, set goals and check others' training tips, running areas, distances and times [7]. The network can create a virtual world or environment, which has to be tailored specifically to each user to support the persuasion and learning process. For example the users have their own avatar, similar to their body shape, weight, height, age, hair color, etc. to personalize [7,12]. Furthermore in the social network we find that operations are to be simplified for example by illustrating distances, time taking etc., to inform others about the user's workout. Here other users can rate each other's workouts, try the suggested routes and rate them to illustrate were the good running tracks are to find, according to what kind of disability each user has. Also we find it interesting to include positive feedback through reward, approval and praise of the users' work [8]. This may be in form of 'likes' (e.g. a thumb on FB) [7], compliments and statements as well as comments on achievements. Another type of positive response can be earning points in the form of symbols such as stars, thumbs or numbers where each user can monitor their progress [7,8].

In this environment, creating different levels that the user can accomplish by completing the various running routes at each level, can persuade and motivate users to keep working out [7]. An example:

- Level 1: A beginner's route of approximately two miles. The route must be completed by the user physically running the distance (GPS). When the route is completed, the virtual avatar moves to the next level.
- Level 2: Route length approximately five miles etc.

In this virtual environment each user chooses his friends and competitors in the same way as on FB, by recommendations, networks, social ties etc. Hereby each user is able to create his own tailored network online, to compete and monitor his and his acquaintances progress [7]. Furthermore this environment hopefully will be able to illustrate how the user moves, using GPS navigation. The avatars simulate the user's presence on a virtual map on for example a smartphone. Hereby the users can monitor his and his friends' movement on the virtual map [12].

4   Future research

In this paper, we have presented our hypothesis and ideas on how to motivate PCs through a social network. As described FB is a possible platform, to persuade as many PCs as possible, with the intention to gather users as well as create an environment for social interaction and support, and hereby change their behavior or attitudes. In our future work we expect to verify these hypotheses and find which kind of platform is advantageous for the PCs. Also we hope to create such a network and evaluate the network during the design process with the help of a social focus group of PCs, to insure participatory design. By involving the PCs in the actual design process, they most likely experience that their feelings, opinions and experiences can enrich and strengthen the technology's potential – and so the persuasion/motivation is further enhanced.

References

1. http://www.sahva.dk/leksikon, http://www.sahva.dk/andet/specialister-i-bevægelse 2012
2. Oestergaard, A.M. 2009. *Faktorer af betydning for succesfuld rehabilitering hos traumatisk amputerede soldater som proteseforsynes*;
   http://www.etf.dk/uploads/tx_subjectdb/Paa_Rigshospitalet_har_vi_.pdf
3. Christensen, B.; Ellegaard, B.; Bretler, U.; Ostrup, E.L. 1995. *The Effect of prosthetic re-habilitation in lower limb amputees. Prosthetics and Orthotics*; 19: 46-52
4. Burger, H.; Marincek, C.; Isakov, E. 1997. *Mobility of persons after traumatic lower limb amputation. Disability and Rehabilitation*; 19: 272-277
5. Murray, C.D.; Fox, J. 2002. *Body image and prosthesis satisfaction in the lower limb am-putee*; Department of Pshycology, Liverpool Hope, Liverpool United Kingdom
6. Jørgensen, Carsten René. 2008. *Identitet*. Hans Reitzels Forlag, København
7. Fogg, B.J. 2003. *Persuasive Technology – Using Computers to Change What We Think and Do*; Morgan Kaufmann Publishes, San Francisco
8. Bertel, L.B. 2010. *The Use of Rewards in Persuasive Design*; Persuasive 2010, Copenha-gen, Denmark
9. Giddens, A. 1996. *Modernity and Self-Identity, Self and Society in the late Modern Age*; Danish 1996, Hans Reitzels Forlag
10. http://www.diabetes.dk/ 2012
11. Fogg, B.J. 2008. *Mass Interpersonal Persuasion: An Early View of a New Phenomenon*; Persuasive 2008, Oulu, Finland
12. http://www.hands-project.eu/ 2012

A Design Study of Interactive Learning Environment for Joyful Behavioral History in Taiwan

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Abstract. The study presents the case study of the virtual reality style interactive learning environment for toy-based behavioral history in Taiwan. It uses the browsing process in spatial wayfinding as the design concept, in turn used to understand the spatial structure and user spatial perception. Results of the study summarize the cognitive models of wayfinding behavior and visual information reception for users in the interactive learning space, along with the operational procedures for webpage browsing style.

Keywords: design thinking, case study, interactive learning environment, joyful behavior

1   Introduction

According to Harnish (2002), memory is a kind of mind activity. Because of the memory ability, humans can connect with the external environment, objects, and events. Even though they are not physically present, the process of encoding, storage, and search can allow people to retrieve their cognitive images of the external environment and its objects. MRC Centre for Synaptic Plasticity (2010) proposes simplifying the compositions in spatial memory in this stage, into a map of the room in memory, in which three relationships exist: 1) what elements exist in the space? 2) what are the relative locational relationships among elements. 3) what are the relative relationships between the self and location of elements, and between the self and the spatial environment. Regarding wayfinding models in the real environment, Christian & Andrew (2008) proposed that, in the spatial structure constructed by humans in the real environment, wayfinding model could be considered the cognitive process by which people are continuously affected by the presentation of visual elements in space. Spatial structure and structural elements in the real environment, as well as corresponding relationships to walkable areas, the overall cognitive representation of the agent, and the corresponding agent operations actually comprise a repetitive interactive process. In the virtual world, Mark (1998) proposed the design principles for a good wayfind-ing model by designing comprehensive guidance visual information in the virtual space: 1) determine what angle would be used to present the overall appearance of space; 2) wayfinding paths can permit different movement speeds when

penetrating space; 3) visualize possible wayfinding paths, and analyze the dynamic development of paths in order to remove doubt and inadequacies; 4) information media in the space should be interactive operational devices; 5) when trying to observe one's location, the map should provide "You-are-here" information; 6) attempt to personalize paths to conform to the needs of the majority; 7) when encountering strange spatial targets, there should be good path suggestions provided to create the concepts of optimal path and shortest path; 8) on the maps there should be clearly labeled and comprehensively stratified information.

2 Design of Interactive Learning Environment

(a) Webpage learning forms   (b) Integration of the virtual reality style interactive learning environment
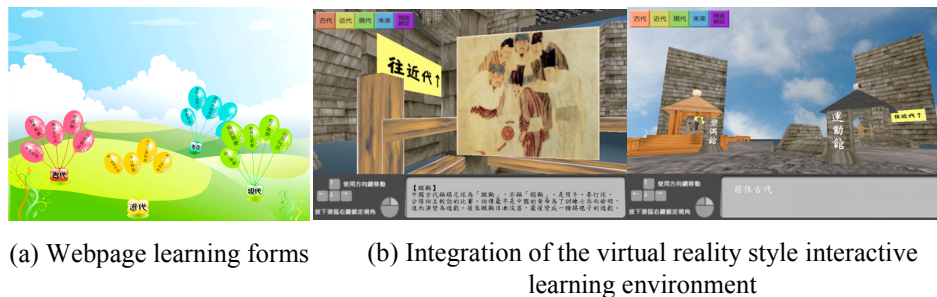
Fig. 1. Toy-based Behavioral History (Compiled by this study)

The study constructs the Toy-based Behavioral History for the analysis of a practical virtual space. The research steps are: 1) learning content design (inclused the past, the recently past, the present and the future toys); 2) virtual space design; 3) webpage learning design; 4) visual interface integration. In this stage, the Quest 3D is used to integrate the joyful behavior development interactive learning environment of web-page browsing style and spatial wayfinding style. As the Figure 1a, the purpose of webpage construction is to integrate all learning content and presentation methods, which absolutely affect the learning effects of users. The learning avatar can use the virtual space to browse content of joyful behavior development in different periods, and the wayfinding route is known through the relationship between spatial structure and unit organizations. In addition, (see Figure 1b and the website of project results: http://can.elt.nhcue.edu.tw/elt972sp/index.php) the information layout of virtual space also provides the interface function of quick links to other periods, the interaction between the learning avatar and virtual objects, and information browsing and other behavioral features all assist the user to understand the virtual space.

3 Discussion on Cognitive Model

Sensory elements are important in the production of digital instructional materials, information perception, and interactive design, and can affect how users perceive and construct the structure of content knowledge. The study by Chen & Stanney (1999)

shows that, at the beginning stages of human construction of information cognitive models, it begins with the information processing of visually perceived information, to establish one's relative relationship to the spatial structure as well as the available spatial behavioral features. Design of the wayfinding mechanism can refer to three auxiliary procedures: intuitive cognitive mapping, wayfinding plan development, and design of physical movement or navigation in the environment. In the wayfinding process, their perceived experiences, personal abilities, motivations, search strategies, and layout of environment when engaging in wayfinding all require deep consideration. Kwan (2001) used the perspective of cognitive behavior to propose the behavioral cognitive model for users in the internet space. Chang & Hsu (2007) discussed the inadequacies of Kwan's cognitive model, such as: the individual's internal cognitive procedures are too simplified, as well as the insufficiently clear explanation regarding the interaction of the access interface and the cyber-environment; the memory processing stage in the access interface does not analyze the correlation between interface features leading to long and short term memory; the knowledge constructed in environments related to the virtual space have not been discussed, how spatial behavioral features produce corresponding spatial perceptions; and finally the three main parts of the cognitive model: insufficient description of the relationships among the individual, the access interface, and the cyber-environment.
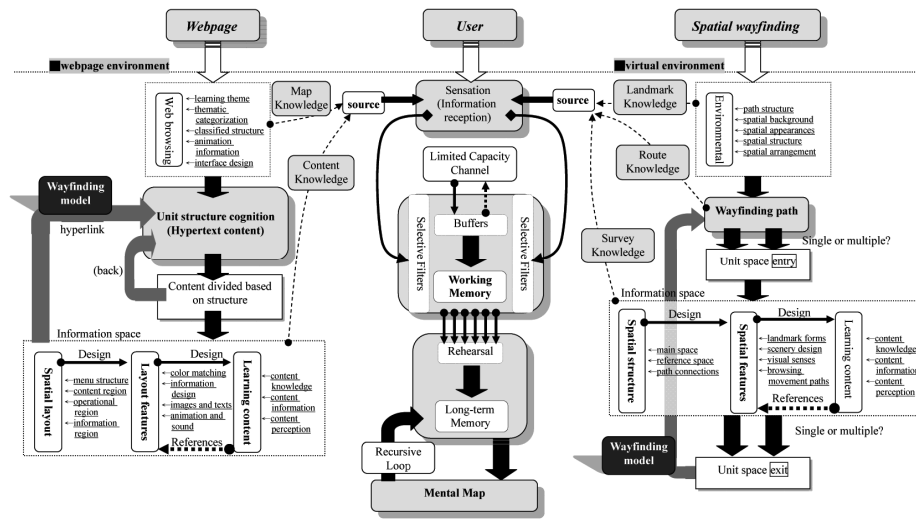
Fig. 2. User-centered virtual space information cognitive models for joyful behavior development (Compiled by this study)

After analyzing the user's behavioral features in the virtual space of joyful behavior development, the cognitive model in Figure 2 is constructed. The cognitive model primarily exhibits the user-centered joyful behavior development virtual space information. When the user conducts the wayfinding model: spatial browsing and wayfinding process, they primarily observe/interpret the conditions of personal space, and

continued accumulation of landmark knowledge as guided by visual cues, including environmental features: route structure, spatial background, and appearance, the arrangement relationship between the spatial structure and virtual objects, such as different periods of joyful behavior development, to use a structurally significant spatial appearance to strengthen the spatial memory of where the user is located. When facing the route choice, there may be multiple paths in the space so that there is different movement in the space; route knowledge must be due to participation and behavioral features for construction. Thus, when engaging in spatial browsing and movement, the basic cognition for the space is determined on the condition of the information space, in order to construct survey knowledge, including describing the perceptive impressions of "spatial structure": such as the main space (or the theme hall features of the period), reference space (the basis of difference between theme halls), and path connection (browsing processes between halls). Describe the conditions of the "spatial features": landmarks, sensations produced by scenery forms (such as the forms of virtual objects), and the behavioral features that determine the following procedures.

4 Future Study

Future studies should apply this cognitive model, including the spatial wayfinding model: the route structure of environmental features, spatial background and appearances, arrangement relationship between spatial structure and virtual objects, and the webpage browsing model: homepage content, unit structure perception, content structurally divided, webpage layout and features, and the connection to learning content, as well as webpage wayfinding mechanisms for empirical studies.

References

1. Chang, Y.P., & Hsu, H.L., (2007). Spatial Cognitive Model in the Cyber-Environment: Space in Digital Cities as an Example, 2007 U-home Conference, Kun Shan University, 15-25.
2. Chen, J. L. & Stanney, K. M. (1999). A Theoretical Model of Wayfinding in Virtual Environments: Proposed Strategies for Navigational Aiding, Presence, 8(6), 671-685.
3. Christian, G. & Andrew, U. F. (2008). Wayfinding Model For Pedestrian Navigation, 11th AGILE International Conference on Geographic Information Science, University of Girona, Spain.
4. Harnish, R.M. (2002). Minds, Brains, Computers: An Historical Introduction to the Foundations of Cognitive Science, Oxford, Massachusetts: Blackwell.
5. Kwan, M. P. (2001). Cyberspatial cognition and individual access to information: the behavioral of cybergeograghy, Eviroment and Planning B: Planning and Design. 28, 21-37.
6. Mark, A. F. (1998). Designing Navigable Information Spaces, Master's thesis, Massachusetts Institute of Technology.
7. MRC Centre for Synaptic Plasticity (2010). Neural Basis of Spatial Memory, Retrived on Setemper 18, 2011 from http://www.bris.ac.uk/synaptic/research/projects/memory/spa-tial-memory/

Dear Diary: A Design Exploration on Motivating Reflective Diary Writing

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Abstract. This research-through-design study explores the motivations and threshold for reflective diary writing, as a case of supporting behavior change through product design. A field study examines how a new design of a diary triggers and stimulates writing and taking a reflective perspective. The most important finding shows that the design changes the overall experience and strengthens the reflective value of diary writing. The findings suggest focusing on motivation and experience design for supporting behavior change.

Keywords: Daily Reflection, Motivation, Diary Writing, Design Exploration, Changing Behavior

1   Introduction

The interest in diary writing is very broad, as it is an essential element in cognitive behavioral therapy that can help address problems relating to eating, sleeping, medication compliance etc. As such there is a broad interest in increasing compliance to diary writing regimes. Typical solutions to this might include computerized tools to improve people's ability to keep diaries, for instance by reminding them to write or reducing the effort required [1]. Such persuasive approaches to diary keeping are suitable because these diaries are often kept for a predefined amount of time and rely on complying with a therapy.

This research focuses on diary keeping as a way to address sleep problems. Several studies have found that a substantial number of adults suffer from sleep problems, which can cause severe health problems and hazards at work or when driving. For example, a 2008 survey by the National Sleep Foundation (USA) found that 15% of respondents sleep poorly occasionally and 6% never sleep well [2]. Often a cause for sleep problems are worries and stress [3].

Diary keeping and cognitive behavioral therapy have been proposed as ways to mitigate this problem. However, diary keeping for sleep needs to be sustained for long and goes beyond record keeping to personal expression and reflection. Diary writing in this case is a personal activity and as a result this study does not depend on compliance. Referring to Fogg's model of behavior we believe it is more fruitful to enhance motivation rather than ability [4].

2   Method

To explore the motivations, threshold and the potential influence of the diary object this study adopts a research-through-design approach. A diary is designed and is seen as an embodiment of several hypotheses concerning aspects that will increase the likelihood of writing. A field study of using this diary helps evaluate these hypotheses qualitatively.

Figure 1 shows the concept diary. A wooden stand holds several folded letters and can display up to four next to each other. The front of each letter features an incomplete sentence, "today was". Participants were asked to finish this sentence with a single word. The letters can be unfolded, the inside of the letters is lined for more elaborate writing.

Fig. 1. The designed diary with letters

This design is based on the following premises:

- Asking for one word will lower the threshold to start writing and the folded letters will stimulate people to continue writing more.
- Making the diary more outstanding in its context will trigger people to write.
- Seeing your previous entries will motivate to write again.
- There is a more emotional value in writing by hand. Also, the design and the materials used are intended to give a personal and warm feeling.

A convenience sample of 10 individuals (5 male, 5 female) used this diary for a week. We examined the relation of the artifact design to their experience through individual in-depth interviews at the end of the trial period.

3 Diversity in Ways of Diary Writing

People wrote about a variety of things: events, experiences, emotions and more practical issues like "to-do's". For some participants reflection became an active mental process rather than helping them wind down after the day; for others it became a moment of transition: *"I think it helps to give closure to the day. It helps when you consciously have to think about it."*

The reported motivations set apart two types of diary writers: The first write to remember and to look back, they often have less writing experience and write more factually. The second are intrinsically motivated by the joy of writing and because writing helps deal with their worries: *"I seldom look back at what I wrote down; it is a matter of putting things down on paper."*

For the two groups the concept diary offered different reflective values. Three of the four people who indicated they would "normally" write with the goal to look back upon, indicated that the cards triggered them to write on a more emotional side. *"I guess I write in a factual way anyhow (...) but that one word tells much more about how you felt about it."*

Those who indicated to be in the habit of writing more expressively had more diverse experiences with the diary. For example, being challenged to write one word helped put emotions in perspective: *"Usually I focus on the excesses, things I want to have off my chest. Now you review the entire day, which gives a more balanced picture."* The visible display of the writings had an additional reflective value*: "It would make me feel more responsible of how things go, not only by feeling my feelings but by actually seeing them."* Two participants remarked how the concept diary was more able to trigger them to write: *"It is more present than a regular diary, it stands right in front of you, it stands out"*.

Some participants would prefer a more mobile diary that would be at hand when one feels the urge to write. Two participants indicated the appreciated how the diary design fitted their irregular habits: *"You can do this when you have the urge to. In a diary it is like "I didn't write for three days, it is disturbing that there are gaps in it." With this it are loose parts that you can pick up separately again."*

4 Fostering reflective writing by design

Analysis of the interview data indicates the emergence of a 'tunneling' [5] process enhancing reflective writing. The interviews show people had diverse motivations and experiences, but all have these steps of the process in common. First of all, participants indicated the diary was more present than a regular diary, which appeared to trigger them to start writing. For some writing one word was very easy and others saw it as a challenge but for all, the diary made the activity more accessible. Other aspects lowered the threshold as well: the separate letters made if feel less of an obligatory routine. Some thought a more portable diary could make the threshold even lower.

Second, people were teased into writing more. Participants mentioned they wanted to explain the word they had written on the front. Others easily wrote just one word

and some wrote in a different order, first writing a story and writing one word as conclusion.

Third, participants commented how looking back on previous entries motivated them to write and for some the aesthetic aspects of the design made them enjoy writing about their day. The prompt to provide one word for completing the sentence on the cover, stimulated them towards an emotional expression which combined with the visibility of previous entries lead to an unexpected experience of diary writing.

In turn, this stimulated people towards the last step: to take a more reflective perspective towards their days. Any diary has this reflective value but this value was enhanced by the design of the diary; it stimulated more emotional and more balanced input, combined with looking back over a longer period.

This analysis shows how the design had impact on all stages of diary writing as well as for the many different approaches people had. The handwritten and aesthetic qualities of the diary enhanced the experience, because it focuses on experience and not on efficiency. Participants appreciated the reflective perspective, but not all were conscious about it during the study period. To maintain this reflective behavior, for it to truly become a part of daily life a personal motivation should be combined with a motivating design.

5   Conclusion

This paper has motivated the design of a physical diary that aims to enhance people's intrinsic motivation for diary writing. A one week long evaluation with 10 participants has first of all given insight in the diversity of people's experiences and motivations. The study validated the design of the diary, showing how diary writers can be guided through this process to become more reflective through product design aspects. This behavior was stimulated by triggering through the visibility and by lowering the threshold and feeling of obligation through separate small entries. Finally the behavior was also motivated by increasing the reflective value through asking for one word and displaying the entries.

Going beyond the use of persuasive strategies and technical means to facilitate a target behavior we hope to have illustrated how product design can encourage behavior change.

References

1. Stone, A.A., Shiffman, S, Schwartz, J.E., Broderick, J.E., Hufford, M.R., Patient compliance with paper and electronic diaries. In: Control Clin Trials april 2003 pp. 182-199.
2. National Sleep Foundatin `http://www.sleepfoundation.org`
3. Morin, M., Charles, R.S., Ivers H.: Role of Stress, Arousal, and Coping Skills in Primary Insomnia MPS – 2003
4. Fogg, B.J.: A behavior model for persuasive design. In: Proceedings of the 4th International Conference on Persuasive Technology Persuasive 09, ACM Press
      Cialdini, R.B. : Influence, The Psychology of Persuasion. Morrow, 1993

Bouncers: a design exploration into sharing and triggering personal activity amongst friends

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Abstract. Sports clubs are loosing their social role leading to a decrease in sports participation. The exploration discussed in this paper attempts to create a virtual sports club to stimulate social connectedness. For this purpose Bouncers, a live wallpaper for android smartphones, was created. Bouncers allows a group of friends to get insight into each other's physical activity. This resulted in an increase in social activity through which persuasion within the group emerged.

Keywords: Social connections, persuasion in groups, design exploration

1   Introduction

Human beings desire to have social relationships. One of the ways to form social relationships and create a social status could be achieved by joining a sports club. However, in our current society the social role of sports clubs is disappearing, resulting in a lower participation level in sports [1]. For society this creates a challenge, as the lower participation in sports can lead to several health issues, like for instance obesity, diabetes, etc. The field of persuasive technology often focuses on such issues and tries to persuade people to become active again.

Next to the trend of declining sports participation we also see social media take over part of the social interaction, taking over the role of sustaining relationships. In this exploration we set out to create a virtual sports club for an active lifestyle to stimulate people to become more socially connected by means of physical activity.

Because people have the urge to fit in, their behavior is influenced by others around them [2]. The influence others have on a person differs by means of their relation to the person [3]. This opens the opportunity to create a virtual sports club through which people can motivate each other to be more active.

2   Bouncers

For this purpose we designed Bouncers, a live wallpaper for android smartphones. The wallpaper was designed to be non-obtrusive and provide a subtle way of displaying information during everyday use of your smartphone. Bouncers visualizes physical activity, using the accelerometer data of the android smartphone. An individual's activity is represented in the speed of one circle in the wallpaper. Other circles represent the physical activity of a selection of your friends. The information about one's physical activity is therefore shared in a small and close group of friends.

As illustrated in Fig. 1, Bouncers shows different circles, each with their own unique color. The large circle represents the owner of the phone and the smaller circles represent his/her selected friends. The speed of each circle corresponds to an individual's activity, measured and processed by the internal accelerometer, processed as a rolling average. Therefore the results are not immediate and can only be perceived over time. Thus the speed correlates with the general amount of physical activity of the individual.

Fig. 1. Bouncers and social interaction

3   Design Bouncers

Smartphones have become everyday wearables just like clothing, shoes and jewelry. This made it possible to extend its communication purposes and integrate Bouncers as a part of everyday life. As an animated wallpaper, Bouncers can serve as a subtle peripheral trigger each time the user interacts with his/her phone.

Bouncers is designed to enable people to become self-aware by providing insight into their own physical activity and the physical activity of others in the group. The

process of self-awareness enables users to reflect on their own norms and values. While designing Bouncers the aim was set for an implicit way of norm activation, as it does not weaken over time which is the case when explicit messaging is used [4]. The implicit method of reflection represents itself in Bouncers as the abstract visualization of how group members compare to each other. The design choice to use abstract visualization enabled the information to be more meaningful for people with little knowledge about the subject. In addition, abstraction allowed privacy as no concrete meaning could be derived from the visualization.

4   Involving users

Bouncers was developed in close cooperation with users to increase acceptance by starting very early on with discussing the concept with them. Through their involvement numerous compatibility and usability issues could be tackled early in the process. This way a working prototype could be spread, allowing us to fully investigate the effect of Bouncers on possible behavior changes and new patterns in different groups of friends.

Bouncers was spread by word of mouth and promoted through email and social media (Twitter, Facebook). This lead to a quick spread of the knowledge about the existence of Bouncers resulting in quite a number of people trying out the wallpaper. Over 30 people spread over 12 groups, used Bouncers for up to a maximum of 4 weeks. To evaluate the effect of Bouncers a selection of 7 participants was interviewed.

5   Persuasion within groups

By means of this abstract and subtle way of sharing one's physical activity in a close group of friends, a context was created in which people could learn about each other and get insight into their own lifestyle and those of their friends. Bouncers was able to trigger new emergent social interaction, see Fig. 1, on a level that was not subject to interaction before. This insight can lead to an increased feeling of connectedness amongst group members.

Bouncers enabled the group to create a context to stimulate intrinsic motivation by means of the persuasion within the group. This particular influence mutual friends can have on each other's behavior has been subject to studies in the past. Many different areas have already been studied such as the influence on alcohol use, drugs use, driving style and physical activity [5].

Bouncers itself was not the main persuasive element within this result. Conversely, the group itself became the main persuasive agent. Bouncers turned out to only be a tool to stimulate group persuasion. The case of Bouncers showed one possible way to strengthen interaction and provide a platform for increasing connectedness by creating a virtual sports club through which activity insight is shared.

6   Discussion

Stimulating group persuasion emerged as an important role of Bouncers. In itself it was not a strong persuasive technology, but Bouncers supported the group in serving as the persuasive factor. For this we needed to design a tool to stimulate persuasion within a group. Bouncers provided an open context for this, resulting in the effect within each group to be different. This very much depended on the nature of the relations within the group. However, an increase in connectivity such as starting a Whatsapp group or daily encounters between group members, did result in an increase in social activity.

The interaction between group members made at least one person change his view on the amount of daily physical activity. Unfortunately, for the others it was unclear whether such changes would also emerge. The long term effect of such an application cannot be predicted or simulated in short evaluations. To get insight into long-term effects a long-term study would be desired.

Sharing intimate information, such as your personal activity, can be seen as an invasion of privacy. However, none of the interviewed individuals indicated to be violated in relation to their privacy. They indicated that choosing with whom they share such information avoids privacy violation. Also the level of abstraction provided a cover against the feeling of being watched. This implies that with the right design considerations on what is shared, how it is shared, for what purpose it is shared and with whom it is shared, people are willing to share intimate information.

7   References

1. Vail. S. (2007) Community Development and Sport Participation. Journal of Sport Managementi, 21(4): 571-596.

2. Thomas Erickson and Wendy A. Kellogg. (2000). Social translucence: an approach to designing systems that support social processes. ACM Trans. Comput.-Hum. Interact. 7, 1 (March 2000), 59-83.

3. Nicholas A. Christakis, James H. Fowler. (2007). The Spread of Obesity in a Large Social Network over 32 Years. *New England Journal of Medicine*, 357: 370-379.

4. Kaars, J., Wijermans, C., de Kort, Y. A. W., McCalley, T., Midden, C. J. H. (2006). Anti-litter bins: Persuasion through non-interactive design. In: Y.A.W. de Kort, W.A. IJsselsteijn, C.J.H. Midden, J.H. Eggen, & E.A.W.H. van den Hoven, (Eds.). *Persuasive 2006. Adjunct Proceedings of the First International Conference on Persuasive Technology for Human Well-Being*: 51-55. Eindhoven University of Technology, Netherlands.

5. Julia A. Graber, Jeanne Brooks-Gunn, Anne C. Petersen (1996). Transitions through adolescence: interpersonal domains and context, 67.

Trust, Discourse Ethics, and Persuasive Technology

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Abstract. In this paper we analyze the role trust plays in an ethical evaluation of PT. We distinguish between trust in PT itself, and trust in those humans who design, produce and deploy it and draw on Discourse Ethics to further distinguish two types of communication embodied in PTs: *asymmetrical* and *symmetrical* communication.

Keywords. Persuasive Technology, Trust, Ethics, Discourse Ethics, Speech Act Theory

1   Introduction

PT raises important issues about trust, because 'trusting' a PT seems to go further than 'trusting' a non-persuasive technology. Users are required to put a more richly normative or even anthropomorphic trust in PTs: one trusts that the technology 'knows' which behavior is – for moral reasons – more adequate and what might help one to adopt that behavior. Such technology invites us, to some extent, to trust it in moral matters.

2   Persuasion and Discourse Ethics

It seems reasonable to classify PT as a communicative or technology, since it mirrors some aspects of human communication. Firstly PT aims at *transferring a message*. Often this message implies an action-guiding imperative. A blinking light in a car might be designed to express something to the effect of: 'Put on your seatbelt!' The second aspect that PT shares with human communication is that it is intended to result in a change of behavioral dispositions and corresponding attitudes. Of course not all human communication is directed at this aim. However, ordinary 'ethical communication' is intended to convince others of the shared value of certain desired behaviors. Therefore a Discourse Ethics (DE) framework is an especially promising means of evaluating the ethics of PT [1].

2.1   Symmetrical and Asymmetrical Communication.

DE distinguishes two types of rationality linked to two types of intersubjective relations. C*ommunicative rationality* is a symmetrical relation between humans; *strategic rationality* presupposes (or establishes) an asymmetrical relation [2]. Both types of relations may result in a change of behavior – but whereas communicative rationality aims to *convince* the other that a certain behavior is desirable; strategic rationality aims to *manipulate* him so that

behavior change is a foreseeable effect. Communicative rationality asks for the rational assent of others concerning what 'ends' or aims we should have, while strategic rationality is about finding the most effective strategy to reach a given outcome or end. When communication is merely strategic, it does not involve communicative rationality, for in this case communication is no different than any other means of achieving behavior change, such as coercive threats or pharmaceutical intervention.

Symmetrical communication allows each party to the communicative act to evaluate and respond to the relevant reasons for action or belief put forward in that act. This response need not be overt; it can consist of a private evaluation of the relevant reasons and the appropriate response. But the possibility of an overt response is an important indication that symmetrical communication is present. DE tries to establish moral rules that indicate whether or not a given discourse may or may not count as an exercise of communicative rationality [3-4]. According to DE, ethically permissible communication about norms and values has to adhere to communicative rationality, and for that reason it must be symmetrical. This implies that only sound arguments should be part of this communication and all relations of hierarchy and authority are inappropriate so long as they prevent rational communicative responses and criticism. The purpose and outcome of the discourse are open in a strong sense, because any party to the communication could be convinced by the other parties to change their behavior or their moral beliefs.

Asymmetrical communication excludes the possibility of reply and criticism. In cases where the purpose is merely to provide information, this is ethically unproblematic: directional signs, for example, communicate asymmetrically but are ethically unproblematic. When used for the express purpose of behavioral change, however, asymmetrical communication is a form of strategic rationality, which is not about finding or agreeing upon shared values based on shared premises, but rather uses the other – as Kant would say – as an instrument for one's own practical goals. Speech and meaning are not addressed to the other person's independent practical reasoning, and so the other person's autonomous practical judgments are thus not respected as intrinsically important. I try to get the other to act so that his behavior matches my aims, but it is purely incidental whether he shares or agrees with my intentions. Strategic rationality thus has its clearest form in pure manipulation and the exercise of power. Strategic rationality can result in behavior change, but by ignoring the independent judgment of those it seeks to change, according to DE it is a morally unacceptable way of reaching this aim.

'Persuasion' falls in between symmetrical and asymmetrical communication, since it does not primarily or exclusively appeal to reason or arguments, nor does it use purely manipulative techniques of behavior change. Indeed the question, under which conditions persuasion can be distinguished from manipulation or propaganda, is an important topic in the ethical literature on PTs [5]. Persuasion seems to share with strategic rationality the emphasis on finding an 'efficient' mechanism of behavior change, and it seems to share with communicative rationality that it tries to do so for a moral reason – assuming that the user either shares the value in question, or would do so if she were fully rational. *Designers* thus seem to have two very different tasks when creating PT: the search for an efficient mechanism on the one hand, and making sure that the PT contributes to a moral value that the user does or would in principle agree upon, on the other. Let us call the second task the *sincerity requirement*. This requirement goes beyond the usual ethical requirements placed on designers. Looking at PTs from the user's perspective, one can see why.

3   Trust and Designing for symmetry

Trust in technology consists of two elements: a judgment that the technology is sufficiently likely to perform a certain way to be worth relying on; and a normative expectation that one is *entitled to* a certain level of performance from the technology. A reliability judgment alone is insufficient for trust because, in a failure of trust, one attributes the failure *to the technology*, not to oneself or to bad luck. A normative expectation must be supposed in order to explain this distinctive feature of trust [6].

Trust in persons also consists in two parallel components: a judgment that the person is worth relying on in a certain domain, and a set of normative expectations that she will behave a certain way in that domain. Here the normative expectations are more richly evaluative, including ethical or moral elements. One supposes that the trusted person will take one's own interests into account [7], that he or she shares your moral values [8], or that she has a moral obligation to behave a certain way [9].

PT needs to do more than merely function reliably (i.e., performing to specification under foreseeable conditions) in order to be trustworthy. It must actually match the values of the user or target individual in order to be trustworthy. In this way the trust that a user places in PT is more like trust in persons than trust in technology. As part of her trust, the user will have certain moral expectations of the technology.

On the other hand, PTs are often not designed so as to respond and adapt to the specific moral expectations of users. They do not have a capacity for symmetrical communication, because they do not incorporate the possibility of hearing, responding and adapting to the moral values of the user. This means that whatever approximation of the user's values is incorporated into the PT is often determined by the designer, manufacturer and/or deployer *a priori*, in an attempt to meet the sincerity requirement.

There are three disadvantages to this method of meeting the sincerity requirement. First of all, it places a greater moral burden on the designer, to be able to anticipate the values of the user and how the user would prefer to implement those values. If the PT itself were able to adjust to the values of the user, then the designer would not have to foresee every instance in which the value is implemented, in order fully to meet the sincerity requirement. But if the PT cannot do this, then the designer must fully anticipate the implementation of the value in every situation in order fully to meet the sincerity requirement, and to be trustworthy by the lights of the user. Practically speaking, this will be very difficult.

Secondly, the *a priori* method of incorporating moral values in PT only partially approximates the value of communicative rationality. Communicative rationality requires, not just that the speaker communicates things that the hearer can rationally accept, but also that there is the possibility of a reverse channel of communication, and the possibility that both parties might adjust their position mutually in accordance with considerations put forward during the conversation. One reason why this is important is that it is respectful to the independent judgment of both speaker and listener. A second reason is that there are often questions about how different values should be balanced in particular contexts. Thirdly, the *a priori* method provides no means for the user to test the trustworthiness of the particular PT. Although it is important for the user to have prior trust in the PT, acquired through contextual information sources or through the reputation of the designer or deployer of the PT, it is also important that the user has an opportunity to gain first-hand experience of the adequacy and fit of the PTs implementation of a given value. In the case

of ordinary artifacts, this empirical evidence of trustworthiness is acquired by engaging in normal use of the artifact, and satisfying oneself that it performs its function. In the case of interpersonal trust, empirical evidence of trustworthiness is acquired in a somewhat different way. It is partly acquired by occasionally making one's expectations and values known to the trusted person, so that she can demonstrate that she is capable of adapting her behavior to those expectations and so, evidently, has the interests of the trusting person at heart.

Therefore, we advocate making PTs more flexible and symmetrical in their design, allowing them to react and adapt to the preferences and values of the user while nonetheless striving to achieve the desired social value. This will relieve designers of the need to make *a priori* judgments of how ethical values should be implemented and balanced against each other and against other personal values.

4 Conclusion

Most PTs nowadays are designed closer to the concept of asymmetrical communication and do not meet the requirements of symmetrical communication. Very often the sincerity condition is not taken into consideration, as it is simply assumed that the user will be sharing the values that the PT is designed to promote. For the perspective of the designer it means that he has to anticipate the values the users will be willing to accept, while the user has to trust (as it were blindly) that the PT is promoting morally sound values. We have argued to place more emphasize on the sincerity condition: making sure that PT contributes to a moral value that the user does or would in principle agree upon. In principle there are two ways to adhere to it: one might be to involve the user more in the design of PT as approaches of participatory technology development have suggested [10]. But the emphasis is here to make the design situation more symmetric (between user's and designer), whereas we suggest to make the PT more adaptive to the user's needs, values and potential worries – thus not changing the design conditions, but rather the designed object itself.

5 References

1. Spahn, A. PT and the Ethics of Communication, *Science and Engineering Ethics*, forthcoming.
2. Habermas, J. *The theory of communicative Action,* Boston: Beacon Press 1984.
3. Apel, K.-O.: *Transformation der Philosophie*. Frankfurt a. M.: Suhrkamp 1973.
4. Kuhlmann, W. *Reflexive Letztbegründung*. Freiburg/München: Alber, 1985.
5. Berdichevsky, D., Neuenschwander, E. Toward an ethics of persuasive technology. C*ommunications of the ACM* 42, 51-58, 1999
6. Nickel, P. Trust in technological systems. de Vries, et al: (eds.), *Norms and the artificial: moral and non-moral norms in technology*. Springer, forthcoming
7. Hardin, R. *Trust.* Polity, 2006.
8. McLeod, C. *Self-trust and reproductive autonomy*. MIT Press, 2002.
9. Nickel, P. Trust and obligation-ascription. *Ethical theory and moral practice* 10, 309-319, 2007.
10. Davis, J. Gernerating Directions for Persuasive Technology Design with Inspiration Card Workshops, T. Ploug, et al (eds.), *Persuasive Technology.* Berlin et al: Springer, 262-274, 2010.

Providing for Impression Management in Persuasive Designs

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Abstract. In this paper, we argue that persuasive technology designers can improve the effectiveness of their design by integrating an impression management mechanism with other persuasive strategies. We illustrate how technologies can be designed to accommodate audience specific self-presentation.

1. Introduction

One of the advantages that Persuasive Technologies (PT) have over a human persuader is their ability to offer greater anonymity to users [1]. Users can disguise some information including name, gender, age, ethnicity, and weight to make a positive impression on certain others. Face-to-face interactions provide little room for information disguise. This makes PT effective and acceptable to places that human persuaders are not welcomed [1]. Human behaviors are context dependent. People do not have a single character, but often display different characters in different environments, situations, and with different people [2]. For example, we tend to behave differently with our spouses, children, students, colleagues, and strangers. Impression Management (IM) is a goal-directed process in which people consciously or unconsciously regulate and control information in a social interaction in order to influence the image others have about them [3]. This is motivated by the internal drive to keep our views, thoughts, and actions consistent [4]. The cognitive dissonance theory [5] suggests that people try to be consistent with their existing views to reduce dissonance. This theory holds attraction for PT designers, since it suggests that inconsistency in beliefs may motivate and trigger behavior change. However, we argue that PT designers employing cognitive dissonance theory and social comparison should integrate mechanisms for IM. This is because for a PT to effectively integrate into user's daily life, it must be able to accommodate a variety of user's behavior needs including the need to disguise and control information [6]. Moreover, IM can be useful not only to the people but to others (followers) in a social system where behaviors can easily be imitated. PT can be designed to allow users to easily create content and selectively share it based on the context (audience). As users go about their daily lives, they should be able to seamlessly manage the impression they create on others.

2. Self-Presentation and Impression Management (IM) theory

IM is the process of managing the image of ourselves that we project to others or the impression we give others about ourselves [7]. Specifically, IM deals with controlling the flow and presentation of information between the performer and his/her audience. In our daily behavior, self-presentation manifests in different ways including in the friends we keep, the way we interact, speak, and look. People engage in self-presentation to achieve different goals. People with low self-esteem self-present to avoid making a negative impression on others, while those with high self-esteem self-present in order to make a positive impression on others [8]. PT can be designed to provide an opportunity for individuals to more effectively manage the impressions they make on others. PT can also allow for greater anonymity and control through selective filtering and sharing of information. This can be achieved by hiding or revealing information as desired. Although the need to manage impression seems ingrained in human nature [9], PT designers are yet to embrace this need. Effective integration of IM will require both context consideration and a reasonable degree of control by the user. For example a physical activity motivating PT can allow the user flexibility to disguise or misrepresent her actual behavior as the need may arise [6]. From the PT literature, only the work by Consolvo et al. [6] considered the need for IM. However, it is important that PT be designed to accommodate the need for individuals to adapt themselves in everyday life to attract a desired response from others, to influence others' perception of themselves and to avoid projecting a wrong or demotivating image to others. Without this, it might be difficult to design PT that will unobtrusively integrate into the user's daily life.

3. Self-Presentation and Cognitive Dissonance

Cognitive dissonance (CD) theory developed by Festinger [5] states that individuals behave to minimize inconsistencies among attitude and behavior to reduce discomfort. In a social environment, dissonance can be evoked in two ways: first, by an individual's attempts to conform to a group belief that contradicts an individual's belief. Second, by an individual doing the opposite of what everyone else does (very difficult) [10]. PT employ CD theory by making individuals commit to a self-determined goal and provide feedbacks which compare goal attainment against goal commitment [6]. In this case, the goal commitment is mostly determined by the individual's self-efficacy – feeling of ability to achieve the goal. Dissonance can also be induced by making an individual to publicly commit to a cause. In this case, the commitment is determined by both the audience and the individual's feeling of self-efficacy since breaking the commitment would lead to dissonance.

IM suggests that people attempt to present and maintain a favorable image in the eye of others. If the reality presents a contradicting image to their intended image it leads to dissonance. Whether an individual will commit to a big or small goal is partly dependent on the impression the individual wants to make on the audience [8]. Using physical exercise as an example, an individual will likely commit to high daily step count goal if he/she is already being perceived or wants to be perceived as physically active by the participating group. Dissonance is induced by publicly displaying as persuasive feedback the goal attainment and matching it with the commitment. This type of feedback which allows no room for an individual to control what and when information is displayed uses a push-based feedback mechanism and does not allow for IM. However, IM can be integrated to complement CD by using pull-based mechanism, where the user actively

seeks feedback and controls when and what is being displayed. This is important considering the role others play in our behavior. Observable feedbacks in a social context often lead to comparison which can amplify or undermine the dissonance effect.

4.   Self-Presentation and Social Comparison

The need to self-present becomes magnified if others are allowed to share some specific information that might depict one in a negative light. According to social comparison theory, people look at others to determine how they compare and how they should behave [11]. This comparison could be either upward or downward. Upward comparison occurs when one compares him/herself with others who he/she perceives as better in a particular behavior. Upward comparison can spur one to action by exposing one's weaknesses in comparison with others and by showing some room for improvement in certain behavior. Moreover, because one can emulate others' success in upward comparison, the emulated person(s) can be seen as a mentor in that particular behavior. Part of the responsibilities of a "behavior mentor", is to show good behavior examples to the followers. A mentor is not necessarily the best in that particular behavior; it is important only that mentors are better in the behavior than their followers. It is also possible for a mentor to be a follower to another person. This scenario can be seen as a behavior ladder. People look up to others in a higher position in the ladder. This is the strength of social comparison as a persuasive strategy. However, upward social comparison has also a dark side. When one compares oneself with somebody that is "too good", one can lose the hope of reaching that level, feel miserable, and might give up. IM can be used to provide a face-saving option for "hidden admirers" to emulate their mentors without exposing their weaknesses thereby reducing the discouragement.

Despite the fact that most PT applications employing social comparison stress upward comparison, evidence suggests that people engage in downward social comparisons more frequently [12]. Downward comparison occur when one compares oneself to people that perform worse than him/herself. This type of comparison often leads to self-praise and positive feedback. Hence, it might be difficult to motivate behavior change using only downward comparison. However, downward comparison could be necessary for self-enhancement. For instance, in the event of relapse in behavior or in a state of unhappiness with one's progress that might lead to behavior abandonment, downward comparison might be necessary to strengthen one's self-efficacy. Yet, it also has a negative side. When one sees oneself as being at the top of the ladder, one might not see the need to stretch him/herself so much. Therefore, he/she may start slipping back. IM can be used to enhance the performance of the aspiring followers thereby allowing no room for the people on top to get "too confortable" and relapse.

A closer analysis shows that most PT interventions employ a hybrid approach to social comparison (allow one to compare oneself both upward and downward). This seems appropriate because it enables the interventions to leverage the advantages of both upward and downward comparison to effect behavior change. However, we argue that allowing for IM through selective disclosure or sharing of comparative information pertaining a target behavior is necessary to improve the effectiveness of social comparison persuasive strategy. Taking from our analogy of behavior ladder above, we assume that each performer has a mentor whom he/she look up to as a positive example (not necessary a perfect example). The follower receives encouragement and motivation from their

mentor's behavior and often follows the mentor's footsteps. The mentors are not infallible and can slack once in a while with regard to the target behavior performance. As a result, IM is necessary, especially at a time of behavior relapse to shield the propagating effect of this relapse in not only the mentors themself but more importantly on the followers who imitate them. Hiding or disguising information about this relapse helps to keep the followers motivation and avoid undesirable imitation. It also provides the self-enhancement needed by the mentor to move on. However, it might be necessary to share the information about the followers relapse with their mentors who serve as an encouragement even in the time of relapse.

Following from the discussion above, the audience (follower or mentor) and level of control (pull-based and push-based feedback, and selective disclosure) emerged as the main consideration when designing for IM in a PT.

5. Conclusion

The need for IM is ingrained in human nature, but. PT researchers are yet to embrace and integrate this need in their designs. Hence, there is a space for PT designers to integrate IM with other persuasive strategies for an effective result. We argue that PT can successfully exploit IM features to create conditions and amplify behavior change. We discussed cognitive dissonance theory and social comparison strategy in line with impression management to illustrate how IM can be used to advantage in a PT. Finally, we identified the audience (mentor or follower) and control (pull-based feedback and selective disclosure) as the two main requirements when designing to accommodate IM. We hope that this work spur research on various ways of integrating IM on PT.

6. References

1. Fogg, B. J. (2003). Persuasive Technology: Using Computers to Change What We Think and Do. Morgan Kaufmann pub.
2. Jeffrey Rosen (2000). Why Privacy Matters. The Wilson Quarterly (1976). 24 (4) 32-38
3. Schlenker et al. (1996). Impression regulation and management: A theory of self-identification. In Sorrentino, & Higgins (Eds.), Handbook of mot. & cognit.: The Interpersonal Cont. 118 -147.
4. Cialdini et al. (1981). Attitude and Attitude Change, Ann Reviews in Psy. (32), 357-404.
5. Festinger, L. A. (1957). Theory of Cognitive Dissonance. CA: Stanford Uni. Press.
6. Consolvo, S. et al. (2009). Theory-driven design strategies for technologies that support behavior change in everyday life. Hum factors in comput. Systems. 405-414.
7. Leary, M. R. (1995). Self-presentation: Impression management and interpersonal behavior. Madison, WI: Brown & Benchmark.
8. Social Influences and Physical Activity http://www.exercisephysiologists.com/SocialInfluences/index.html. Accessed Feb. 2012
9. DuBrin, A. J., (2010). Impression Management in the Workplace Research, Theory, and Practice. Routledge Pub. 238
10. Lewis, M., Liar's Poker, Coronet, London, 1990
11. Festinger, L. (1954). A theory of social comparison process. Human Relation. 117-140.
12. Examining Forced Social Comparisons: Effects of Ethnicity and Gender. http://www.acrwebsite.org/volumes/display.asp?id=11108. Accessed Feb., 2012

Persuasive Technology And Mobile Health: A Systematic Review

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Abstract. Mobile Health (mHealth) is currently a topic of great interest worldwide. The major goal of most mHealth projects is to induce long-lasting behavior change among healthcare providers or patients or both. Clearly integration of Persuasive features has great potential for enhancing the effectiveness of mHealth solutions. In this paper we report the results of a systematic review of peer-reviewed papers describing mHealth interventions with a view to identifying the persuasive features employed, either explicitly or implicitly. Results have been summarized using descriptive statistics including cross-tabulations with types of mHealth interventions. Our results provide insights into the persuasive features that have been deemed to be useful across mHealth implementations in general and also across specific types of mHealth interventions.

Keywords: Persuasive Technology, Mobile Health, Captology, Pervasive computing, Behavior change, Technology Adoption, Smartphone, Cell phone, Tablet, PDA Smartphone.

1   Introduction

Mobile Health (mHealth) solutions, defined as the use of portable electronic devices such as cell phones, tablets, PDAs to support healthcare (Free, Phillips, & Felix, 2010), are generating great worldwide interest. Conferences like the mHealth summit in Washington D.C., which gathered more than 3200 attendees from 48 countries (mHealthSummit, 2011) and large scale projects such as the Project Masiluleke based on joint efforts from mobile operator MTN, handset manufacturer Nokia and National Geographic Society to launch a mass awareness campaign on HIV/AIDS, reaching over 350 million SMS per year, are current examples of such interest (Pop! Tech, 2010).

1.1   Mobile Healthcare - mHealth

The World Health Organization's Global Observatory for eHealth (GOe) defines mHealth or mobile health as *"medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices."* (World Health Organization, 2011). This definition includes the use of multiple features like voice, short messaging service, general packet radio service, global positioning system and Bluetooth technology.

The portability of mobile devices provides numerous benefits while some limitations include reduced screen size, physical memory and processing capabilities, and power supply limited to a few hours (Kailas A, 2010).

1.2   Captology: Persuasion through technology

Fogg (2003) describes *Captology* as "*the study of user's interactions with computers, focusing on the psychological drivers involved for pursuing an intended goal defined as change in people's behaviors or attitudes without coercion or deception*" (Fogg B. , 2003). His work also describes three different roles of computers when interacting with individuals: *Tools, Media* and *Actors*. Each of these roles includes a different set of features that contribute to its persuasive effect when promoting behavior change. In addition Fogg (2003) describes a set of persuasive attributes specific to mobile devices. Clearly, the relationship between mHealth and persuasive technology is of great interest.

2   Related work

Riley Studied the relationship between behavior models and mobile interventions. (Riley, 2011). Similar work has been conducted such as a study describing the persuasiveness of six related alcohol-intervention websites (Oinas-Kukkonen, 2009). Chatterjee and Price (2009) provide a useful framework for the analysis of mHealth technologies.

3   Methods

Meta-search engines were used to ensure inclusion of major online libraries, including PubMed, EMBASE, HAM TMC. The search strategy included the following criteria: Out of the 13 categories defined by WHO for mHealth interventions, only those that were consumer-oriented were selected (*information initiatives, health survey and surveillance, mobile telemedicine, raising awareness, app reminders, treatment compliance, community mobilization and health promotion, health call center/telephone line*). Implementations only, with publication dates: 2007 to 2011.

4   Results

Major results of the systematic review are presented here in the form of tables and figures. Table 1a is a cross-tabulation of PPT attributes versus categories of mHealth and, finally, Table 1b is a similar cross-tabulation of mPT attributes.

mHealth Category	Primary Persuasive Technology (PPT) Attributes																	
	Reduction	tunneling	Tailoring	Suggestion	Selfmonitoring	Surveillance	Conditioning	Cause and Effect	Virtual Rehearsal	Virtual Rewards	Simulations in RealWorld	Attractiveness	Psychological cues	Similarities	Praise	Reciprocity	Adoption of roles	
Unclassified				1%	3%		1%	1%										**6%**
Health Promotion				3%	5%		1%	1%		3%	1%		1%	1%			3%	**19%**
Health Survey					1%								1%		1%			**4%**
Information Initiatives	3%			5%	1%		3%	1%	1%	1%							1%	**17%**
Patient Monitoring	1%	1%		1%	4%	1%		1%		1%			4%		3%		3%	**21%**
Raising Awareness	1%			4%														**5%**
Treatment Compliance	4%	1%		4%	4%	1%	3%		1%	1%	1%	1%		1%	3%		3%	**28%**
Total	**9%**	**3%**	**0%**	**18%**	**17%**	**3%**	**9%**	**5%**	**3%**	**6%**	**3%**	**1%**	**6%**	**3%**	**6%**	**0%**	**9%**	**100%**

Table 1a. Primary Persuasive Technology attributes per Mobile Health intervention Categories. Note that Suggestion in Information Initiatives is the most frequent persuasive feature found across all papers.

mHealth Category	Mobile Persuasion Technology (mPT) attributes													
	Timing	Convenience	Simplicity	Mobile Loyalty	Mobile Marriage	Information Quality	Social Facilitation	Social Comparison	Normative Influence	Social Learning	Competition	Cooperation	Recognition	TOTAL
Unclassified							1%			3%	1%			**6%**
Health Promotion		1%	4%				4%	3%	3%	3%	4%			**23%**
Health Survey									1%					**1%**
Information Initiatives	1%	3%	3%	1%	1%	3%			1%			1%		**16%**
Patient Monitoring	3%		4%	1%		1%	1%	1%	3%	1%	1%			**19%**
Raising Awareness	1%		1%							1%				**4%**
Treatment Compliance	3%	1%	1%			1%	4%	4%	3%	3%	3%	4%	1%	**30%**
Total	**9%**	**6%**	**14%**	**3%**	**1%**	**6%**	**12%**	**9%**	**12%**	**12%**	**10%**	**6%**	**1%**	**100%**

Table 1b. mPT attributes related to Mobile Health interventions. Note that simplicity and social facilitation, with normative influence and social learning represent most persuasive features of mobile health implementations.

5 Discussion

Very few papers reviewed included Persuasive Technologies studies during the conceptual design process (n=7). Most of the persuasive features listed are the result of unintended persuasive features included by only a small number of papers. Tables 1a and 1b show that all mHealth categories do not make use of all primary persuasive features. Thus there seems to be potential for increasing their effectiveness if more persuasive

features could be included. The persuasive feature of Computers as media was underused across all implementations. Cause and Effect (5%) and Simulations with Virtual Rehearsal (3%) were among the least used features.

6   Conclusion

mHealth applications that apply principles of persuasive technology could more easily achieve this potential. In this systematic review of peer-reviewed papers on mHealth interventions we have identified persuasive strategies that have been incorporated explicitly, or more often, implicitly, by the investigators. Our results provide insights into the current state of the art with respect to persuasion in mHealth and offer guidance to designers and developers of mHealth solutions.

7   References

Mobile Year in Review 2010. (2010). Retrieved October 2011, from Mobile Future:
[http://www.mobilefuture.org/content/pages/mobile_year_in_review_2010?/yearendvideo

Alagöz, F., Calero, A., Wilkowska, W., & Ziefle, M. (2010). *From Cloud Computing to Mobile Internet, From User Focus to Culture and Hedonism The Crucible of Mobile Health Care and Wellness Applications*. Aachen, Germany : IEEE.

Bickmore, T., Mauer, D., Crespo, F., & Brown, T. (2007). Task Interruption and Health Regimen Adherence. *PersuasiveTechnology*. Stanford,CA.

Cacioppo, R. E. (1986). The elaboration likelihood model of persuasion. In L. Berkowitz, *Advances in Experimental Social Psychology* (pp. 123-205). San Diego, CA: Academic Press.

Chatterjee, S. (2009). Healthy Living with Persuasive Technologies: Framework, Issues, and Challenges. *Journal of the American Medical Informatics*, Volume 16 Number 2.

Chatterjee, S., & Price, A. (2009). Healthy Living with Persuasive Technologies: Framework, Issues and Challenges. *J Am Med Inform Assoc*, 171–178.

Connelly, K. (2007). On Developing a Technology Aceptance Model for Pervasive Computing. *Proceedings of Ubiquitous System Evaluation*. Bloomington, IN.

DeRenzi, B., boriello, G., & Jackson, J. (2011). Mobile Phone Tools for Field-Based Healthcare Workers in Low Income Countries. *Mount Sinai Journal of Medicine*, 78:406-418.

Donner, J. (2008). Research Approaches to Mobile Use in the Developing World. *Information Society*, 24 :140-159.

Engadget. (2011, 09 12). *Smartphones out-ship feature phones in Europe, Samsung leads the way*. Retrieved 1 2012, from Engadget: http://www.engadget.com/2011/09/12/smartphones-out-ship-feature-phones-in-europe-samsung-leads-the/

Florez-Arango, J., Iyengar, M. S., Dunn, K., & Zhang, J. (2011). Performance factors of mob ile rich media job aids for Comunity Health Workers. *J Am Med Inform Assoc*, 131-137.

Fogg, B. (2003). *Persuasive Technology: Using Computers to Change What We Think and Do*. San Francisco, CA: Morgan Kaufmann.

Fogg, B. (2009). A Behavior Model for Persuasive Design. *Persuasive'09*. Claremont, California, USA.

Fogg, B., & Hreha, J. (2010). Behavior Wizard: A Method for Matching Target Behaviors with Solutions. *Persuasive Technology Lab @ Stanford Universit*.

Fogg., B. (1997). *Charismatic Computers: Creating More Likable and Persuasive Interactive Technologies by Leveraging Principles from Social Psychology*. Doctoral Dissertation: Stanford University.

Free, C., Phillips, G., & Felix, L. (2010). *The effectiveness of M-health technologies for improving health and health services: a systematic review protocol*.

Hung, M.-C., & Jen, W.-Y. (2010). The Adoption of Mobile Health Manage ment Services: an Empyrical Study. *J Med Syst*.

Kailas A, C. C. (2010). From mobile phones to personal wellness dashboards. *IEEE Pulse*, 57-63.

King, W., Dent, M., & Miles, E. (1991). The persuasive effect of graphics in computer-mediated communication. *Computers in Human Behavior*, 269-279.

Klaassen, R. (Decemb er 10, 2009). COPD home interaction device.

Mechael, P. (2009). The Case for mHealth in Developing Countries. *Innovations*, Vol. 4, No. 1, Pages 103-118.

Mechael, P. (2010). *Barriers and Gaps Affecting mHealth in Low and Middle Income Countries: Policy White Paper*. New York City, NY: Columbia University The Earth Institue - mHealth Alliance.

mHealthSummit. (2011, December 5). *mHealthSummit 2011 Opening Release Report*. Retrieved from mHealthSummit: http://www.mhealthsummit.org/pdf/mhs11_opening_release.doc.pdf

mobihealthnews. (2010). *The World of Health and Medical Apps*. Chester Street Publishing.

Piscitelli. (2004, 09 19). *Captología o el estudio de las computadoras como tecnologías de la persuasión*. Retrieved from filosofitis: http://www.filosofitis.com.ar/2004/09/19/captologia-o-el-estudio-de-las-computadoras-como-tecnologias-de-la-persuasion/

Pop! Tech. (2010, January). *Project Masiluleke*. Retrieved from poptech.org: http://poptech.org/system/uploaded_files/27/original/Project_Masiluleke_Brief.pdf

Räisänen, T., Oinas-Kukkonen, H., & Leiviskä, K. (2009). Managing Mobile Healthcare Knowledge: Physicians' Perceptions on. In P. Olla, & J. Tran, *Mobile Health Solutions for Biomedical Applications* (pp. 111-127). Hershey, PA: Medical Information Science Reference.

Sarasohn-Kahn, J. (2010). *How smartphones are changing health care for consumers and providers*. Oakland, CA: California Healthcare Foundation.

Torning, K., & Oinas-Kukkonen, H. (2009). *Persuasive System Design: State of the Art and Future*. Claremont, CA.

Varshney, U. (2007). Pervasive healthcare and wireless health monitoring. *Mobile Networks and Applications*, Volume 12 Issue 2-3.

Vital Wave Consulting. (2009.). *mHealth for Development: The Opportunity of Mobile Technology for Healthcare*. Washington, D.C. and Berkshire, UK: UN Foundation-Vodafone Foundation Partnership.

World Health Organization. (2011). *mHealth: New horizons for Health thorough mobile technologies*. Switzerland.

Zhang, J., & Butler, K. (2007). UFuRT: A Work-Centered Framework and Process for Design and Evaluation of Information Systems. *Proceedings of HCI International*. Houston, TX.

A long-term study of energy eco-feedback using non-intrusive load monitoring

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Abstract. Electricity consumption in households is responsible for a signifi-
cant portion of the total use, making this an important problem to tackle in the
broader sustainability field. Researchers often report that raising users' aware-
ness of their consumption results in real savings. Here we present the results of
a long-term study of a low cost non- intrusive load monitoring (NILM) and eco-
feedback system capable of providing real time and historical consumption in-
formation. The system was deployed in 13 single houses and apartments in an
urban area in Portugal. 58 weeks after the deployment it was observed that,
even though the users were more aware of their consumption, no significant
steps were taken to decrease it

Keywords: Eco-feedback, NILM, Energy Consumption, Long-term study

1   Introduction

The world is witnessing a change in habits of energy consumption in households for
the past couple of decades, with electricity emerging as the main source of energy
consumed. Statistics show that electricity consumption in domestic environments
increased by 6.4% in 2010[1]. And according to [2] increasing the energy efficiency
in residential buildings is considered one of the top 11 actions that will lead to large
savings regarding carbon emissions. Additionally, the largest efficiency improve-
ments appear, as expected related to electricity consumption activities like water heat-
ing, lightning and electric appliances.

It is believed that eco-feedback technology will play a central role in motivating
sustainable behavior. Eco-feedback is not a new subject, and early literature [3] shows
that even with low-level feedback it is possible to change residents' behavior. In
Norway researchers found that by improving the accuracy off electricity bills and
providing extra information would encourage consumers to read them more often and
with greater understanding, promoting a behavior change [4], [5]. Real time eco-
feedback was the subject of research in [6]. Where the authors performed a pilot eval-
uation of two low-cost monitoring systems in case study homes, and found that users
quickly discovered that by looking at the differences in demand from turning on and
off respective appliances they could easily approximate the energy use of each indi-

vidual appliance, which may indicate that power disaggregation by individual appliances may play an important role in future energy monitoring solutions.

Peer pressure was the subject of interest in [7] and one of the results was the observation of the response-relapse behavioral pattern, meaning that after a while the user behaviors would relapse to those prior to the study.

While in these studies the main feedback was given in amount of energy used, other studies looked at different ways of providing such feedback. For example, Broom et al. [8] ran a 3-month study in 9 households, where they deployed an ambient interface for energy feedback that translates electricity consumption into graphical patterns displayed in a clock-like device. In the end they observed that people became more aware of their energy consumption, and were able to associate the displayed patterns with actual appliances.

2 Method and Results

This paper presents the results of the long-term deployment of a low-cost real time eco-feedback solution in 13 households in an urban area in Europe (Portugal). The system, a custom- made non-intrusive load monitor is capable of measuring the energy consumption in Watts, as well as detecting power events (such events are an abrupt change in the consumption normally associated with an appliance changing its state). All the families were already familiar with this kind of device, since they used an older version of the system for 3 months. The study started once all the systems were remotely updated to the new version. In the next 2 days the users were informed about the update. During the 58 weeks of the study we kept an aggregated database with consumption data that reached more than 5 GB and 2 million data points. This paper presents the first approach to analyze this data set. The exploratory nature of this analysis means that no hypotheses were defined, and the data set was analyzed as an all. Comparisons between houses are postponed for future analysis.

2.1 Consumption through the study

To verify if there was any decrease in electricity consumption we ran a correlation between the energy consumption and the week of the study, $r=0.026$,$p < 0.0001$.

Note that even though this correlation was significant it has a small r value. One possible cause for this is that when we conducted this study the subjects have already been in contact with the system for 3 months (in which we actually observed a decrease in consumption [9]) and already made small adjustments in their routines to reduce their overall consumption. To test this result further we ran a linear regression algorithm and got the following equation relating the consumption and the week of the study:

$$\text{EnergyConsumption} = 0.687 \text{ x WeekInStudy} + 423.2$$

By simply assigning the value 0 and 58 to the WeekInStudy variable, we get a difference of about 40Wh between the first week and the last week, which is really small (a

small lamp can spend that energy in about an hour). As result we can safely assume that there was no real change in the consumption during the course of the study.

To explore those results we individually asked families about any change in the consumption, most of them confirmed that there was no real saving in the electricity bill at the end of the month, but some of the families noticed a decrease.

2.2 Consumption vs Power Events

The relationship between energy consumption and power events seems obvious (since an appliance triggers events and consumes energy). However this relationship is not a simple as it might look, a high number of events could be related to low consumption (for example a high consuming appliance being turned on just when it is used), and the opposite is also true.

To determine the strength of this relationship we ran a Pearson's correlation, $r = 0.413$, $p < 0.0001$. This confirms the strong relationship between consumption and events. We also noticed that users rapidly became aware of the strong relationship between the events and consumption. The relationship was also tested comparing different days of the week. There was no significant difference between the consumption throughout weekdays, but the difference was significant for power events this may indicate that even though the energy consumption is almost similar through the week, there is difference in how consumers use their appliances between weekdays.

2.3 Interaction with the system

Like it was explained in the Introduction the subjects were familiar with eco-feedback devices. They used one for 3 months, and it was noticeable a drop in interaction with it after 4 weeks [9]. To verify if this phenomenon would be present in the 2nd deployment we assumed that the number of interactions would negatively correlate with the week of study. The Pearson's correlation for this data returned a significant negative correlation, $r = -0.163$, $p < 0.0001$. We also ran a linear regression algorithm and got the following equation:

$$\text{NumberOfInteractions} = -0.014 \text{ x WeekInStudy} + 0.871 \qquad (2)$$

Also regarding the interaction with system, it was shown that the greatest decrease in interactions with the system occurred in the first four weeks like it was previously reported in [6]. For this the dataset was separated in 2 groups (first 4, and the remaining weeks) and we ran 2 regressions analyses, the results showed that the slope in the first 4 weeks (-0.054) is greater that in the rest of the study (-0.013), this indicates that the decrease in that period is greater that in the rest of the study.

When talking with the users we enquire them about this decrease of interest in the sys-tem. Some families justify it by the lack of time in their routines, others feel like after a few weeks they already had a good perception of their consumption.

3   Conclusions.

The scope of this study was limited to aggregate data and important results can surface when we compare different houses or different conditions within the same house. We found that events are related with energy consumption and this preliminary research might indicate that the increase in consumption is normally associated with more appliances. We did not found any significant difference between consumption on different days of the week but there was a difference in the power events, which might indicate different usage patterns during the week.

We also confirmed what other researchers found, users lost interest in the system after a while and even the small updates delivered over time were not enough to prevent this. From informal conversations with users it was noticeable that our system helped increase their perceptions on energy consumption that was perhaps the biggest contribution of our work. To better understand our speculations it would be important to use more qualitative data like investigate users routines during the period of the study. We also plan on extending the level of energy ci desegregation of our system to measure the added value of this feature in terms of energy savings.

4   References

1. Enerdata Global Energy Statistical Year Book 2011: `http://yearbook.enerdata.com` (January 2012)
2. Pacala, S., & Socolow, R.: Stabilization wedges: solving the climate problem for the next 50 years with current technologies. Science, 305(5686), 968-72. (2004)
3. Kohlenberg, R., Phillips, T., & Proctor, W.: A behavioral analysis of peaking in residential electrical-energy consumers. In: Journal of Applied Behavior Analysis, 9(1), 31-18. (1976)
4. Wilhite, H.: Experiences with the implementation of an informative energy bill in *Norway*. Ressurskonsult report 750, Oslo. (1997)
5. Wilhite, H., Hoivik, A. Olsen J. G.: Advances in the use of consumption feedback information in energy billing: the experiences of a Norwegian energy utility. In: Proceedings of the European Council for an Energy-Efficient Economy. (1999)
6. Parker, D., Hoak, D., Meier, A., & Brown, R.: How much energy are we using? Potential of residential energy demand feedback devices. In: 2006 Summer Study on Energy Efficiency in Buildings. (2006)
7. Peschiera, G., Taylor, J.E., Siegel, J.A.: Response-relapse patterns of building occupant electricity consumption following exposure to personal, contextualized and occupant peer network utilization data. In: Energy and Buildings, vol. 42, pp. 1329–1336, (2010)
8. Broom, L., Katzeff, C., Bång, M., Nyblom, Å., Hjelm, I. S., & Ehrnberger, K.: Coffee maker patterns and the design of energy feedback artefacts. In: Proceedings of the 8th ACM Conference on Designing Interactive Systems. 93-102: ACM. (2010)
9. Nunes, N. J., Pereira, L., Quintal, F., Bergés, M. (2011). Deploying and evaluating the effectiveness of energy eco-feedback through a low-cost NILM solution. In: Proceedings of the 6th International Conference on Persuasive Technology. (2010)

Mastery and autonomy in medication with a mobile self-report system: A project in action

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Abstract. The overall aim of this research program is to design and examine if a mobile phone-based self-report system can be used to a) mediate knowledge about hypertension b) improve adherence to antihypertensive treatment and c) increase patient participation and autonomy.

Keywords: ePROM, adherence, mobile phones, hypertention.

Background

There is a pressing need to develop effective strategies to make the delivery of healthcare more efficient and responsive to patients' needs by addressing the problem of poor adherence to medication from an interdisciplinary perspective. Adherence is defined as: 'The extent to which the patient's behavior matches agreed recommendations from the prescriber' [1]. As patients' beliefs and perceptions of their wellbeing, illness and treatment may be the key to address the question of adherence, tools for monitoring treatment need to take these factors into account [2]. Such information can only be gained directly from the patient and Patient-Reported Outcome Measures (PROMs) are commonly used for this purpose. In the past decade electronic PROMs have become increasingly popular and the use of mobile phones as a medium for patient reporting is growing. Mobile phones are also becoming an important method for patient-monitoring in chronic disease to facilitate communication between providers and patients, and their use will undoubtedly increase [3]. There are surprisingly few research studies that "focus on mobile phone technology for disease management and health monitoring" [4]. Still rapid advances in the application and development of the technology have been witnessed in such areas as the management of cancer,

asthma, diabetes, and the care of older people [5]. An increasing recognition of patients' competence: i.e., their capacity to understand medical data, to provide therapeutic goals, to make consequent decisions, and also to evaluate their own quality of life is essential for a person centered care. People may be motivated by a need for mastery and competence in areas, which allow them to feel more independent and self-confident. New behavior can be learned and many people may be capable of adapting their behavior to meet a basic need, i.e., to feel as well as possible [6]. To serve the patient's best interests and encourage patients and caregivers to actively exchange ideas, can be an important way to realize mastery and autonomy in care [7]. In the present project there exists a challenge in the combined intention to simulate adherence with the use of technology with very clear persuasive qualities and intentions [8] and, on the other hand, the intention to attain enhanced knowledge of hypertension to attain mastery and autonomy from the individual patient's point of view. The overall aim of this research program is to design and examine if a mobile phone-based self-report system (ePROM), using the patient's own mobile phone, can be used to a) mediate knowledge about hypertension b) improve adherence to antihypertensive treatment and c) increase patient participation and autonomy, taking into account patients 'common-sense' beliefs about their illness and treatment as determinants of adherence.

Method

The project requires several types of knowledge and research activities as well as multifaceted network of human actors and technologies. The project as such is based on a large population-based study of hypertensive patients' views and experience of hypertension [9]. Further, there is an intention to explore patients' and health care providers' experiences of treatment, and to identify factors in the communication between patients and healthcare providers that contribute to improved adherence to antihypertensive treatment and quality of care. In this endeavor focus groups interviews were pursued (three with patients, two with providers) June-August 2010. Between November 2010-August 2011 ten design meetings were held with participating researchers and experts. During these meetings many issues were discussed but the primary intention was to design an ePROM for the mobile phone platform. The questionnaire was pilot tested in a group of 21 patients, who were interviewed about their understanding of the question and response alternatives as to readability and relevance. In the next step the use of mobile phone for follow-up will be tested in a larger group of 50 patients during 8 weeks, with at strategic inclusion. Inclusion criteria will be: >30 years of age or older, diagnosed as hypertensive and prescribed antihypertensive medication; alert and oriented; Swedish-speaking with different ethnic backgrounds; access to a functioning mobile phone; and allowing access to information on the actual amount of drugs dispensed to the individual patient by pharmacies in Sweden from the national prescribed drug register (Läkemedels-förteckningen at Apotekens Service AB). Patients' self-reporting can be followed up as graphs in an internet-portal, which indicates that the patients in an illustrative way can relate their medical use as well as non- pharmacological treatment to how they

use as well as non- pharmacological treatment to how they feel. Such graphs can also form the basis for follow-up appointments and as authentic starting points in productive conversations and hence, motivate the patients to adhere to the treatment recommendations and alternatively, reinforce an already functional adherence. Adherence to treatment will be checked through data of prescription drugs dispensed from pharmacies in Sweden and by questions in the mobile phone. Audio/video recordings of patient – physician/nurses follow-up consultations to obtain authentic evidence of the use of the ePROM instrument in clinical practice will analysed. Further the involved parties will be interviewed about their experiences.

Preliminary results

At this point there are two types of preliminary results. The first is in form of the views from patients and providers (physicians, nurses, pharmacists). Providers accentuated how to handle the data obtained by the mobile phone and how to relate it to hypertension. Patients wished to emphasize how they felt and lived in relation to their blood pressure. Patients expressed a wish and a need for understanding relationships and to be in control of their high blood pressure. The providers doubted the patients´ ability to be participating partners in care while patients sought for knowledge and understanding. Dizziness, stress, headache and tiredness were symptoms that were suggested to be followed up on an everyday basis. The use of a mobile phone self-reporting system was preferred during times of less well-controlled blood pressure or at start or change of medication. This result has served as an input to the design process of the ePROM in a preliminary version that will be tested in the Spring of 2012. Another type of preliminary result is from the analysis of the design process. A broad analysis of actors and intentions involved in this process indicates that the network of participants involves researchers in Care Science, Sociology of Science, Education, experts on methodological aspects of the investigation and on the ePROM instrument. In line with previous research about the design of technology to be used in healthcare [10] the design work involved many types of participants with their particular knowledge. The technology included the ePROM in its mobile platform but also a web-based platform by which the patients and providers can view the data registered by the patients i.e. symptoms, well-being, life style habits and blood pressure. The discourse involved a previous research study of patients' experiences and views of hypertension [9]. Another aspect was patients' and providers' views about hypertension in the focus groups used as an input to the design. There was also a discussion about the aim of the project at large, how to safeguard the scientific quality of the study and its result, as well as of the questions that were to be a part of the ePROM. Important issues here were the areas for questions (wellbeing, health related activities, symptoms, data of measured blood-pressure, and encouraging health messages). The exact wording of questions and answers to put in the telephone from a general viewpoint as well as a viewpoint taking into account the available telephone platform were also important. Another issue was the model for distribution of the questions (frequency, timing, selection of messages for the individual person).

Outlook

The persuasive aspect [8] of this project is challenging involving a network of technologies: (1) an ePROM instrument in a mobile phone platform, (2) an instrument for measuring blood-pressure as well as (3) a web-based platform for looking at patient reported data. In this manner, the research project involves the arrangement of a situation of negotiation [11] and exchange of knowledge between the patient and the provider in the consultations associated with regular treatment. However, for this to happen both groups must have reasonable adoption rates of the technologies [8]. To go beyond this research arrangement it needs to be translated into an accepted method in healthcare. If this is accomplished the human effects in form of individual patients' mastery of chronic illness in form of hypertension as well as adherence to medication instructions is gained. For society as a whole this also has significant positive economic effects. Therefore, it would be of interest to examine the impact of adherence of this person centered hypertension management method in daily clinical practice.

References

1. Haynes, R., Yao, X. et al.: Interventions to enhance medication adherence. Cochrane Database of Systematic Reviews 4, CD000011 (2005)
2. Bokhour, B. G., Berlowitz, D. R. et al.: How do providers assess antihypertensive medication adherence in medical encounters? Journal of General Internal Medicine 21, 577-583 (2006)
3. Scientific Advisory Committee of Medical Outcomes Trust: Assessing health status and quality-of-life instruments: attributes and review criteria. Quality of Life Research 11, 193-205 (2002)
4. Department of Health and Human Services Food and Drug Administration, Center for Drug Evaluation and Research (CDER), et al.: Guidance for industry: Patient-reported outcome measures: Use in medical product development to support labeling claims. Draft Guidance, U.S (2006)
5. Blake, H.: Mobile phone technology in chronic disease management. Nursing Standard 23(12), 43-46 (2008)
6. Leplege, A., Gzil, F., Cammelli, M., Lefeve, C., Pachoud, B., Ville, I.: Person-centredness: conceptual and historical perspectives. Disability Rehabilitation Oct 30-Nov 15; 29(20-21), 1555-1556 (2007)
7. Quill, T. E., Brody H.: Physician recommendations and patient autonomy: finding a balance between physician power and patient choice. Annals of Internal Medicine Nov 1, 125(9), 763-769 (1996)
8. Chatterjee, S., Price, A.: Healthy living with persuasive technologies: Framework, issues, challenges. Journal of American Medical Informatics Association 16 (2), 171-178 (2009)
9. Kjellgren, K.I., Ahlner, J., Dahlof, B., Gill, H., Hedner, T., Saljo, R. Perceived symptoms amongst hypertensive patients in routine clinical practice- a population-based study. Journal of General Internal Medicine 244, 325-332 (1998)
10. Lehoux, P., Hivon, M., William-Jones, B., Urbach, D.: The worlds and modalities of engagement of design participants: A qualitative case study of three medical innovations. Design Studies 32, 313-332 doi:10.1016/j.destud.2011.1.001 (2011)
11. Maitland, J.: Towards negotiation as a framework for health promoting technologies. SIGHIT Record 1 (19), 10-19 (2011)

Trusting Automation Technology for Safer Roads: The Effect of Shared Driving Goals

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Abstract. Automation technology can increase safety on the road, but only when it is trusted. As shared goals lead to social trust, and people exhibit social responses towards intelligent machines, we hypothesized that shared driving goals would also lead to increased trustworthiness and acceptability of Adaptive Cruise Control Systems (ACCs). In an experiment, participants ($N = 61$) were presented with descriptions of three ACCs with different automation levels which were described as systems that either shared their driving goals or did not. Trustworthiness and acceptability of the three ACCs were measured. Results indicated that participants judged ACCs sharing their own driving goals to be more trustworthy and acceptable than ACCs not sharing their driving goals. Furthermore, participants judged ACCs that took over driving tasks while providing information as more trustworthy and acceptable than ACCs that took over driving tasks without providing information. Thereby, these results help opening the road to safer driving.

Keywords: trust, acceptance, adaptive cruise control, automation

1 Introduction

More than 50 percent of all car accidents happen due to human error [1]. Intelligent automation technology in cars could increase driving safety. However, drivers have to trust the technology before they accept it [2]. The media equation hypothesis [3] suggests that people might trust automation technology in the same way as they trust humans. In the research on trust in humans, the model of salient value similarity states that people are more likely to trust other people and institutions that have values and goals similar to theirs [4]. Therefore, we expected that automation technology that shares the goals with its user would be judged more trustworthy and acceptable than automation technology that does not.

In a previous experiment [5], we confirmed this expectation and showed that automation level also influences trust and acceptability judgments of automation technology. However, safety was included as one of the driving goals in that study, leaving an alternative explanation for our results. That is, the results could be explained by automation technology being safe versus unsafe instead of by shared versus unshared goals. In the current study, we test the effect of shared goals while excluding the safety goal. Furthermore, in the current study we use a different, more widely used measure of acceptability. Finally, this study serves as a replication of our first study.

2   Method

2.1   Participants

Sixty-one participants (20 women and 41 men) were randomly assigned to the conditions of a 2 (goal sharing: shared versus unshared) x 3 (automation level: ACC_{info} vs. $ACC_{info+action}$ vs. ACC_{action}) mixed model design with goal sharing as a between-subject factor and automation level as a within-subject factor. The two dependent variables were trustworthiness and acceptability of Adaptive Cruise Control systems (ACCs).

2.2   Materials

We presented participants with descriptions of three ACCs that differed in their automation level. One ACC system (ACC_{info}) was described as a system that only provided information to the user about when and how hard the user needed to accelerate or brake to reach the driving goal of the ACC. A second ACC system ($ACC_{info+action}$) was described as a system that would take over accelerating and braking of a car to reach the driving goal it was made for, while giving information about when and how hard it would accelerate and brake. A third ACC system (ACC_{action}) was described as a system that would take over accelerating and braking of a car to reach the driving goal it was made for, without giving information. As we only used descriptions of ACCs, participants did not receive actual information of ACCs or get to experience actual ACC systems.

Trustworthiness was measured by seven seven-point Likert scale questions (1 = "totally disagree", 7 = "totally agree") which were based on a questionnaire that measures trust in automation technology [6]. Answers to these questions were averaged to form a reliable measure of trustworthiness (Cronbach's alpha = .91). Responses were coded such that higher scores indicate higher trustworthiness.

Acceptability of the ACCs was measured with a questionnaire [7] consisting of nine five-point bipolar questions, ranging from -2 to +2. Scores to these questions were averaged to form a reliable measure of acceptability (Cronbach's alpha = .97). Responses were coded such that higher scores indicate higher acceptability.

2.3   Procedure

Participants were seated in a cubicle in front of a computer and presented with three driving goals. The driving goals (with their framing in parentheses) were comfort (relaxed driving, no sudden braking and accelerating), energy efficiency (saving fuel while driving), and speed (reaching the desired destination in the least amount of time). Participants were instructed to rank the driving goals from one to three, one being the most important driving goal, three being the least important.

Participants were then presented with descriptions of three different ACCs. Each description included the ranking of the three driving goals both *for the participant* and

for the ACC system. In the shared goals condition, all ACCs had the *same ranking* as the participant. In the unshared goals condition, all ACCs had the *reversed ranking* to that of the participant (e.g. if the participant ranked speed as the most important driving goal, speed would be the least important driving goal for the ACC system).

For each ACC system, trustworthiness and acceptability were measured using the questionnaires described above. After the experiment, participants were thanked, paid for their participation, and debriefed.

3 Results

3.1 Trustworthiness

A two-way mixed ANOVA was conducted on trustworthiness with goal sharing and automation level as factors.

Goal sharing. Results revealed a main effect of goal sharing, $F(1, 59) = 3.48$, $p < .05$ (1-tailed), $\eta_p^2 = .06$. In the shared goals condition, ACCs were judged more trustworthy ($M = 4.40$, $SD = 1.05$) than in the unshared goals condition ($M = 3.95$, $SD = 0.86$).

Automation level. Mauchly's test indicated that the assumption of sphericity had been violated ($\chi^2(2) = 32.16$, $p < .001$), therefore degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = 0.70$). Results revealed a main effect of automation level, $F(1.40, 82.77) = 25.15$, $p < .001$, $\eta_p^2 = .30$. Planned contrast analyses showed that ACC_{info} was judged as more trustworthy ($M = 4.78$, $SD = 1.15$) than ACC_{action} ($M = 3.65$, $SD = 1.35$), $F(1, 59) = 33.44$, $p < .001$, $\eta_p^2 = .36$. Furthermore, $ACC_{info+action}$ was judged more trustworthy ($M = 4.10$, $SD = 1.16$) than ACC_{action}, $F(1, 55) = 16.27$, $p < .001$, $\eta_p^2 = .23$. Lastly, ACC_{info} was judged more trustworthy than $ACC_{info+action}$, $F(1, 59) = 15.95$, $p < .001$, $\eta_p^2 = .21$. There was no significant interaction between automation level and goal sharing, $F(2, 58) = 1.67$, *ns*.

3.2 Acceptability

A two-way mixed ANOVA was conducted on acceptability with goal sharing and automation level as factors.

Goal sharing. Results revealed a main effect of goal sharing, $F(1, 59) = 7.95$, $p < .01$, $\eta_p^2 = .12$. In the shared goals condition, ACCs were judged more acceptable ($M = 0.58$, $SD = 0.74$) than in the unshared goals condition ($M = -0.10$, $SD = 0.80$).

Automation level. Mauchly's test indicated that the assumption of sphericity had been violated ($\chi^2(2) = 33.13$, $p < .001$), therefore degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = 0.70$). Results revealed a main effect of automation level $F(1.39, 82.22) = 4.67$, $p < .05$, $\eta_p^2 = .07$. Planned contrast analyses showed that acceptability of $ACC_{info+action}$ ($M = 0.22$, $SD = 0.94$) was higher than acceptability of ACC_{action} ($M = -0.13$, $SD = 1.00$), $F(1, 59) = 26.10$, $p < .001$, $\eta_p^2 = .31$. No other differences between the automation levels were signficant. There was

no significant interaction between automation level and goal sharing, $F(2,58) = 1.01$, *ns*.

4   Discussion & Conclusion

The current research investigated the influence of goal sharing (shared versus unshared) and automation level on the trustworthiness and acceptability of an ACC system. We presented participants with descriptions of three ACCs: one that only provided information (ACC_{info}), one that took over driving tasks and provided information ($ACC_{info+action}$), and one that only took over driving tasks, without providing information (ACC_{action}). For half of the participants, these ACCs did not share their own driving goals, for the other half, these ACCs did share their driving goals. For every ACC system, trustworthiness and acceptability were measured.

The current research replicates and expands the findings of our previous study [5]. That is, results again suggest that shared goals lead to increased trustworthiness of ACCs, even when the safety goal is omitted. Furthermore, using a more widely used measure of acceptability, the current results suggest that shared goals also lead to increased acceptability of ACCs. Lastly, for both shared goals and level of automation, this study replicates the findings of [5]. This study suggests that to increase safety on roads by introducing automation technology, sharing goals with the driver might increase the trustworthiness and acceptability of automation technology. Thereby, the current results help opening the road to safer driving.

5   References

1. Treat, J. R., Tumbas, N. S., McDonald, S. T., Shinar, D., Hume, R. D., Mayer, R. E., ... Castellan, N. J. (1979). Tri-level study of the causes of traffic accidents: Executive summary (NTIS Technical Report No. DOT HS-805 099). Bloomington: University of Indiana.
2. Lee, J. D., & Moray, N. (1992). Trust, control strategies and allocation of function in human-machine system. *Ergonomics, 35,* 1243-1270.
3. Reeves, B., & Nass, C. (1996). The media equation: How people treat computers, television, and new media like real people and places. New York: Cambridge University Press.
4. Siegrist, M., Cvetkovich, G., & Roth, C. (2000). Salient value similarity, social trust, and risk/benefit perception. *Risk Analysis, 20,* 353-362.
5. Verberne, F. M. F., Ham, J., & Midden, C. J. H. (2011). Trust in smart systems: Sharing driving goals and giving information to increase trustworthiness and acceptability of smart systems in cars. Manuscript submitted for publication.
6. Jian, J., Bisantz, A. M., & Drury, C. G. (2000). Foundations for an empirically determined scale of trust in automated systems. *International Journal of Cognitive Ergonomics, 4*, 53-71.
7. Van der Laan, J. D., Heino, A., & De Waard, D. (1997). A simple procedure for the assessment of acceptance of advanced transport telematics. *Transportation Research, C5*, 1-10.

Bibliographic Analysis of Persuasive Systems: Techniques, Methods and Domains of Application

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Abstract. This paper presents findings of our study on peer-reviewed papers published in the International Conference on Persuasive Technology from 2006 to 2010. The study indicated that out of 44 systems reviewed, 23 were reported to be successful, 2 to be unsuccessful and 19 did not specify whether or not it was successful. 56 different techniques were mentioned and it was observed that most designers use ad hoc definitions for techniques or methods used in design. Hence we propose the need for research to establish unambiguous definitions of techniques and methods in the field.

Keywords: Theories, methods, systems evaluation, system features

1   Introduction

The application of interactive technology for changing human behavior continues to attract attention both in research and the industries. However, there is inadequate empirical knowledge on the range of techniques, methods and application domain. As such, we seek to understand how persuasive technology (PT) designers have applied theories, methods and techniques across the various domains. We reviewed applications published in the International Conference on Persuasive Technology from 2006 to 2010. We envisaged that this will provide researchers with information on existing PT applications and provide clues to issues that need attention.

The remainder of this paper presents the motivation of the study followed by the methodology used for review, then findings, discussions and conclusion.

2   Research Motivation

Researchers such as Torning et al [1] have conducted similar studies by evaluating full papers in Persuasive Conference proceedings from 2006 to 2008 using the Persuasive Systems Design (PSD) Model [2]. They established that most of papers published were experimental with 84.4% addressing behavior change instead of attitude

change. They also observed that tailoring, tunneling, reduction and social comparison were the most studied techniques whereas competition and verification were less discussed. In another study, Lehto and Oinas-Kukkonen [3] observed that reduction, self-monitoring, simulation, and personalization were the most used techniques for accomplishing user's primary task support as compared to tailoring when they evaluated web-based applications with the PSD. In both studies the terminologies used were redefined to conform to the system features of the PSD model thus less detailed information was made available on methods or techniques used by the researchers. Hence, we seek to evaluate existing persuasive applications and identify theories, methods and techniques that have been used for designing them.

3   Method

For the sake of coherence, we reviewed proceedings of the Persuasive Conference series from 2006 to 2010. Ideally it would be more appropriate to review all PT applications published, however the vast number of publications makes it impossible to do so with any keyword. Also, in order to ensure an appreciable standard and quality, the Persuasive series was used, since it is the only comprehensive conference on PT. In all, we identified 53 papers that discussed a PT application, however 44 were selected based on the definition of PT [4, 5]. A catalogue was developed based on: name of system, type of interface used, domain of application and change type. Particularly, we considered the intention of the designer to either change attitude towards target behavior (ATTB) or current behavior (CB) as defined in [6].

4   Findings

Contrary to the findings by Torning et al [1], 23 (52.3%) of the 44 reviewed papers were intended to change behavior. This disparity may be attributed to our study considering ATTB whereas theirs consider attitude and behavior, hence they may have considered systems designed for ATTB as changing behavior. As mentioned by Torning et al [1] and, Lehto and Oinas-Kukkonen [3] most of the papers failed to provide a clear definition of the reviewed system. Also, it was observed that 23 (52.3%) systems were reported to be successful and 2 (4.6%) unsuccessful whereas 19 (43.2%) did not specify whether or not the system was successful.

Our findings also indicated that majority of systems are designed for health promotion. Incidentally, all the Persuasive conference proceedings since 2006 were dominated by themes related to health promotion. This also confirms the claims [7] that PT has a potential of providing effective solutions to preventive healthcare. 11 (25%) were designed for environmental issues whereas 4 (9.1%) were for commerce and 3 (6.8%) for education. The number of applications designed for security and leisure recorded one each and one paper did not specify the domain of application [8].

In order not to redefine terms and meanings of techniques used, a list of all words used for defining techniques, methods or system features in the reviewed papers was created and tabulated. A total of 56 techniques or methods were listed and we ob-

served that the most frequently used was feedback (see Table 1). 19 (43.2%) papers mentioned feedback as a technique or method for changing behavior or attitude towards the target behavior followed by self-monitoring and suggestion which recorded 16 each, representing 36.4%. Social role was used in 11,whereas tailoring and tunneling was used in 10. Reminder was mentioned in 9, and rewards and reduction in 7. In all, 8 out of 21 applications designed to change ATTB used simulation or feedback and 6 used self-monitoring. For applications designed to change behavior, self-monitoring recorded 11 out of 23 whereas 9 used reminders. Suggestion was also used in 8 applications designed for health as compare to 4 in environmental applications. Feedback was mostly applied in applications designed for health or environmental issues with a record of 9 each. Also, a total of 15 theories, frameworks or models were recorded. 24 (54.6%) papers did not specify the theory or framework used; in this 11 were designed to change ATTB whereas 13 were for behavior change. The most applied framework was the Fogg's functional triad [4] with 13.7%. The transtheoretical model, TTM [9] was used in 4 applications designed to promote healthcare. The rest of the theories recorded a frequency of one. Interestingly, the PSD model [2] was not identified in any application.

Table 1. Ten most used persuasive techniques in applications from 2006 to 2010

Technique/ Domain of application	Commerce	Education	Environment	Health	Leisure	Security	Total
Feedback	1		9	9			19
Self-Monitoring	1		2	11	1	1	16
Suggestion	1	2	4	8		1	16
Social role	1	1	1	7		1	11
Simulation			5	4	1		10
Tailoring	1	1		7		1	10
Tunneling	1	1		6	1	1	10
Reminders		1		7	1		9
Reduction				5	1	1	7
Reward			2	5			7

5 Discussion and Conclusion

One cannot rule out the fact that PT design methods continues to be one of the most compelling issues in the field as most designers apply ad hoc methods for design. This might be due to the interdisciplinary nature of the field making most designers tend to apply models in their respective domain which have been proven to be successful in

human-human persuasion (observe that the TTM was mostly used for developing health related applications). Nonetheless, there is a need for investigations to ascertain whether this approach to design is effective. Another issue which appears to be over-looked is the definition of distinct techniques or methods. Although one may argue that the 56 techniques identified can be classified into a smaller number as in the case of the PSD model, there is the need for further research to establish a clear under-standing of terms and vocabulary used in the domain. The current ad hoc adoption of terms for techniques may further inhibit the use of a well-structured procedure for designing PTs. For instance, [10] claimed that the persuasive technique employed in persuading users to conserve water was feedback. However, their provision of an ambient display suggests a technique which can also be considered as self-monitoring. In most cases a designer's definition of a technique or method engulfs a number of other techniques or methods hence making it challenging to identify dis-tinct methods or techniques without ambiguity. As such it will be more helpful if a separation can be made between techniques and methods in persuasive technology.

We thus propose that there is the need for the creation of a "Persuasion Techniques Catalogue" which will guide researchers on distinct definitions of terms and empha-size that the systems features in the PSD model can be expanded with a well-defined distinction between methods and techniques.

Reference

1. Torning, K. and H. Oinas-Kukkonen. Persuasive system design: State of the art and future directions. in Persusive 2009. 2009. ACM New York, NY, USA.
2. Oinas-Kukkonen, H. and M. Harjumaa, Persuasive systems design: Key issues, process model, and system features. Communications of the Association for Information Systems 2009.
3. Lehto, T. and H. Oinas-Kukkonen, Persuasive features in web-based alcohol and smoking interventions: A systematic review of the literature. J Med Internet Res, 2011. 13(3): p. e46.
4. Fogg, B.J., Persuasive technology: Using computers to change what we think and do2002: Morgan Kaufmann.
5. Harjumaa, M. and H. Oinas-Kukkonen. Persuasion theories and it design. in Lecture Notes in Computer Science. 2007.
6. Wiafe, I., K. Nakata, S. Moran, and S. Gulliver. Considering user attitude and behaviour in persuasive systems design. in European Conference on Information Systems. 2011. Hel-sinki, Finland.
7. Ijsselsteijn, W., Y. De Kort, C. Midden, B. Eggen, and E. Van Den Hoven. Persuasive technology for human well-being: Setting the scene. in Persuasive Technology. 2006.
8. Ju, W. and D. Sirkin. Animate objects: How physical motion encourages public interac-tion. in Persuasive Technology. 2010.
9. Prochaska, J., C. Redding, and K. Evers, The transtheoretical model and stages of change. Health behavior and health education: Theory, research, and practice, 2002. 3: p. 99-120.
10. Kappel, K. and T. Grechenig. Show-me: Water consumption at a glance to promote water conservation in the shower. 2009. ACM.