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A Method for Co-Designing Theory-Based Behaviour Change Systems for Health Promotion

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Abstract. A methodology was defined and developed for designing theory-based behaviour change systems for health promotion that can be tailored to the individual. Theories from two research fields were combined with a participatory action research methodology. Two case studies applying the methodology were conducted. During and between group sessions the participants created material and designs following the behaviour change strategy themes, which were discussed, analysed and transformed into a design of a behaviour change system. Theories in behavioural change and persuasive technology guided the data collection, data analyses, and the design of a behaviour change system. The methodology has strong emphasis on the target group's participation in the design process. The different aspects brought forward related to behaviour change strategies defined in literature on persuasive technology, and the dynamics of these are associated to needs and motivation defined in literature on behaviour change. It was concluded that the methodology aids the integration of theories into a participatory action research design process, and aids the analyses and motivations of design choices.

Keywords: Health promotion, Participatory action research, behavioural change systems, persuasive design

1. Introduction

Behaviour change systems and persuasive technology aim at changing people's behaviour, typically towards a healthier behaviour [1]. A large number of behaviour change systems aim at increasing physical exercise or reducing behaviours such as smoking or alcohol intake. However, since behaviour change is very hard to accomplish, it is argued that theories on behaviour change are essential to apply in the process of designing and evaluating such systems [2, 3], which is rarely the case in existing examples. Some instruments and models incorporate some of the theories, such as the Behavioural Change Wheel [4], which is intended to function as instrument in the development process. However, another essential factor is how potential users can be engaged in the design process in order to increase ownership of the problem and instruments, and for capturing the diversity in attitudes, needs, preferences and motivation levels. This is essential in order to allow the system to be tailored to an

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individual's particular needs, preferences and situation. Such studies are rarely described in research literature, and participatory design methodologies do not incorporate knowledge about behaviour change.

Therefore, our aim is to define and develop a methodology for co-designing theory-based behaviour change systems for health promotion that can be tailored to the individual. The main research question is how theories on behaviour change and persuasive technology can be combined with participatory action design involving the targeted user group in order to i) capture participants' diverse attitudes, needs, preferences and motivation, and ii) design the adaptive behaviour necessary for supporting the change of behaviour in an individual. The main contribution of this research is a method that both allows users participate in the development, and that helps developers form designs of behaviour change systems that are based on theories on behaviour change and that adapts to the individual.

2. Methods

Research literature on behaviour change, behaviour change systems and persuasive technology was reviewed [3, 5-12]. Key concepts and models were identified and a selection was made of the concepts that were considered most important and relevant for the targeted domain. Aims and tasks to be conducted during the participatory action research design process were defined based on the theories, and formed an outline for the design process.

The outline was applied in two case studies, targeting respectively increase of desired behaviour and decrease of undesired behaviour. The first aimed at designing a behaviour change system for *increasing physical activity* among older adults. Since the role of the system was intended to be a kind of physical exercise advisor, the participants' relationship with health professionals and experiences relating to this was included in the process outline, and explored in the workshops. Workshops with nine older adults (divided into two groups), lead by two researchers, one designer and one physiotherapist, were conducted and audio recorded. Recordings, homework material and other material that was generated during workshops were analysed iteratively, and results were used for adapting the content of next workshops. The resulting design was analysed and evaluated based on theories on behavioural change and persuasive technology, and research on behavioural change systems. Based on the analyses the method was generalized and supplemented with additional themes. The generalized method was applied in a second case study. Two groups of designers and health professionals developed two initial designs of a *smoking cessation* intervention.

3. Results

The Participatory Action Research process based on theories on Behaviour Change and Persuasive technology is defined as a methodology (PAR-BCP) outlined Table 1. The outline functions as a checklist in the process of organizing tasks to be conducted during a design process. The methodology puts strong emphasis on the target group's participation in the design process. The following aspects are captured by applying the PAR-BCP Checklist, and explored together with the participants:

1. (diversity of) attitudes towards the targeted activity in focus and technology,

2. (diversity of) attitudes towards, and desires regarding the technology's potential pro-active behaviour such as encouraging and reminding messages,
3. (diversity of) attitudes, and desires regarding passive, summative communication of accomplishments,
4. (diversity of) attitudes, and desires regarding embedding social aspects and features, and
5. (diversity of) attitudes and desires regarding the system's potential agency and transparency.

These different aspects relate to the following behaviour change strategies defined in a framework of tailoring concepts [13]: *feedback, adaptation, inter-human interaction*, *user targeting*, *goal setting*, *context awareness* and *self-learning*. Different kinds of *feedback* are explicitly explored in the process, and the information about needs, motivation, diversity in attitudes, preferences etc., are elaborated for developing e.g., *goal setting* and *adaptation* strategies. The needs defined by Self-Determination Theory (SDT) are *competence*, *autonomy* and *relatedness* [7]. SDT distinguishes between *extrinsic* motivation, triggered by factors external to the individual, and *intrinsic* motivation, triggered by values internal to the individual. The system can be adapted based on an individual's level of motivation in relation to a particular activity.

The methodology incorporates the following seven design postulates for persuasive system design [3]: i) information technology is never neutral, ii) people like their views about the world to be organized and consistent, iii) direct and indirect routes are key persuasion strategies, iv) persuasion is often incremental, v) persuasion through persuasive systems should always be open/transparent. vi) persuasive systems should aim at unobtrusiveness and vii) persuasive systems should aim at being both useful and easy to use. These postulates are explored in the design process and embedded in the PAR-BCP Checklist (Table 1).

During and between group sessions the participants create material and designs following the behaviour change strategy themes, which are discussed, analysed and transformed into a design of a behaviour change system. The range and character of different attitudes and preferences illuminated in the design process can be captured and be taken into consideration when developing the adaptive, self-learning and context-awareness functionalities. These mechanisms are also important for supporting the incremental nature of persuasion.

3.1. Outcome of the Case Studies

The older adults in the first case study collaborated in creating new content and behaviour that was integrated in an existing mHealth application [14]. The second case study generated two different design proposals, where one provided solutions to obstacles found in the first study related to diversity in attitudes towards feedback.

In the first case study the initial version of the PAR-BCP Checklist was followed in detail with focus groups targeting each topic. In the second case study the PAR-BCP Checklist was used more as a checklist to assure that all aspects had been considered. The groups focused to large extent the nature of the smoking behaviour in order to identify what activates the behaviour in different individuals, and what are the perceived short term and long-term consequences. These were also the key topics in the meetings with the potential user group.

Both studies captured the diversity of attitudes towards the activity, the potential change of behaviour and towards using technology. The need for personalization was

illustrated by the very different activators that individuals mentioned in the smoking cessation case, and in the case with older adults by the opposite effects that the same message could have.

Table 1. PAR-BCP Outline: Generic outline of the PAR-process with exemplified activities.

Goal	Themes and Examples of Activities
Defining the behaviour / activity Understand and define the behaviour and activity to target.	**Define behaviour, and identify activators and consequences** Elaborate on what triggers the behaviour, and how consequences are perceived long term vs. short term.
Motivation level and attitudes Understand the target user group's/ participants' experiences and attitudes towards the targeted behaviour/activity and new technology.	**Motivation to conduct targeted behaviour / activity and use technology** Brainstorm about motivation and experiences of conducting the behaviour/activity. Participants express what they do/want to do with new technology in the activity context. Elaborate on *"Do I have to, do I want to, what's in it for me?"* long term vs. short term.
Unobtrusiveness, usefulness and ease of use Understand expectations and obstacles for use.	**Interaction design** Write a narrative about how to communicate through, and interact with (smart) technology when setting goals and when conducting the activities.
Pro-active support/feedback Build knowledge about what kind of feedback motivates participants to do the activity, and what feedback can be discouraging. Identify differences and similarities between individuals.	**Designing pro-active and passive feedback** Discuss different modalities for communication (images/text, sound, light, vibration etc). Write the messages they want to receive when they have or have not performed planned activity. Evaluate and rank feedback messages. Discussion about how they interpret and experience the content of the feedback messages.
Passive support/feedback Build knowledge about how to visualize activity progress and results / performance.	**Visualizing results and performance** Use cards/pictures for inspiration or sketch visualisations, discuss what the visualisations mean to each participant. Select and present favourites.
System's agency and transparency Explore what participants find important in the patient-health professional relationship, and in technology that builds trust.	**Agency and behaviour** Based on experiences with health professionals, describe desired behaviour and situations. Create profiles for agents/avatars with different personalities.
Inter-human interaction Explore how social interactions can support behaviour change.	**Designing for inter-human interaction** Describe desired social meeting points, and values to promote in these points that aid behaviour change.
Evaluating the design Evaluate design proposals.	**Evaluating the design** Evaluate design proposals in the form of mock-ups and prototypes, based on the above themes. Can be done during group sessions and/or in daily life.

The transparency of the system, i.e., knowing the purpose of its behaviour and having an image of who, or what, the sender of messages is, was shown to be very important for creating trust in the user. In the case of smoking cessation, the design choices converged towards making the system solely an instrument for the individual without interference from healthcare or health-based advice regarding smoking. Since the user was assumed to know well the health aspects of smoking that could form evidence-based rational arguments for cessation, and which have not so far made the persons quit smoking, such arguments were deliberately excluded. Instead, emotion-based arguments and goals associated to personal gains were included by the user. In the case with older adults they saw benefits of viewing the system as a coach with

physiotherapeutic expertise, but manifesting different attitudes to fit different persons' preferences.

4. Discussion and Conclusions

A method and an instrument are developed for the purpose of designing behaviour change systems that aim at having a sustainable effect on behaviour. The method fuses participatory action research methodology with theories and models of behaviour change and persuasive technology. The method and instrument were applied in two case studies with two different aims: reduction of unwanted behaviour, and increase of wanted behaviour. Comparison with other instruments, such as a behaviour model for persuasive design [12] and the behavioural change wheel [4] shows that the existing instruments do not guide how incorporating users in the design process.

The conclusion was made that the method aids the integration of theories into a participatory action research design process, and aids the analyses and motivations of design choices. As such the instrument can function as a checklist when designing behaviour change systems.

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