Symposium

Towards engaging and personalized mHealth tools: co-design, data-driven and just-in-time adaptive approaches

Convenor: Monique Simons (Wageningen University & Research)
Chair: Monique Simons
Discussants: Olga Perski

Summary of proposal

Emerging technologies such as virtual coaches, smartphone apps, smart garments (i.e. mHealth tools) offer great potential for supporting people in adopting healthy lifestyle behaviors. Research shows that mHealth tools can be effective in promoting health behaviours (such as physical activity and healthy dietary intake), although effect sizes vary a lot and effects are mainly short term and not sustainable in the long term. The effectiveness of mHealth tools depends on the inclusion of effective behavior change techniques, but also on sufficient and sustained engagement with the mHealth tool by the end-users. However, getting end-users to engage with a mHealth tool and keep on engaging with it is challenging. Little is known on how to create more engaging mHealth tools, what factors and approaches contribute to higher engagement levels in mHealth tools and how big data (e.g. log event data) and machine learning can be utilized to gain more insights in these factors. In this symposium, four presenters from different disciplines (i.e. system engineering, design, health promotion) will share their results on how to develop more engaging and personalized mHealth tools. We will focus on the value of co-design approaches in the development process of a virtual coach for supporting older adults to adopt a healthy diet (Lean Kramer), on the potential of wearable sensors and adaptive interventions for increasing engagement in an exergame (Ayla Schwarz), on how just-in-time support in a physical activity promoting smartphone app impacts its feasibility and acceptance (Karlijn Sporrel), and lastly on the importance of gaining insight into personal preferences using log data factors to enable personalized mHealth tools (Raoul Nuijten). Finally, the discussant (Olga Perski, expert on engagement in digital health applications) will reflect upon the presentations to elicit a lively audience discussion on challenges and next steps towards the development of more engaging mHealth tools. Topics that will be discussed include how to come to a uniform definition of engagement, how to measure engagement, how to harness data science (e.g. machine learning, self-learning algorithms) for personalized and engaging mHealth and what can be learned from design research.

Presentation abstracts

Presentation 1

Title: Engaging co-design for engaging Embodied Conversational Agents

Presenter and first author: Lean L. Kramer; Department of Consumption and Healthy Lifestyles, Wageningen University & Research; lean.kramer@wur.nl
Co-authors: Lean L. Kramer¹; Marije Blok²; Lex van Velsen³; Bob C. Mulder⁴; Emely de Vet¹
Rationale
Embodied Conversational Agents (ECAs) are computer-generated, animated conversation partners which allow for rich and persuasive automated communication. Earlier studies showed that older adults report high ratings of acceptance, enjoyment and usability after receiving lifestyle coaching from an ECA. However, high levels of engagement are often lacking: usage decreased after time, limiting engendering behaviour change. This can – at least partly – be attributed to the design process. The views of individual users, and particularly of older adults, are not sought to inform the design process, while such a co-design process is linked to an improvement in both the impact and uptake of eHealth technologies.

Aim
In this article we explore the needs and wishes of community-dwelling older adults towards an ECA, and we aim to deliver design guidelines for ECAs in the context of dietary behaviour. Thereby we advance knowledge on 1) co-design processes with older adults, 2) co-design of an ECA, and 3) co-design of nutritional support.

Methodology
We conducted a study with community-dwelling elderly in the Netherlands, consisting of two parts. First, participants completed a seven-day lifestyle diary. Second, participants joined a total of three co-creation sessions (N=13). In the first session participants discussed the meaning of healthy living and healthy eating. During the second session participants formulated dietary advice and during the last sessions participants created their own ECA.

Analysis
Thematic analysis was used to analyse all data.

Results
The main themes that emerged around healthy living were: The social context, autonomy, a positive mindset, and nature. Healthy eating entailed both balance and mindfulness. Barriers towards healthy eating were knowledge, hedonic motivation, physical limitations, and loneliness. Although preferences for the design of the ECA varied greatly, there were five commonly preferred design characteristics: Friendly, warm, trustworthy, concerned, and competent.

Conclusions
The co-design approach allowed us to lay the foundation for our ECA. We advise to: 1) aim for a positive co-creation process in order to increase engagement and disclosure, 2) aim for a holistic approach, and 3) clearly identify the aim of the intervention for both designers and participants.

Presentation 2
Title: Differences in user engagement between a dynamically and non-tailored exergame among adolescents: results from a cluster-randomized controlled trial.
Rationale
Physical activity interventions for youth are direly needed given low adherence to physical activity guidelines, but these interventions suffer from low user engagement. Serious games, such as exergames that require bodily movement while played, may provide an engaging form of physical activity intervention, but are not perceived as engaging to all. Dynamic tailoring by smart garment can adapt the content and progress of the game to the individual needs of the player, and may be a possible engaging strategy.

Aim
The aim of this study was to evaluate whether dynamic tailoring in a serious mobile exergame (European Horizon 2020 project SmartLife, Grant Agreement No. 732348) for adolescents that is played in leisure settings, can create higher user engagement compared to playing a non-tailored exergame.

Methodology
In a cluster-randomized controlled trial, differences in user engagement between a dynamically-tailored and non-tailored condition were assessed in adolescents (12-18 years old). Dynamic tailoring was delivered by an accelerometer sensor that was integrated in a smart garment. In total, 94 participants (M age=14.61±.1.93; 35% female) participated and were assigned to one of the intervention conditions. Behavioral engagement was measured based on game metric data including the amount of play time and number of completed sessions. Subjective engagement was measured with the validated Kids Game Experience Questionnaire (GEQ) on a 5-point scale.

Analysis
Multiple Mann-Whitney tests were conducted in SPSS 25.0. Level of significance was set at p<0.05.

Results
Very few differences were found on user engagement: narrative sensation, which relates to narrative presence was higher in the dynamically-tailored condition, but the non-tailored condition showed higher behavioral engagement (longer play-time).
Conclusions
Play duration was very short and there may have been a flooring effect. Moreover, there was room for improvement in game design to create a more appealing game, and the smart garment may have created an additional barrier to gameplay. Sensing options for tailoring that are integrated in the game app itself may offer a more engaging solution, to be tested in future research.

Presentation 3
Title: A 5-week randomized feasibility study of physical activity mHealth tools: exploring the user’s experiences and engagement with a self-regulation app and a self-learning app.

Presenter and first author: Sporrel, K; Utrecht University

Co-authors: Wang, S; Ettema, D; Nibbeling, N; Kröse B; Deutekom, M; de Boer, R; Simons, M

1 Department of Human Geography and Spatial Planning, Utrecht University
2 Informatics Institute, University of Amsterdam
3 Department of Applied Psychology, Amsterdam University of Applied Sciences
4 Faculty of Sports and Nutrition, Amsterdam University of Applied Sciences
5 Faculty of Digital Media and Creative Technology, Amsterdam University of Applied Sciences
6 School of Social Sciences, Consumption and Healthy Lifestyles, Wageningen University & Research

Rationale
Although self-regulatory physical activity (PA) mHealth tools have the potential to motivate individuals to engage in regular PA, it is not well understood which features determine effectiveness and engagement level. One method that is theorized to enhance self-regulation mHealth tools is the use of personalized just-in-time prompts, in which the user receives a reminder ‘at the right time’ to persuade the user to engage in PA. With the artificial intelligence advances, it is now possible to build such ‘smart’ tools. Critical to development of effective PA mHealth tools is to gain insights into the perceptions of the end-users regarding the tools.

Aim
The main objective is to examine user experience and the behavioural engagement among adults regarding two versions of the PAUL app: a self-regulation version (Basic PAUL) and a just-it-time self-regulation version (Smart PAUL).

Methodology: Approximately 30 healthy Dutch adults living in Amsterdam or Utrecht (18-55 years old) will participate in this RCT (running from the start of November till December 2019). The intervention includes a one week pre-post accelerometer measurement, a 4-week intervention in which the users are randomly assigned to use either Basic PAUL or Smart PAUL, questionnaires to determine the user experience, socio-demographics and determinants of PA behaviour, and a semi-structured exit interview.

Analysis
An independent t-test will be performed to explore the differences between the Basic and Smart app in behavioural engagement, and user experience questionnaires. The exit interviews will be analysed with Atlas.ti, while using the framework approach.
Results
The perceived user friendliness, attractiveness, satisfaction and usefulness of the two versions of the PAUL app will be reported. Furthermore, we will discuss the results of the exit interview regarding the perceptions of the persuasive strategies in the app (i.e. goal setting, monitoring, feedback, providing instructions and reminders). Finally, the behaviour engagement (e.g. how much do the participants use the app and its functionalities) will be addressed.

Conclusion
We will determine the user experience and the engagement behaviour of Basic PAUL and Smart PAUL. Examining the user experience and engagement of exercise applications is important to determine its feasibility and acceptability.

Presentation 4
Title: A perspective on key challenges in personalization for sustained user engagement: applying machine learning techniques to ‘understand’ user preferences and tailor persuasive messages

Presenter and first author: Nuijten, R.C.Y.; r.c.y.nuijten@tue.nl

Co-authors: Van Gorp, P.M.E.1, D'Hondt, J.E.1, Kaymak, U.1, Le Blanc, P.M.2, Kemperman, A.D.A.M.3, Van den Berg, P.E.W.3, Simons, M.4

1 Information Systems group, department of Industrial Engineering & Innovation Sciences, Eindhoven University of Technology.
2 Human Performance Management group, department of Industrial Engineering & Innovation Sciences, Eindhoven University of Technology.
3 Urban Planning and Transportation group, department of the Built Environment, Eindhoven University of Technology.
4 School of Social Sciences, Consumption and Healthy Lifestyles, Wageningen University & Research.

Rationale
Although mHealth tools have proven to be efficient in promoting healthy behaviours in the short-term [1,2], these interventions often fail to retain their impact in the long-term [3]. To design mHealth tools that remain sufficiently engaging over time, especially personalisation strategies (i.e., tailoring an intervention to the needs of a user) may be beneficial to explore [4].

Aim
The aim of this talk is to present two recent studies on key challenges in personalisation for sustained user engagement.

Methodology
The first study (N = 68), explores whether user preferences can be derived from user event data. In personalisation, it often remains challenging to find the right target variables without having to employ questionnaires, which users often perceive as cumbersome. Therefore, this study aims to predict user’s personal preferences based on 4-weeks of event data, derived from an mHealth tool.
The second study evaluates the effectiveness of personalized messages on actual behavior. Tailoring persuasive messages has shown to be effective in many domains, including healthcare [5]. Nevertheless, most studies only measure the impact of persuasive messages on subject’s attitudes, and not on subject’s actual behaviour. Therefore, in a six-week randomised controlled trial (N = 149), we have evaluated whether adaptive persuasion not only improves attitudes, but also has the potential to evoke behavioural change.

Analysis
In both studies, machine learning techniques were employed to predict user preferences, or message fit, respectively, based on user event data and message feedback.

Results
In the first study our models could predict subject’s personal preferences better than random. In the second study, it was demonstrated that the treatment group (N = 75) did better appreciate the messages they received than the control group (N = 74), but at the same time the treatment group did not report higher levels of physical activity.

Conclusion
From the first study, it is concluded that user preferences may be derived from user event data. From the second study, it is concluded that adaptive persuasive techniques may be employed to influence attitudes, but these methods are likely to require additional intervention strategies to evoke actual behavioural change.

References