

# HealthCloud: promoting healthy living through co-design of user experiences in a digital service

Åsa Wikberg-Nilsson<sup>1</sup>, Jörgen Normark<sup>2</sup>, Cecilia Björklund<sup>3</sup>, Sarianne Wiklund  
Axelsson<sup>4</sup>

<sup>1</sup>*Industrial design, Luleå University of Technology  
asa.wikberg-nilsson@ltu.se*

<sup>2</sup>*Industrial design, Luleå University of Technology  
jorgen.normark@ltu.se*

<sup>3</sup>*Occupational therapy, Luleå University of Technology  
cecilia.bjorklund@ltu.se*

<sup>4</sup>*Physiotherapy, Luleå University of Technology  
sari-anne.wiklund-axelsson@ltu.se*

## Abstract

The aim of the interdisciplinary HealthCloud pre-study project was twofold: to further knowledge of user experiences of inclusive interface design specifically for an ageing population, and to develop a digital service for senior persons with sensory decline to promote healthy living and active ageing. A co-design approach was chosen to investigate the project aim and knowledge and user experiences was jointly developed and evaluated in three sequential steps in a participant-group of senior persons. In the design of the conceptual user interface, the identified core aspect involved a strive for utility: quality of appropriateness in use, and significance: how designs assume meaning in the ways they are used, as well as simplicity: to reduce, organize, and making it enjoyable to use. The digital service outcome consists of validation of previous research themes: keeping the family together; enjoying life at home; being close to nature; self-development; and promoting conditions for healthy ageing. The pre-study project outcomes are prototypes of digital health service content and interfaces, aimed for a future digital HealthCloud service. Participants in the reference-group found the developed interface easy to use regardless of previous computer skills and they were also motivated and stimulated by the developed prototypes for promoting active ageing on a daily basis. Participants also expressed a desire to display and recommend such digital services to others, which indicates a positive user experience of co-designing digital services.

**Keywords:** *User experience design, Inclusive design, Co-design, Active ageing*

# 1 Introduction

The focus of this paper is HealthCloud, a planned future digital service that aims to empower and enable persons in the third age to improve wellbeing and healthy living. The interdisciplinary HealthCloud pre-study project for this reason explored both senior persons' user experience of interacting with digital systems and explored how to promote active ageing through an online-service. The project idea was to use inclusive co-design, through which the participatory senior persons in their third age<sup>1</sup> would have possibility to partake in the design of the online-service in relation to service content and interface design. The overall objective of the HealthCloud pre-study project was exploring possibilities to empower senior person's ability to take control and affect their own health and well-being with support of a co-designed digital user-friendly service, more specifically aiming:

- A. To further knowledge of user experiences of interface design, with focus on experiences of inclusiveness for an ageing population
- B. To explore content and user experiences of a digital service that intends to be promoting healthy living for senior persons with sensory decline

Drawing on design for active and healthy ageing, participatory user experience design and inclusive design for people in the third age, we in this paper present the idea, implementation and outcomes of the HealthCloud pre-study project.

## 2 Design for Active and Healthy Ageing

The future society should be accessible and inclusive for all generations, and an active ageing, i.e. the right of being active despite reduced abilities, are primary strategies for health recommended by WHO (2002). It is also implemented as a European and national recommendation in Sweden (SNIPH, 2006). Health, participation and security are three of UNs cornerstones for an active ageing. Currently, there is a growing ageing population, at the same time as an on-going explosion of digital technology and services. In paradox, digital systems or interfaces are rarely developed based on senior people's skills, neither their conditions, for example impaired vision and hearing, nor on their cognitive and sensory understanding of different information and feedback. The concept of designing for accessibility vary between different fields. 'Design for all' grew from the strive for designing products for a wide range of users, based on a wish to increase satisfied users and clients (Aragall & Montana, 2012). The concept of 'Universal design' is by Mace (1985) described as an inclusive design approach that embrace solutions that everybody should be able to use. Connell et al. (1997) refines the Universal design approach through the principles of equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, and size and space for approach and user regardless of user's body size, posture or mobility. 'Inclusive design' is an approach not comprising a set of fixed criteria but emphasizing the design practice responsibility of embracing users with various special needs (Morrow, 2002; Keates & Clarkson, 2004). Keates and Clarkson (2004) however acknowledge that few designers adopt the inclusive design approach due to insufficient resources or time, inadequate access to users, inexperience in dealing with users, and/or lack of demand from clients. This is evident within various Health care services, systems and interfaces, which neither seems based on user experiences, nor on the aspect of being

---

<sup>1</sup> The third age is the period after retirement, when person has opportunities to guide their own life according to their resources. During this period persons are usually promoting their own health, to gain capacities aimed at reducing functional losses that may occur in later life.

proactive, i.e. outside health care initiatives for active ageing. Even though E-health has been developed based on the user perspective, it is mainly focused on fragile older persons and providing healthcare at home (Geraedts et al., 2017; De Luca et al., 2016). Less focus has been directed towards the support outside the healthcare in a proactive approach, and the sustainability of a healthy life and wellbeing (Schraefel & Churchill, 2014). E-health that is offered today is based on health professionals processing data provided by older persons and professionals offering solutions to the older persons' health issues (Lluch & Abadie, 2013).

The Swedish national goal for health is to create social conditions for good health on equal terms for the entire population, which highlights equality and sustainability in health for all groups (The Ministry of Health and Social Affairs, 2002). In this, prerequisites to reach sustainability in health is stated as to support empowerment and the ability to use ICT. The first prioritized area for Health 2020 in Europe is to invest in health from a lifecycle perspective and give people influence over their lives (WHO, 2013). There are several reasons for focusing on the health of the ageing population (PHAS, 2017): e.g. the life expectancy increases in Sweden, diseases and disabilities are more common among the older population, and people over the age of 75 years has a reduced function of living with disabilities within one or multiple areas in their lives. Also, research of senior persons in Sweden shows that sustainability of living healthy and active living includes strategies of: maintaining control, influence of others, and the importance of identifying a solid motivator (Wiklund Axelsson, 2015). Björklund's (2015) research of senior persons in Sweden identified five core health projects that senior persons recognise as relevant for healthy living: A. Keeping the family together; B. Enjoying life at home; C. Being close to the nature; D. Self-development; and E. Promoting conditions for healthy ageing, which will be further explored in the current project.

According to The Swedes and the Internet report (2017), the majority (56%) of the oldest age group in Sweden use Internet today. Complicated technology and lack of interest is according to this report the main reason for not using the Internet among older persons. Other reasons for low computer usage among senior persons are in this report described as various sensory losses such as reduced hearing, dimming eyesight and loss of memory functioning and decline in motor skills. Therefore, there is a need of designing a user interface and a digital service that ensures ease of use and enabling user experience, for persons with sensory losses. In the current project, a drive was that of being aware of older person's experiences and expectations as an important criterion for design of digital services. Recent research found that older persons have positive expectations on health-related ICT regarding their quality of life (Wiklund Axelsson et al., 2013). E-health involves a broad group of activities that use digital means to increase access to deliver health-related information, resources and services, skills, as well as promotion of positive changes in health behaviours and manage of diseases (WHO, 2017). The Swedish version of eHealth 2025 has been developed to include and support equal health, independence, empowerment, participation, accessibility, and to be user-friendly (Government offices of Sweden, 2017).

### **3 Participatory user experience design**

The current project builds on a design lab approach as described by Wikberg Nilsson (2012). In turn, this draws on several other approaches, e.g. Participatory design (PD), originally referred to as the collective research approach (Ehn, 1988), with roots in Scandinavian design practices. Suchman (1993) describes this as an emphasis on interaction and collaboration between those involved in the doing design, and those involved in using design. Elsewhere,

Suchman (2002) criticizes the design practice boundaries being built up as separated domains separated from user situations. Sanders (2000) stresses the shift from designing for users, to designing with users, requiring new ways of thinking, acting and doing, similar to the original PD approach as described by Muller et al. (1993). During the last decades, the focus of co-creation highlights user experience. Sanders and Stappers (2008) emphasize to involve diverse people in the process, and changing the focus from the product or technology, to broader societal needs in diverse contexts. As Sleeswijk Visser et al. (2005) stress, users are experts on their own experiences, and if the objective is a good user experience they should obviously be involved in the design process. The role of the designer hence shifts from being a translator of user needs to a facilitator of co-design processes (Sanders & Stappers, 2008), managing methods and tools for supporting the participants' ability to partake.

The overall reason for engaging in co-design has in the current project been to enable senior persons to share their experiences of digital services and partake in the design of a future digital health service, both in regards to its content and its user interface design. In design of user interfaces, function has long been the predominant concept to achieve satisfied users, resulting in focus of the designer's intent of the artifact (Simon, 1996), in an effort to design a course of action that will result in user satisfaction (Archer, 1969). However, Heskett (2005) in functionality's place, highlights utility, the quality of appropriateness in use, and significance, how forms assume meaning in the ways they are used, as more valid terms to explore how functionality are experienced among users. User experience (UX) design involves all aspects of how people interact with a product (Alben, 1996): how it feels to touch; how it feels in their hands; how it makes sense; what the experience of using it is; and how it fits into their settings. The goal of UX hence is to improve user satisfaction through ease of use and pleasure provided by the product or service. Hassenzahl and Tractinsky (2006) state an initial attempt to move away from the traditional task-oriented human-computer interaction (HMI) approach, to that of satisfying human needs. Kujala et al. (2011) states "enjoyability" as the main factor in UX design and emphasize users being involved in explorations of what constitutes meaningful and memorable experiences. In this, there is a shift for designers to move from explorations of current end-products, to co-design of future enjoyable experiences.

#### **4 Designing for people in their third age**

As people in their third age risk having decreasing sensorial inputs, e.g. visual, speech and hearing, cognitive, memory and attention, to name a few (Johnson & Finn, 2016), there is a current societal challenge in adapting technology and services to such needs. According to Maeda (2012), technology has made our lives fuller, but at the same time disturbingly full of complexity and information overload. Achieving simplicity in the digital age in this view should involve a strive for simplicity by sorting, labelling, integrating and reducing unnecessary information; organizing and structuring things so they appear fewer; and saving time; making it time efficient to use. Knowledge makes things appear simpler (Maeda, 2012), yet it does not seem time efficient to educate all people in becoming digital literates. Therefore, the user interface should include being able of making mistakes, getting efficient feedback on your actions, and being able to repeat the actions. Also, relevant in terms of design for use is the concept of *affordance*. Norman (1998) describes this as users' experiences of action possibilities, e.g. what they perceive can be done through interacting with a product, system or a service. When designing interfaces for people in their third age, there are some general guidelines, e.g. (Johnson & Finn, 2016) states that:

- legibility of essential text should be maximized
- colour should be used sensibly
- visual design should generally be simplified
- the need for vertical scrolling should be indicated
- long lists of options should be avoided
- a consistent graphical language should be used o text alternatives should be provided for non-text content
- important content should be made noticeable and easy to scan.

In this view, it is important to take into account that senior persons tend taking longer time to learn new applications or devices, taking longer time to complete tasks, using different search strategies, performing worse on tasks relying on memory, being more distracted, having a harder time dealing with errors, making more erratic or accidental movements with the pointer, making more input errors, and having more trouble hitting on-screen targets.

## 5 Method

The HealthCloud pre-study project invited participants to partake in the development of a digital service prototype based on their specific preferences, needs and conditions. The project was implemented in five iterative steps: *inspiration*, *exploration*, *ideation*, *implementation* and *finalization*, during three workshops with a reference group. The participants were part of retirement organizations [SPF and PRO] in Norrbotten, Sweden. The participants' age ranged from 71 to 82 years old (mean 75 years), two were women and five were men. All of the participants self-rated through a visual analogy scale (VAS) sensory losses in reduced hearing, dimming eyesight, mobility, sensibility and loss of memory functioning. Reduced hearing, dimming eyesight and mobility was the highest rated score among all the participants. The process consisted of three workshops where the participants interacted with various interfaces, gave their feedback, and took part in discussions of core health aspects.

The first workshop included *inspiration* and *exploration* where the interdisciplinary research team with experiences in design and health care presented information of the project and it's aims, information on user interfaces, and importance of health literacy and empowerment. In this, the participants discussed ICT and health services, and the previously described core health themes. The participants also discussed and gave their feedback on user experience, based on viewing different sites with diverse visual information, text-based information, symbols and icons, colours, feedback, interactions, and personalization. The workshop also included the test of different types of user interfaces (website based, video based, and interactive online tool) guided by eye-tracking and interviews. Eye-tracking is used to get insights into human behaviour and product performance by recording information on where people look, in for example, user interfaces (Tobii, n.d). Eye-tracking information can be used to aid usability studies (Manhartsberger & Zellhofer, 2005), and can provide an objective measure of the participant's cognitive process. (Tatler, Kirtley, Macdonald, Mitchell & Savage, 2014). However, eye-tracking needs to be combined with other methods in order to provide valid information to the researcher, for example regarding the participant's intentions, motivation, and comprehension (Bojko, 2013; Holmqvist et.al, 2011). For this reason, the eyetracking tests were complemented with interviews of user's experiences.

The second workshop focused on *ideation* of a conceptual digital health service in content and design. This workshop also aimed at confirming the five core health themes as relevant for the

participants, and explore them in terms of how the participants could interact with them in an online-service. The participants were asked to more in depth discuss and present their usage and anticipated needs for ICT-use in order to support daily life, health and well-being. The participants also explored how the core functions of the UID could be structured, in terms of preferences of responses and feedback in different user sensations and perceptions and there was also further testing of various interfaces through eye-tracking, complemented by interviews.

The third workshop focused on *implementation* and *confirmation*. Based on the previous workshops the research group developed two interactive prototypes for the HealthCloud service. The participants interacted with the prototypes and evaluated the interfaces and the content. The participants also used Product Reaction Cards (Benedek and Miner, 2002), a user experience design method where the participants choose among a large number of words to verbalise their experience of the conceptual digital service interfaces. They provided valid feedback on how the prototypes could be further refined and detailed for usage to support elderly persons active ageing, health and well-being.

## **6 Results**

### **6.1 Workshop 1 - inspiration and exploration**

The participants were initially asked to discuss user interface aspects such as the use of pictures, text, symbols, video, and audio. In general, pictures seemed to stimulate emotional reaction among the participants. However, the participants' meaning making of the picture differed widely. For example, a picture of a bicyclist could for one participant symbolized harmony, but for another workout and training. The method spurred discussions about various aspects, which was the general idea. The participants had more similar experience when it came to the use of text in websites and similar. They agreed that in many occasions the text is too compact and should be interspersed with pictures, and if the text get too compact and overwhelming the motivation to read through the text declines. The participants in general liked symbols but agreed that they do not evoke such emotional reaction as pictures and saw symbols as harder to interpret and thought that the same symbol also can mean different things. In general, they preferred clear and distinct symbols with high contrast. The use of video, especially in websites, were not perceived as positive. The fast pace of some videos makes it hard to perceive the message in the video and makes it difficult to concentrate. The participants thereafter discussed aspects that could promote health and wellbeing in a digital service and supported the core health themes as important aspects for maintaining health throughout life even though the preferences and priorities amongst the themes varied. They were however unsure if they today in any way used digital aids to support such health projects. In terms of using digital aids in general, and although firstly describing themselves as non-tech-savvy, they described using various digital services for communicating with families and friends, using e-mail and social medias, making ticket reservations for traveling and amusements, and contacting health services, and so forth.

### **6.2 Workshop 2 - exploration and ideation**

The participants were in this workshop initially asked to discuss e-health, and their current use of such services; i.e. whether they currently used Internet to check health tips and similar matters. The participants were a bit hesitant towards the fast technology development. They compared with bank services, and said that first some bank services disappeared, and then people started to use Internet services instead. In these participants' mind it ought to be the

other way around, first start with Internet services, and then gradually remove personal services. Some of these participants found it somewhat difficult to learn new interfaces, for example when a bank has a certain interface and then change, they said that it is difficult to learn something new, whether it deals with learning a new phone or a new website. Digital aids in their minds should be user friendly, this would as they claimed counteract loneliness for some seniors, simplify their everyday life, take care of both body and mind through keeping track of their health through digital aids. Although, they also emphasized relations to other people as important, and that it is difficult to get to know new people when you are older. To become part of different networks is therefore important, and be able to choose what to participate in. The core health themes, introduced in the first workshop, was further discussed. The participants felt that the themes were evoking positive thoughts and feelings and that the projects were connected with one another to support the participants' health and well-being. They described individual aspects and activities in relation to the different themes, and how some of the activities were supported by digital aid, or otherwise how it had possibility to be so. The importance of social activities was focused, as they said that staying in touch with old friends and finding new ones can be difficult in their age.

### 6.3 Workshop 3 - implementation and confirmation

In between the second and third workshop, the project team developed prototypes based on the participants' output from the first two ones. The focus was on making simple-to-use interfaces with focus on the agreed core health themes and promote a good user experience through interacting with them. As the participants preferred symbols and images before texts, one of the prototypes were based on symbols and the other one on images. In the final workshop, the participants were introduced to the two prototypes, see Figure 1. They were firstly asked to interact with the prototypes and provide their feedback based on questions such as if it was intuitive, easy to grasp and so forth, further described in upcoming sections.

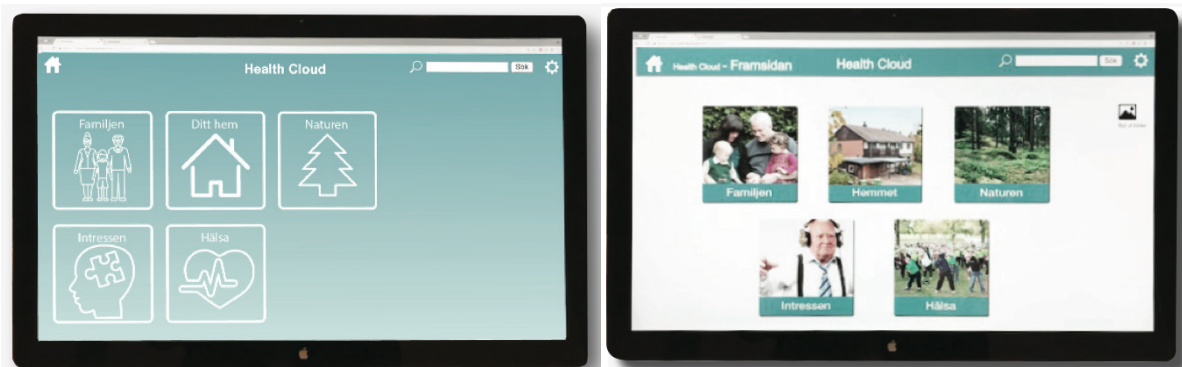


Figure 1. Left: Prototype A. Right: Prototype B.

#### 6.3.1 Prototypes

Prototype A has an interface design consisting of a main page with five symbols and text, see figure 1, hence, incorporating the participants' experiences of symbols as intuitive and easy to grasp, yet strengthened with text to assume meaning. The participants initial response to prototype A was that it was easy to grasp, simple to use, and comprehensible. They all stated that the interface was understandable, and that the icons for the different sub-pages were clear and straightforward. Several of the participants found the icon representing family somewhat discriminating, because the persons in the icon had sticks, a symbol for an elderly person they did not agree with. The chosen words through the Product reaction cards method for

prototype A was: simple, understandable, useful, available, easy to use, engaging, meaningful, effective, fast, and enabling. This indicates that prototype A has a user-friendly design that they experienced as valuable.

Prototype B has a similar interface design as the previous one, with the main difference of using images instead of symbols, see Figure 1, this in line with some participants' preferences. The participants' initial experience of prototype B was that it was easy to use, but some also said that it was more interesting to have images instead of icons. In the discussions they agreed on that it was more personal to have images, and that they would prefer to have own images and change images every now and then. They all considered B to be structured and usable. The chosen words through the Product reaction cards method was for prototype B: professional, usable, efficient, creative, motivating, fast, simple, intuitive, easy-to-use, friendly, meaningful, available, understandable, wanted, consistent, controllable, and reliable, all indicating that prototype B contributed in providing a good user experience.

The participants expressed "enjoyability" with both concepts, stating that they never thought that all of their different and diverse needs and preferences could be joined in a single system. The participants suggested that there should be two additional themes added to the HealthCloud, one "Personal". e.g. "Lotta-My self"; and one for "activities that were important to keep track of" e.g. engagements such as PRO meetings. They stated being impressed by the interface design, although, its actual content and design were aspects and factors they had chosen or otherwise expressed themselves. Both prototypes were designed to be as simple as possible, stressing consistency, easy-to-use and straight-forwardness. The simplicity in the design was also something they appreciated. Another aspect was that of the possibility of personalization. The participants expressed a need for exchanging pictures to your own preferences, and also to be able to vary the user interfaces in terms of sizes of text fonts, images, and content, in line with research on personalization (Normark, 2014). Overall the participants supported the idea of the HealthCloud digital service as a clear and simple design with possibilities to promote health and well-being.

## 6.4 Analysis

The strength of a qualitative research approach can be potential of making new discoveries through the holistic search of perceived meaning and experience (Miles & Huberman, 1994). The aims of the current project were those of furthering knowledge of user experiences of interface design, with a focus on people in the third age, and exploring content and user experiences of a digital service that intends to be promoting healthy living for senior persons with sensory decline. Although aware that the results of this pre-study project cannot be generalized into design principles for interface designs for senior persons, the outcomes are in line with previously stated design guidelines of making things affordable (Norman, 1988), simple to use through labelling, integrating and prioritizing (Maeda, 2012), focus on the experience of using it: e.g. sense-making, and contextualising, as suggested by Alben (1996), and adapting it to people in their third age, through e.g. sensible use of text and colours, simplified visual designs, consistent graphics, easy-to-scan and so forth, as suggested by Johnsson and Finn (2016). The research validity can in qualitative research take on different meanings, for example, in line with Lindhult (1998), we propose a *scientific* validity being that of applying valid theories and methods for the research objectives, a *pragmatic* validity involving a strive for pragmatic solutions that are useful and practical for the intended users, and a *normative* validity being the strive of improving something for the user groups.



The robustness of the current results can however only be discussed through actual usage of the digital service. The aim of this pre-study was to explore some of the basic functions of the HealthCloud digital service. The main contribution of this pre-study project is for this reason how the participants experienced *utility*, the quality of appropriateness in use of the HealthCloud digital service, and the *significance*, how the interface design assumed meaning for the participants in the way they were intended to be used, which we consider indicate positive user experiences in both cases. The utility can be exemplified through the five core project themes: A. Keeping the family together; B. Enjoying life at home; C. Being close to nature; D. Self-development; and E. Promoting conditions for healthy ageing, which the participants explored and confirmed as appropriate and fundamental for healthy living and active ageing. The utility can also be exemplified through the prototypes interface design, which the participants considered to be simple, consistent, easy-to-use, and straight forward in terms of accessing the core themes. The participants took part in exploring significance in various interface designs and gave important input on their experiences which resulted in the prototypes. The prototypes for this reason assumed meaning for them, as it was designed in accordance with their preferences and specific needs in terms of being inclusive. For this reason, we consider co-design as a vital part in inclusive digital service design. Further work is to launch a HealthCloud digital service and through co-design further explore and test the core design principles that contribute in a digital service that contributes in promoting an active ageing.

## 7 Discussion

The overall objectives of the HealthCloud project was to further knowledge of user experiences of interface design with a focus on inclusive design for an ageing population, and to explore content and user experiences of a digital service that intends to be promoting healthy living for senior persons with sensory decline. The pre-study outcomes are: 1) the digital prototypes that needs further refining and user testing before launch, however, some important aspects have been identified. The importance of co-designing digital services and interfaces with actual users to emphasize their insights, ideas, and visions is one of them; and 2) the participants' support of the structure and content of the five core health themes as relevant for promoting well-being. In the design of the digital service prototypes, the identified core aspects were a strive for simplicity: to reduce, organize, and making it inspiration to use. Participants in the reference-group found the developed interface easy to use regardless of previous computer skills and they were also motivated and stimulated by the prototypes for promoting their health on a daily basis. Participants also expressed a desire to display and recommend such digital services to others, which to some extent indicates a positive user experience. The main surprise of this project was the participants initial state of their lack of experience in using IT-related tools, however, they have more skills and experiences than they believe themselves.

Through active participation in the design of the HealthCloud digital service, the idea was that the outcome should ensure that senior persons influence the design and hence contribute in making it more inclusive, as well as that the content of the digital service would contribute in promoting healthy living and active ageing. Through the current project approach, it was evident that many of the websites and digital service those participants use neither satisfy their needs nor are in line with their preferences. Although there cannot be general senior persons digital interface preferences, as preferences differ between people and aren't

homogenous within a user category, it was evident that previously stated guidelines of user experience and interface design are not implemented to a satisfying level in the websites those participants interact with. Hence, it is important to embrace an inclusive co-design approach to satisfy senior users, as more and more services become digital and the ageing population is growing.

The HealthCloud pre-study project contributes to design of ICT by furthering knowledge of how senior persons experience utility, the quality or appropriateness of a design in use, and significance, how designs assume meaning in the ways they are used. This was clear both in the participant discussions of the Core Health Projects, and how they could be implemented, and in the discussions and testing of the digital service prototypes and their content. Another outcome of this project is the promotion of design based on user experience, rather than technology development, and hence contribute to knowledge of how to utilize and improve the user satisfaction. A digital service like HealthCloud, we consider illustrates possibilities of promoting healthy living and active ageing, an outcome that the current approach of co-designing user experiences confirmed and contributed in making more apparent.

## Acknowledgement

We want to express our deep gratitude to the participants in the HealthCloud pre-study project, for enjoyable design-labs and great chats.

## References

- Alben, L. (1996). Quality of Experience. *Interactions of the ACM, May + June 1996, 11-15*
- Aragall, F. & Montana, J. (2012). *Universal Design: The HUMBLE Method for User-Centered Business*. Aldershot: Gower Publishing Ltd
- Archer, L. B. (1969). The structure of the design process. In G. Broadbent & A. Ward's (eds) *Design Methods in Architecture*, 76-102. London: Architectural Association Paper No. 4
- Benedek, J., & Miner, T. (2002). Measuring Desirability: New methods for evaluating desirability in a usability lab setting. *Proceedings of Usability Professionals Association, 2003(8-12), 57*.
- Björklund, C. (2015). *Temporal Pattern of daily Occupations and Personal Projects Relevant for Older Persons' Subjective Health*. Doctoral dissertation, Luleå University of Technology, Department of Health Science's.
- Bojko, A. (2013). *Eye tracking the user experience: a practical guide to research*. Brooklyn, New York: Rosenfeld Media.
- Connell, B. R., Jones M., Mace R., Mueller J., Mullick A., Ostroff E., Sanford, J., Seinfeld, E., Story, M., Vanderheiden G. (1997). *The Principles of Universal Design, Version 2.0*. Raleigh, N.C.: Center for Universal Design, North Carolina State University
- De Luca, R., Bramanti, A., De Cola, M.C. (2016). Tele-health-care in the elderly living in nursing home: the first Sicilian multimodal approach. *Ageing Clinical and Experimental Research, 28:753–759*
- Ehn, P. (1988). *Work-Oriented Design of Computer Artifacts*. Stockholm: Arbetslivsinstitutet
- Geraedts H.A., Zijlstra W., Zhang W., Spoorenberg S.L., Báez M., Far I.K., Baldus H., Stevens M.A. (2017). Home-Based Exercise Program Driven by Tablet Application and Mobility Monitoring for Frail Older Adults: Feasibility and Practical Implications. *Preventive Chronic Disease, 14:12*

- Government office of Sweden. Swedish eHealth Agency. (2017). *Visionen för e-hälsa arbetet*. <http://www.government.se/government-agencies/swedish-ehealth-agency-ehalsomyndigheten/> [2018-05-29]
- Hassenzahl, M. & Tractinsky, N. (2006). User experience – a research agenda. *Behaviour & Information Technology*, 25(2), 91-97
- Heskett, J. (2005). *Design: a very short introduction*. Oxford: Oxford University Press
- Holmqvist, K., Nyström, M., Andersson, R., Dewhurst, R., Halszka, J., & van de Weijer, J. (2011). *Eye Tracking: A Comprehensive Guide to Methods and Measures*. Oxford University Press.
- Johnson, J., & Finn, K. (2017). *Designing User Interfaces for an Ageing Population: Towards Universal Design*. Cambridge, MA: Morgan Kaufmann.
- Keates, S. & Clarkson, J. (2004). *Countering design exclusion: an introduction to inclusive design*. London: Springer
- Kujala, S., Roto, V., Väänänen-Vaino-Mattila, K., Karapanos, E. & Sinnelä, A. (2011). UX Curve: A method for evaluating long-term user experience. *Interacting with computers*, 23(5), 473-483
- Lindhult, E. (2008). Att bedöma och uppnå kvalitet i interaktiv forskning (In Swedish). In B. Johannisson, E. Gunnarsson & T. Stjernberg's (eds) *Gemensamt kunskapande – en interaktiva forskningens praktik*, 333-348. (In Swedish). Växjö: Växjö University Press
- Lluch, M. & Abadie F. (2013). Exploring the role of ICT in the provision of integrated care- Evidence from eight countries. *Health Policy*, 111, 1-13
- Mace, R. (1985). *Universal design: barrier-free environments for everyone*. Los Angeles: Designers West
- Maeda, J. (2012). *The laws of simplicity*. Cambridge, Mass.: MIT Press
- Manhartsberger, M., & Zellhofer, N. (2005). Eye tracking in usability research: What users really see. *Usability Symposium*, 198: 2, 141-152.
- Merlijn Kouprie, M., & Sleeswijk Visser F. (2009). A framework for empathy in design: stepping into and out of the user's life. *Journal of Engineering Design*, 20:5, 437-448
- Miles, M.B. & Huberman, A.M. (1994). *Qualitative data analysis: an expanded sourcebook* (2<sup>nd</sup> ed.). Thousand Oaks, CA: Sage
- Ministry of Health and Social Affairs. (2002). *Mål för folkhälsan*. (Prop. 2002/03:35). Retrieved from <http://www.regeringen.se/rattsdokument/proposition/2002/12/prop.-20020335/> [2017-11-30]
- Ministry of Health and Social Affairs. (2007). En förnyad folkhälsopolitik. (Prop. 2007/08:110). Retrieved from <http://www.regeringen.se/rattsdokument/proposition/2008/03/prop.-200708110/> [2017- 11-30]
- Morrow, R. (2002). *Building and Sustaining a Learning Environment for Inclusive Design: A Framework for teaching inclusive design within built environment courses in the UK*. Belfast: Centre for Education in the Built Environment
- Muller, M. J., Wildman, D. M. & White, E. A. (1993). Participatory Design. *Communications of the ACM*, 36:4, 24-28
- Norman, D. A. (1998). *The design of everyday things*. London: MIT
- Normark, C. J. (2014). The User as Interface Designer: personalizable vehicle user interfaces. PhD Thesis in Industrial design. Luleå: Luleå University of Technology
- Public Health Agency of Sweden [PHAS]. (2009). *Det är aldrig försent. Förbättra äldres hälsa med mat, möten och aktivitet*. <https://www.folkhalsomyndigheten.se/the-public-health-agency-of-sweden/> [2018-05-29]

- Sanders, E. B-N. (2000) Generative tools for co-designing. In: Scrivener S.A.R., Ball L.J., Woodcock A. (eds) *Collaborative Design*. London: Springer
- Sanders, E. B-N. & Stappers, P. J. (2008) Co-creation and the new landscape of design. *CoDesign*, 4:1, 5-18
- Schraefel, M.C., Churchill F. E. (2014). Wealth Creation: Using Computer Science to Support Proactive Health. *Computer*, 47:11
- Simon, H. A. (1996). *The Sciences of the Artificial*. Cambridge, MA: MIT Press
- Sleeswijk Visser, F., Stappers, P.J., van der Lugt, R. & Sanders E. B-N. (2005). Contextmapping: experiences from practice. *CoDesign*, 1:2, 119-149
- Suchman, L. (1993). Foreword. In D. Shuler & A. Namioka's (Eds) *Participatory Design: principles and practices*, vii-ix. Hillsdale, NJ: Lawrence Erlbaum Associates
- Suchman, L. (2002). Located accountabilities in technology production. *Scandinavian Journal of Information systems*, 14:2, 91-105
- Swedish National Institute of Public Health [SNIPH]. (2006). *Healthy ageing – A challenge for Europe*. (R 2006:29). Huskvarna: NRS Tryckeri AB.
- Tatler, B. W. Kirtley, C. Macdonald, R. G. Mitchell, K. M. A. and Savage, S. W. (2014). The Active Eye: Perspectives on Eye Movement Research. In M. Horsley, N. Toon, B. A. Knight, & R. Reilly (eds.), *Current Trends in Eye Tracking Research*, 3-16. Springer International Publishing
- The Swedes and the Internet report (2017). Internetstiftelsen I Sverige. Retrieved from: <http://www.soi2017.se/the-swedes-and-the-internet-2017-summary/> [2018-05-29]
- Tobii (n.d.) *Eye tracking metrics*. Available at: <https://www.tobii.com/learn-and-support/learn/steps-in-an-eye-tracking-study/interpret/eye-tracking-metrics/> [2017-09-06]
- Wikberg Nilsson, Å. (2012). *Re-thinking designing. Collaborative probing of work and workplace change*. Doctoral dissertation, Luleå University of Technology
- Wiklund Axelsson, S (2015). *Prerequisites for sustainable life style changes among older persons with obesity and for ICT support*. Doctoral dissertation, Luleå University of Technology, Department of Health Sciences.
- Wiklund Axelsson, S., Nyberg, L., Näslund, A. & Melander Wikman, A. (2013). The anticipated positive psychosocial impact of present web based e-health services and future mobile health applications: An investigation among older Swedes, *International Journal of Telemedicine and Applications*, 2013:2-9
- World Health Organization [WHO] (2017) *Ageing and life course*. Available at: [http://www.who.int/ageing/active\\_ageing/en](http://www.who.int/ageing/active_ageing/en) [2017-06-15]
- World Health Organization [WHO]. (2002). *Active Ageing: A policy framework*. Geneva: World Health Organization.
- World Health Organization [WHO]. (2013). *Health 2020: A European policy framework supporting action cross government and society for health and well-being*. Copenhagen: World Health Organization.