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Designing Self-care for Everyday Life.
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Preface

Managing chronic conditions can be challenging. People in such conditions, and the people around them, have to, for example: deal with symptoms, adapt to the resulting disability, manage emotions, and change habits to keep the condition under control. Self-care technologies have the potential to support self-care, however they often disregard the complexity of the settings in which they are used and fail to become integrated in everyday life.

The present collection of papers forms the Proceedings of the Workshop "Designing Self-care for Everyday Life" conducted last October 27th, 2014 in Helsinki, where 14 participants from 7 different countries spent the day discussing how to design self-care technologies that are in harmony with people's everyday life. During the morning, discussions were driven by poster presentations focused on the participants' work. In the afternoon, we engaged in a participatory design exercise focused on the self-care of Parkinson's disease. Our discussions were driven by the experience of two people living with Parkinson's that participated in our workshop. At the end of the exercise, each group presented the different insights, concepts and problems that each patient experiences in their everyday life with the disease. Last, we all engaged in a broader discussion with a mapping exercise of issues and challenges in relation to self-care.

The contributions featured in the proceedings have been **peer-reviewed** by the members of the Workshop Program Committee and selected on the basis of their quality, alignment with the workshop theme, and the extent (and diversity) of their backgrounds in design. They express points of view of researchers from both Academia and Industry and provide relevant insights in the design and development use of technologies for self-care.

We want to thank all the participants and co-authors for contributing to the Workshop. We are particularly grateful to the two patients, members of the Finnish Parkinson's Association, who accepted to participate in the workshop and enabled researchers to get a perspective on the challenges of their lives. We also want to thank all the Programme Committee members for all their work during the reviewing process as well as the organisers of NordiCHI 2014 for providing useful facilities.

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Aarhus, October 2014

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ALADIN: Adaptive Voice Interface for People with Disabilities

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ABSTRACT
This position paper gives an overview of our ongoing work within the ALADIN project, which aims to develop an assistive vocal interface for people with physical impairments. Unlike most current Automatic Speech Recognition solutions, the system is trained by the user, which provides extra challenges to the design of the interface. We describe three iterations of our user tests, showing how constraints and multimodal design influence the user expectations and interactions.

Author Keywords
Assistive technology; Speech interaction; Learning systems

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

While a lot of systems in the home can now be remotely controlled by people with motor impairments, the means of controlling them are not always ideally suited to their abilities. Current solutions rely mostly on button-based remote controls or a graphical user interface operated using switches or other means such as a sip-and-puff device (see figure 1), which are controlled with varying ease-of-use.

A voice-operated interface could help regain people with motor impairments the ability to control their home, domestic appliances, or entertainment devices, voice control, contributing significantly to their independence of living and quality of life [7].

In this paper, we describe the speech recognition system for people with disabilities developed in the ALADIN project. We describe the overall project goals and three iterations of user tests, focusing on how our methodology of testing influenced the way in which users interact with the vocal interface.

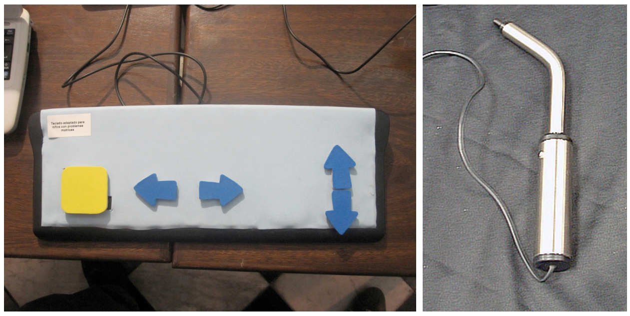

Figure 1. Adapted keyboard for children [3] (left) and a sip and puff device [4] (right), two examples of existing interfaces for people with disabilities

AIM OF THE PROJECT
The ALADIN project was set up to create an adaptive, learning speech recognition system for people with disabilities, offering control over a wide range of applications. So far, vocal interfaces have not yet seen a wide adoption in assistive technologies, despite the obvious advantages as an interface for people whose impairment restricts (upper) limb use and thus their ability to use more traditional remote controls. There are several reasons why speech recognition is difficult to implement for this target group:

- A lot of users who could benefit from voice control due to motor impairments also suffer from a speech pathology, making state-of-the-art speech recognisers unusable for them.
- Current vocal remotes require the user to use pre-defined commands, forcing them to adapt to the system and learn the proper commands.
- Progressive diseases often lead to changing speech patterns, which requires a constant adaption of the system.

There are already a number of solutions that address some of these problems, but are lacking in other aspects: the Pilot Pro [5], for example, offers a fixed number of pre-programmed functions and a very hard to use training method. Castle OS [1], a more recent solution that is not aimed specifically at people with disabilities, features a more intelligent and expandable set of controls, but uses natural language recognition, unsuitable for people with speech impairments.

The aim of the ALADIN project then, is to provide users with a system that can be adapted to their specific living situation and can learn their commands instead of the other way around, deducing grammar and vocabulary from the user's speech. This deduction happens based on examples of commands, which are given using traditional remote controls and via speech at the same time. The system then links sounds from the user's speech with concepts in their commands (such as open/kitchen/door).

DESIGN PROCESS

As this project is a collaboration between HCI researchers and speech recognition researchers, the work on both sides necessarily runs parallel to each other. During the course of the project, we started off with user research (both contextual inquiries in the homes of users, and context mapping sessions [8]), moving to several user tests informing the system's design.

User Research

We visited the residences of 10 people (aged 9-48, average age 30), all of whom had physical limitations: half of the participants lived independent or assisted, and half of them were physically completely dependent, and lived at their parents' homes or in a residential care center. Points of interest in this contextual inquiry were physical and cognitive possibilities and limitations, the living environment (adjustments made, tips and tricks of the user to adapt to his environment, most important/preferred places in the house), problems encountered, organization of daily tasks, and assistance of devices or caregivers.

Apart from the contextual inquiry, two context mapping sessions were organized. These sessions focussed on the current quality of life of people with physical limitations, and how speech technology could help them achieve a better quality of life. The first session was held with two caregivers and two occupational therapists, while the second session was held with six people with physical limitations (aged 23-53, average age 43), and three caregivers that accompanied them. The context mapping sessions further enriched the results of the contextual inquiry by offering a more detailed insight in what is important in the lives of people with physical limitations, and how speech technology can be useful to them (see figure 2).

Both the contextual inquiry and the context mapping sessions were used as input to determine the application that was to be developed in the ALADIN project. The conclusion was that the main areas in which voice control would be useful were home automation (opening doors, blinds, switching lights, etc.), entertainment and communication. For the young participants in our research, entertainment was more important than home automation, as they liked receiving a lot of attention from their parents and their caregivers. However, for the adult participants, living as independently as possible clearly was an important factor determining their quality of life. For this reason, home automation was selected as the focal use case in the ALADIN design process. This process, starting from scenario sketches and Wizard-of-Oz prototyping of home automation, will lead to a field test involving the entertainment component, using voice-controlled televisions installed in the homes of several users.

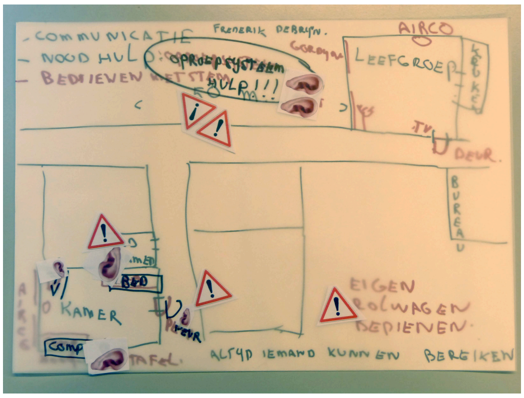

Figure 2. Context mapping outcome: a participant's living environment. The exclamation marks indicate dangerous situations, the ears indicate potentially interesting uses for speech technology.

Sketched Scenarios

To gauge how people would want to use a voice-controlled home automation system, we used the 'sketched scenario' method, in which we presented a group of users, some of whom were part of the first stage of user research, with visualisations of interactions, and asked them to utter the voice commands they would use to control this interaction (see figure 3).

The focus of this study was not to simulate system interaction in a very realistic way, but rather to explore the variation in how the targeted user group addresses a voice interaction system. Significant diversity was found in interaction styles: voice commands ranged from a purely 'technical', command-style interaction to a more anthropomorphized, natural communication with the system. In addition, some respondents addressed individual devices, without addressing the voice-control system separately, while other respondents addressed the voice-controlled system as a whole, telling it to act on the environment and control other devices. For this last group, addressing separate objects such as doors felt very unnatural. On the other hand, the device-oriented way of thinking implies a different technology approach, in which the system can identify the users' intentions based on their location and context (for instance, 'light on' turns on the lights in the room where the user is, without specifying which particular lamp).

Figure 3. Sketched scenario used during our first tests.

Wizard of Oz

The second medium-fidelity approach to user tests came in the form of Wizard of Oz testing, which has its roots in the testing of speech recognition applications [6]. Because we mainly focused on home automation at this point, an efficient way of simulating typical home automation tasks was needed that could also be used on location with test users, whose mobility was often limited. This simulation was made in the form of a virtual 3D environment, modeled after an adapted home for people with disabilities (figure 4). Using the Unity3D application, we could open doors, turn on lights, adjust the bed, etc. from a separate interface, allowing a researcher behind to scenes to manipulate the 3D home based on voice commands from the user, who was taken through a scenario with a moderator. This proved to be a much more immersive experience for users, and created a much more realistic representation of the envisioned interaction.

Figure 4. Screenshot from the 3D virtual home.

In the Wizard-of-Oz tests, participants were asked to address the system using a system name before uttering their commands. While this was necessary primarily for technical reasons, this change resulted in a smaller diversity of command styles: as participants had to name the speech system, they no longer addressed individual devices in the environment, but addressed the system as a whole. In other words, this primarily technical constraint limited the users' interaction styles, making the participants' commands more coherent. This meant it was easier to have a uniform starting word/phrase, which taken together with the smaller variation in commands, aligns better with the capabilities of the speech recognition system.

However, some problems remained, as users did not always use consistent words to denote the different devices that they could control. For instance, a few people used "Aladin, turn on the light" as a command turning on a specific light, which would lead to an ambiguous input for the system. Other types of commands proved confusing as well, such as doors which were often addressed using the name of the room on the other side of the door (e.g. "Aladin, open the bedroom door") but, when addressed from the other side, the same door would be called by a different name ("Aladin, open the living room door"). For this reason, and because of the need to provide an easy way to teach the system new commands and correct wrongly interpreted commands, we developed a tablet interface that could be used alongside ALADIN.

Figure 5. Mockup of the tablet application

Multimodal interface

The usefulness of a multimodal interface has previously been shown in the area of assistive technology, and especially when used in combination with speech recognition [2]. The main functions of the tablet interface (figure 5) are to (1) provide richer feedback from both the system (showing when the system is listening, or reporting possible problems) and the devices (showing which lights in the house are still on, the temperature of the thermostat, etc.), (2) function as a back-up interface for correcting misunderstood commands or as a fallback, and (3) provide an easier system for training the system.

While using this input method seemingly defeats the purpose of having voice control, we have adapted it to our user group by using large vertical buttons which can be activated using swabbing, which means a button is selected upon release of a finger input, rather than on the first contact, a method originally developed and successfully tested for older people with tremors [9]. Furthermore, the interface can be used by caregivers during the heaviest training period, or by users themselves using their existing scanning/switch inputs.

During the development of this tablet interface, we used an interactive mock-up of the application which could send and receive information from the 3D home used earlier. Because we did not yet have a functional speech recognition system, a second researcher controlled the application and navigated the 3D home from a separate interface in a Wizard of Oz setup.

The extra information offered on the tablet interface limited the variation in commands even further. By seeing feedback about the system state, users also get information about devices that can be controlled, and which states are available. For instance, in a home automation environment, users get feedback on which lights they can control, how they can address them, and which states are available (e.g. different brightness levels for dimmable lamps vs. binary on/off for non-dimmable lamps). During the tests with the tablet interface, the swabbing proved to be effective in helping users suffering from tremors, while the interface was adjusted to provide full-screen instructions during use of the voice interface, to support the training and usage process of the system.

FUTURE WORK

Our future work will involve a series of 2-week long field trials in the homes of users, offering them a way to control their television sets using a working prototype of the ALADIN system working via infrared commands. While this provides a 'plug and play' solution to integrating with existing systems, the system will not know what the infrared commands mean, so no correction is possible, and the system will not be able to share common concepts in different but similar commands (such as "*volume* up" and "*volume* down"). More work will be needed to integrate with existing systems for home automation, entertainment and ICT, such as mapping the available commands using meaningful data structures.

CONCLUSION

The results from the ALADIN project have shown that there is a lot of potential for speech interaction to improve the quality of life of people with physical impairments. Speech interaction could provide significant added value in domains such as home automation, communication and entertainment. However, the ALADIN design process has also shown that adaptation to the specific target group is necessary. To be optimally accessible, speech systems benefit from adaptation to the users' specific voice characteristics, as well as from a multimodal setup providing rich feedback and an alternative input modality.

When speech systems are adapted to the specific needs of people with physical impairments, they can become important instruments for self-care. As such, the technology can allow caretakers to focus more on the people with impairments themselves instead of operating devices. For people with physical impairments themselves, the technology can be instrumental in becoming more independent, and in achieving a better quality of life.

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Connecting the player to the doctor: utilising serious games for cognitive training & screening

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ABSTRACT
In this paper, we discuss the limitations of common cognitive training and cognitive screening methods, and examine how serious games could address some of these issues. We propose a cognitive game system, supporting self-care of cognitive health, in non-clinical settings, which can also function as a connection between the players/patients and their mental health clinician.

Author Keywords
Cognitive screening; cognitive training; dementia; self-care; serious games.

ACM Classification Keywords
H.5.m. Information Interfaces & Presentation: Miscellaneous

INTRODUCTION

Older adults often present symptoms of associated memory impairment, both for declarative and episodic memories. These symptoms can be caused by normal aging processes, but also indicate the potential development of Alzheimer's disease (AD) - the most common form of dementia [16]. Although current Alzheimer's treatments cannot stop Alzheimer's from progressing, they can temporarily slow the worsening of dementia symptoms and improve quality of life for those with Alzheimer's and their caregivers. Today, there is a worldwide effort to find better ways to treat the disease, delay its onset, and prevent it from developing [9].

Dementia is a devastating disease for the patient, their carers, and family. The cost of dementia care is also starting to have a significant impact on the healthcare systems of many countries [12]. Despite the increasing costs, and potentially because of the cost of front line care, there are limited resources available to support research into early detection and monitoring of pre-clinical patients. As a result of this, the cognitive assessment for the progression of cognitive impairments is mostly based on the passage of time rather than the cognitive performance of the patient over a specific period of time, making it difficult to track the point in time when the cognitive decline begins to takes place. Consequently, doctors treating dementia do not have the right kind of data at the right time in order to be able to help the patient most effectively. This situation, mostly affects the patients at preclinical stages and those of Mild Cognitive Impairment (MCI), which

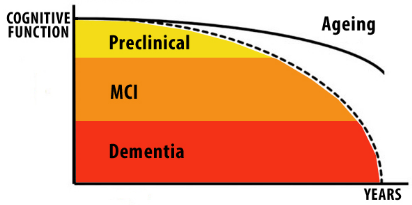

Figure 1. The continuum of normal ageing and Alzheimer's cognitive decline [19].

is considered to be the transition phase between healthy ageing and dementia [14] (Fig. 1). The progression from MCI to dementia appears to be time dependent - occurring primarily within the initial 18 months [3] - and the doctor could treat the patient more effectively with access to timely monitoring, since initiating treatment early may have significant and clinically meaningful advantages in the course of the dementia disease, for example in early clinical trials with donepezil shows potential to delay the onset of Alzheimer's dementia [8]. *Cognitive training* has shown promise as a preventative treatment in the premorbid stage. Clinicians encourage older adults to engage in self-care for cognitive health, through everyday cognitively stimulating activities in non-clinical settings (e.g. patients' homes, senior centres et al.) [21]. Another preventative approach is the identification of patient's cognitive status by *cognitive screening* in clinical settings (i.e. hospitals, memory clinics etc.).

In this work, we discuss cognitive training and cognitive screening, focusing on current limitations, and propose a cognitive game system, utilising Augmented Reality (AR), to address those problems. Through the proposed system, we are planning to further examine our research hypothesis that the introduction of Augmented Reality gaming can benefit the cognitive training and screening processes, being a tool for self-care of cognitive health and connecting the player to the doctor when that is necessary. In the context of this study, self-care of cognitive health takes the form of an active process of engaging individuals to take responsibility for managing aspects of their mental health and adopting behaviours that prevent cognitive decline. Through active participation in their health management, patients are empowered to have more control over their daily lives by purposely engaging in cognitively stimulating activities, self-monitoring and implementing a course of actions in a timely manner (e.g. visiting the mental health clinician) that can lessen or slow down the debilitating symptoms of cognitive decline [4].

COGNITIVE SCREENING: TESTS & LIMITATIONS

Cognitive impairment is measured objectively by standard neuropsychological (cognitive) tests. Cognitive screening represents the initial step in a process of further assessment for dementia and can help identify potential cases for assessment, thus leading to early diagnosis. Early diagnosis provides the opportunity for cognitive training and pharmacological management, if appropriate, with the hope of preserving or improving executive function, behaviour, and cognition [11]. Screening for dementia is usually accomplished by means of cognitive tests. The most widely-used are the Mini-Mental State Exam (MMSE) [5] for screening severe dementia and the Montreal Cognitive Assessment (MoCA) [15] for screening Mild Cognitive Impairment (MCI).

However, these screening tests present certain intrinsic limitations [11]. MMSE contains *culture, gender, and educational bias*. Additionally, patients with high premorbid intelligence or education show a ceiling effect, thus leading to false negatives. Great age, limited education, foreign culture, and sensory impairment can conversely produce false positives. Therefore, the MMSE score is adjusted for age and education [11]. Demographic based adjustments are common for the majority of cognitive tests, however the MoCA test is increasing in usage, as it appears to have less bias related to cultural and educational elements [11].

Almost all screening tests, as longitudinal and mostly static (pen and paper) measures of screening, they are susceptible to the *learning effect* and are considered to be *psychologically stressful*, presenting a risk of false positive results with concomitant distress and potential stigma for a person labelled with cognitive impairment. Furthermore, most of these tests *target specific stages of cognitive impairment*, not providing an objective overview of the patient's cognitive status (e.g. MMSE cannot be used to identify MCI). Finally, one needs to consider the capacity of local health care services given the *economic burden of increased screening* [11].

COGNITIVE TRAINING: GAMES & LIMITATIONS

Examination of the range and limits of cognitive reserve capacity (plasticity) by means of cognitive training has been suggested as a promising diagnostic strategy for the early identification of dementia, particularly Alzheimer's disease, in sub-clinical populations [6]. Furthermore, cognitive training aims to help people with early-stage dementia delay the disease's onset and make the most of their memory and cognitive functioning despite the difficulties they are experiencing, by utilising compensatory and/or restorative strategies [1]. Cognitive training shows promise in the treatment of AD, with primarily medium effect sizes for learning, memory, executive functioning, activities of daily living, general cognitive problems, depression, and self-rated general functioning [17], the retrospective and observational designs of the human studies have led to difficulty interpreting the direction of causation between cognitive function and cognitively stimulating activities [13]. To face the new challenges that arise from an ageing society, serious games are presented as a cognitive training platform to slow the cognitive decline of impaired patients.

Figure 2. Using AR cube/markers to manipulate in-game elements.

Cognitive training games present several problems and have their own limitations. Current cognitive training games *focus mainly and directly on the serious aspects*, i.e. the stimulation of the targeted cognitive functions, at the expense of the game design. Consequently, a large number of cognitive training games are *low-quality games*, not utilising the appropriate game design and game mechanics and fail to either engage or entertain the player.

From an interaction point of view, most of the cognitive training games presented in [13] suffer from multiple important limitations since they *do not fulfil perceptual and interaction needs of cognitively impaired patients* [2]. These games are designed exclusively as entertainment or wellbeing games, with a "typical user" in mind [10], which have acquired serious games characteristics through studies that test their efficacy on a group of patients. These games may be suitable for cognitively impaired patients, but are not specifically designed and targeted for them. As a consequence, many of the current serious games for dementia do not take into consideration the fragile cognitive state of the player, thus adding extra cognitive (and possibly physical) load through complicated and non-customisable interaction techniques, complex and non-adaptive game scenarios, and cognitively dense artistic design [2].

A significant limitation that runs through most of the current cognitive training games is that there is still *a gap between non-clinical and clinical settings*, that does not allow those games to act as accredited screening and self-monitoring tools for the early identification of cognitive decline, and to connect with formal care, such as medical experts. The value to the medical profession is limited by the lack of data collection and analysis related to cognitive function and status. Game performance indicators such as game score often bear little relationship to general cognitive competence.

A PROPOSED COGNITIVE GAME SYSTEM

The main idea that runs through this work is that cognitive games (i.e. games for cognitive training and screening) can potentially be a tool for self-care of cognitive health, providing cognitive exercise and self-monitoring. The proposed cognitive game system is the study object of the GameLab in Gjøvik University College and its functionality covers the preclinical and early MCI stages of cognitive impairment (Fig. 1), where the users can have subjective memory complaints, however present normal performance of activities of daily living (ADL) and normal general cognitive function, and where there is no need for formal and/or informal care.

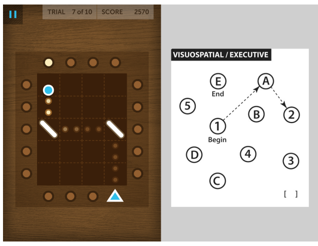

Figure 3. The Pinball Recall Lumosity game for cognitive training of working memory (*left*) and a visuospatial/executive "find the logical path" exercise from the MoCA screening test (*right*).

Architecture

The architecture of the system consists of a wearable and mobile system, based on the use of AR and on manipulating the in-game elements using hand movements. More specifically, the system consists of a pair of AR glasses and a number of AR markers (Fig. 2) for "building" the AR scene and manipulating the in-game objects. We focus on AR glasses (Google, Glass, Meta Spaceglasses et al.), since glasses are an accepted way of altering our perception of the world.

Interaction

Recent advances in technology (e.g. gestures/hand tracking, Augmented Reality, biosensors, high-fidelity Virtual Reality et al.) allow us to have several new interaction methods at our disposal. New interaction techniques can *reduce the cognitive load of in-game instructions*, *stimulate and register the physical abilities of the players*, and *provide the developer and the formal care with secondary data*. In our study, we utilise the Augmented Reality technology in order to overcome the interaction problems, related to traditional interaction techniques [2, 10] and we hypothesise that AR can be utilised to implement a cognitively-suitable interaction technique for elderly players. AR has been shown to provide a pleasant cognitive training experience for elderly players, because of its simplicity and usability of the interface, as described in the Eldergames project (presented as a mixed-reality platform) [7]. Furthermore, AR systems improve task performance and can relieve mental workload on assembly tasks. The ability to overlay and register information on the interaction space in a spatially meaningful way allows AR to be a more effective instructional medium. However, the limitations in the current calibration techniques, display and tracking technologies (e.g. the occlusion of AR markers issue) are the biggest obstacles preventing AR from being a wide-spread medium [20]. As designers, we are planning to make use of the performance gains of AR and address its problematic areas, by implementing an interaction technique for elderly players, which is based on assembling in-game elements by moving AR markers (such as AR cubes - Fig. 2) with hand movements, attempting to provide a pleasant cognitive training experience and stimulate the motor skills of the players as well. Furthermore, the collection of untrained secondary data, facilitated by the proposed interaction technique (e.g. hand movements coordinates, revealing hand tremors), provides extra data for clinical evaluation, which is potentially less effected by the learning effect of the games [18].

Content

Cognitive screening tests and cognitive training exercises have game-like elements or, at least, elements that can be gamified (e.g. Fig. 3). That alone allows us, as game designers, to *implement game scenarios where cognitive training exercises coexist with the cognitive screening ones*, developing a healthcare instrument of dual nature. The content of the proposed game is based on a set of puzzle mini-games, targeting the visuospatial, memory, attention, problem solving and logical reasoning cognitive functions amongst others. The functionality and the cognitive-related content of the games, as well as the proper interaction movements (focusing on motor skills) will be decided by the team's neuropsychologist. As examples of best practices concepts of popular and entertaining puzzle and platform games (e.g. Wooord, Threes, 2048, DragonBox), as well as gamified versions of cognitive tests' exercises, will be examined for integration and implementation purposes. *Cognitive games' content can also be dynamic*, as opposed to the static/paper version of the widely-used cognitive screening tests, thus eliminating the learning effect. In the proposed game, several levels of the mini-games will be dynamically generated and new levels will be added frequently as expansion packs or downloadable content. The dynamically generated content will be based on a validated and pre-approved set of rules for level generation, where the content will be changing but its essence and functionality will remain the same.

Intrinsic objective

A cognitive game can give the player an informal measurement of his/her cognitive performance through the game score. Taking as a prerequisite that the proposed game's content consists of accredited cognitive exercises (i.e. the mini-games), *the correlation of the game score with the cognitive status of the player* (as screened by the "gold standard" methods - the MoCA test in our case) could provide the player/patient a constant monitoring of his/her mental health. The vision of the project is a system where gaming is used as a motivational and engaging way of cognitive self-monitoring and, if indications of cognitive decline appear, the player will be notified by an in-game message to reach out for formal care and treatment. If the player is an already enrolled cognitively impaired patient, the doctor will have the opportunity to follow his/her performance, get notified of sudden cognitive changes, get supplementary secondary data (e.g. hand movements coordinates), as well as, choose the set of games that are suitable for the player's cognitive status and set the game score/performance thresholds. Consequently, the constant cognitive monitoring and screening of the player can provide the opportunity for formal care to assess the progression of cognitive impairments based on the cognitive performance of the patient and provide treatment only when necessary, *thus reducing the financial burden on the social welfare system.*

CONCLUSION

Current cognitive training and screening methods, even being of great scientific and health value, present certain limitations.

	Limitations	Cognitive games' solutions
Cognitive screening	culture, gender, and educational bias	dynamically generated, updated content
	learning effect	dynamically generated, updated content
	psychologically stressful	entertaining game experience
	target specific stages of cognitive impairment	various sets of exercises/games
	economic burden of screening/automated screening	fewer and more targeted medical examinations
Cognitive training	low-quality game design, too "serious" - less fun	entertainment is an important target, inclusion of game professionals
	no perceptual/interaction needs of CI patients	examination/use of current interaction technologies/techniques
	no link between non-clinical and clinical settings	correlation of game score and real cognitive status, connecting player to the doctor

Table 1. A summary of the cognitive screening and training limitations and how cognitive games can address them.

With the current advances in technology we hypothesise that an optimised version of the two processes can be introduced as a tool for self-care of cognitive health: cognitive games. Cognitive games can be studied not only as a mean to surpass those limitations (Table 1), but to motivate the player in order to provide himself/herself and the system with objective cognitive data. If this data is interpreted and handled correctly, they potentially can reveal the cognitive changes of the player, connecting him/her with the formal care in a cognitive-timely manner. Even though, such a project is of a long-term nature, we consider that its promising character is worth further discussion and examination.

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The Healthy Elderly: Case Studies in Persuasive Design

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ABSTRACT
Self-care and self-management are focus points in transformations in Health Care and Well-Being in The Netherlands. Citizens should live healthy and be active every day and manage their life themselves. In this context, we explore how persuasive information technology may support citizens in developing and maintaining healthy behavior. In two cases: in the Dutch cities Wijchen and Arnhem, we have designed concepts of services in co-creation with professionals and citizens. These concepts are based on persuasive guidelines and positively tested with professionals and citizens. In this paper we present these concepts and provide ideas for future work on self-care and persuasion. In particular we highlight the importance of thinking in terms of persuasion networks and experience blend.

Author Keywords
Persuasive design, co-creation, healthy behavior, blended experience, quantified self.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

INTRODUCTION
Due to demographic changes in the Netherlands - in particular an ageing population – concerns are raised about the sustainability of the Dutch healthcare in the near future. In response, three transformations in healthcare are often proposed: a shift from *care to prevention*, a shift towards *self-orchestration* of care processes by patients and a shift from *professional* to *informal care*, such as provided by families [6,7]. Inspired by the growth of the mobile market and trends such as gamification [12] and the quantified self [13], we partner with health care organizations to explore the possibilities of persuasive apps and services that support and promote a healthy lifestyle.

In the past decade a substantial body of work on the topic of persuasive technology, in particular in the context of health, has emerged. Apart from ideas, put forward by Fogg [4] and Cialdini [1], designers have tried to incorporate several (predictive) psychological models such as the Theory of Planned behavior, and the Health Believe Model into the design of persuasive systems [5]. Moreover, many intervention studies have shown how often relatively short term, targeted interventions can have positive effects on the behavior of participants.

Despite these apparent solid theoretical and empirical foundations, several authors have raised concerns about the applicability of this body of work to the design of persuasive systems [5,9,11]. Indeed, it is a non-trivial problem to translate existing theory to the design of applications that citizens will use voluntarily for a long period of time in a realistic context of use [10]. One problem is that it appears to be difficult to use the –mostly predictive- social psychological theory as generative starting point for design [5,11]. One alternative is the Persuasive System Design model by Oinas-Kukkonen et. al. [11], although quite abstract and as such it leaves much space for exploration.

We try to provide talk-back to this body of literature by executing, and critically evaluating, real-world case studies of persuasive design. We start with the challenges as put forward by stakeholders in health care who have the intention to implement the resulting applications and services. Like [9], we follow an opportunity oriented design-research approach, which centralizes the complexities of the interactions of health seeking citizens and health-providers [8,9]. In the remainder of this paper we will focus on two cases which revolved around the idea to design apps and services to persuade elderly citizens (above 50) to adopt a more active lifestyle, one with the municipality of Arnhem, the other with an health-care organization and the municipality of Wijchen. After describing the cases, we will provide a speculative discussion of our key-lessons in the project and highlight future work.

CASE 1: HEALTH-I

The case
Our first case was executed with the municipality of Arnhem. Arnhem, a middle-sized city in the Netherlands (150.000 inhabitants) wanted to explore the possibility to stimulate its citizens, in particular those above the age of 60, toengage more in physical exercise. This was a very open-ended project so we set up a radically iterative, co-creative project, using provocative prototypes in the 1:10:100 project setup [15]. The project quickly took a personal informatics –or quantified self - direction. Users were enabled to collect information about their own activity levels and the municipality could facilitate users who wanted to move more. A particular challenge was to find

the right functionality and tone of voice for this target group. Also, the role of the municipality as the persuader was discussed at length.

The concept

In the Health-i concept the elderly buy a commercially available fit-bit [2] bracelet and wear it at all times to register their activity levels. A dedicated app provides users with a personal dashboard. The dashboard has four elements. First there is a daily movement monitor, which compares the movement of the elderly with the (national) movement norm. It features a tree which grows when the elderly move more, and a status bar indicating the amount of movement compared to the norm (full circle, figure 1, left). Next to this, there is a section for achievements, the current activity status of friends (thus setting a social norm) and an activity suggestion as provided by the municipality. Other screens allow the user to browse a movement history and a more extensive overview of activities in the city.

Figure 1: a screenshot of the Health-i dashboard.

Evaluation

This project focused on the translation of the quantified-self (QS) trend to a target group which is much less tech-savy and values achieving less than the early adopters of QS solutions. Nevertheless, it seemed quite possible to make this translation: the health-I concept was created with active involvement of the elderly and its simplicity, its lowered focus on "achievement", and its friendly visual language resonated with them. The application seems to fill a niche between existing pedometers, and apps for running and other sports which provide social and self-monitoring features, like those provided in this concept.

During the project the role of the municipality as a persuader was downplayed (early, more provocative concepts, involved the system punishing users which did not move enough, for example). In the final concept the municipality contributes to the self-management of exercise by the elderly (by supporting the app) and by providing an overview of activities in the municipality.

CASE 2: PROJECT MOVERE

The case

Our second case was executed with ZZG Zorggroep de Meander, a healthcare organization in Wijchen, who wanted to stimulate moving behavior of 'young elderly' (aging 50 years or above, in particular the usage of a brand new fitness center specifically targeting this group. Like in the first case, a co-creative project with provocative prototypes using the 1:10:100 approach [15] was used to clarify the problem definition and to find opportunities for support in the community. Within the 1:10:100 framework, Service Design [14] and the Development Oriented Triangulation framework [16,17] was used to give guidance to design and research activities. Although the health-care organization originally asked us to design an app which would convince elderly who were not engaging in exercise at all ('the couch potatoes') to visit the sports-centre, during the project the scope broadened to moving in general and the target group to younger elderly in general. An opportunity was found in social support for sporting elderly in general and supporting the smooth transition of one type of activity to another, for example in the case of (temporarily) decreased fitness in particular. User research showed this was one of the problems which resulted in longer periods of movement abstinence.

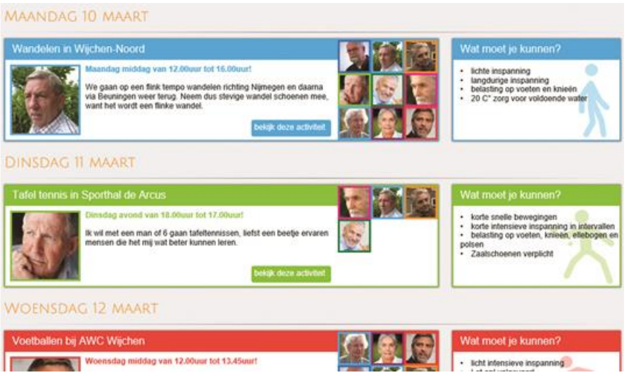

Figure 2: Screenshot of the activity calendar, showing pictures of the organizers, participants, and meta-information about the type of activities.

The concept

Central in the concept is an activity calendar, which provides an open system in which anyone, including the new fitness centre, can create an activity (Figure 2). Creators are required to specify the type of the activity (for example 'light exercise', 'short duration'), experts could be active in the community to make corrections to organizers. Users can subscribe to activities in the calendar and it is shown who has already subscribed with thumbnail pictures. This provides a social motivation to participate in the activity for users. When a user has participated in an activity it is show on his 'activity chain' which provides a record of past movement behavior and can serve as a conversation help when consulting a doctor. Figure 3 shows a screenshot of the “activity chain”.

Figure 3: The personal activity chain, shows past activities in a non-normative way, and could serve in a discussion between the user and a health professional.

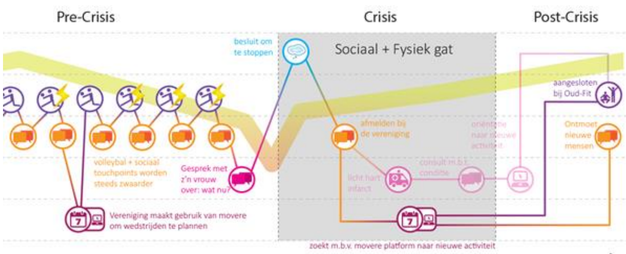

Figure 4: Customer journey depicting a scenario of a user who had to quit volleyball because of physical strain, the crisis situation is alleviated because of the activity calendar.

Figure 4 shows how the system may support changes in movement pattern. The assumption is users already use the system when doing one type of sport. Once a crisis occurs for the user, he has alternatives at hand and can choose an alternative sport easily. A consult with a professional who also participates in the system might be an extra motivation to do so.

Evaluation

Like the first project substantial effort went into finding a tone of voice in the interface which was simple and empowering. It is non-trivial to find forms, which help elderly to monitor their own behavior, without targeting achievement as a value. The ‘activity chain’ is an interesting idea because it does not imply a movement norm or target, but it can still serve as a motivator.

Also in this project the role of the health-care organization as persuader was downplayed during the project. While the original idea of the health-care organization was to stimulate citizens to come to the sports-centre which they started up, during the project they saw a more neutral role might be more effective. As anyone can participate and promote activities in the proposed platform the health care organization can be one of the voices in a network, rather than the provider and messenger at the same time.

DISCUSSION

Despite the sizable body of work on persuasive interfaces, designing sustainable self-care applications remains a challenge. The opportunities we find in the spaces between formal care, informal care, and self-care, and between prevention and care tie our stakeholders: end-users, health-care providers, medical staff, municipalities and system providers, together in new ways. This requires a mind shift of all stakeholders, and leads to complexities which are not sufficiently covered in the literature.

Towards the notion of persuasion networks

In the projects we presented in this paper we encountered a mind shift from thinking in terms of persuader and persuade to a more networked view. Our partners took a more modest role and saw opportunities in supporting the self-management of the elderly and to facilitate easy access to reliable health related information, social support from peers and initiatives in the neighborhood.

Current literature on persuasion, however, still works from the dyadic model of persuasion. Oinas-Kukkonen [11], for example, makes a distinction between 3 types of persuaders: *exogenious* persuaders, who create the technology, *endogenious* persuaders: those who give access to or distribute the interactive technology to others, and *autogenous* persuaders: the end users who adopt the technology. In a networked view on persuasion, these roles blur. In our second project the health care organization assumes all three roles – currently as creator, later as provider and at use time as user of the system-, but others play several of these roles as well.

One framework which may help in drawing a more nuanced picture might be found in Fishers’ work on meta-design and participation cultures [3] the framework allows for many roles; ,existing ones which can be mapped, or new ones which are created by the possibilities of the system of which each has its persuasive profile (see [7] for an example). Together these players and roles form a persuasion network, which can adapt to different persuasion needs of the diversity of users it may facilitate.

Experience blend as a framework for designing persuasive experiences.

While the existing sets of guidelines for persuasive systems [1,3,11] can provide a valuable resource in the design, certainly as a checklist guiding detailed design considerations, we found those to be less valuable in finding the right tone of voice and functionality for the groups we were targeting. Moreover, sustainable use of these apps may strongly on the fit of the functionality, messaging and experience design of the app in the daily life of the users, which can be achieved by integration in existing social media streams [18], or existing experiences [19].

In particular the concept of *experience blend* [19] could offer a valuable way of thinking about the design of persuasive interfaces. In [19] we analyzed several ways in which novel experiences could be blended in the lives of users: experience stacks, contextualized experiences and experience bridges. In particular the idea of experience bridges turned out to be relevant for the second case in this paper, where several uses-cases needed to be connected elegantly in the concept design. Likewise the other types of experience blend may turn out to be valuable starting points to design for persuasive interfaces.

Concluding

There are opportunities in the growing adaptation of mobile technologies to support users to stay healthy. This could relieve some of the strains of the current health-care system, provided that successful services can be designed. However, this involves designing systems that define and support a wide range of stakeholders to play a role in this shift and which can be integrated seamlessly in the life and work practices of its end-users.

ACKNOWLEDGMENTS

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The Helpstone - An interactive transitional object

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ABSTRACT

This paper describes the design of an interactive artifact for mediating communication between patients and caregivers in therapeutic situations. The device - the Helpstone - works both as a tangible interface and a very specialized mobile logging device for bridging the gap between non-clinical and clinical settings in mental health therapy. We discuss the motivation and design rationale for and the design of the Helpstone. We also explore some challenges of designing for empowering patients and providing artifacts to promote self-help and for mediating communication between therapist and patient.

Author Keywords
Transitional object, mental states, therapy, design, tangible interfaces

ACM Classification Keywords
H.5.2. Human factors

INTRODUCTION

This paper describes the design of an interactive artifact for mediating communication between patients and caregivers in therapeutic situations. The device - the Helpstone - works both as a tangible interface and a very specialized mobile logging device for bridging the gap between non-clinical and clinical settings in mental health therapy.

There are many challenges in providing suitable therapy for mental health issues. One particular challenge is how the patients can remember relevant events and psychological states that have occurred between counseling sessions and communicate these in the counseling session.

To support this process we have designed a prototype for logging the duration and severity of mental states in a very simple manner. The Helpstone supports this by being a stone-like object with tangible interface that is manipulated by squeezing. The stone records the longevity and firmness of the squeeze and the data can be accessed through a Bluetooth interface and are displayed on an app on an iPad.

In this position paper we discuss the motivation and design rationale for and the design of the Helpstone. We also explore some challenges of designing for empowering patients and providing artifacts to promote self-help and for mediating communication between therapist and patient.

BACKGROUND AND RELATED RESEARCH

The Helpstone is designed with recognition of that the therapeutic situation transgresses the immediate counseling session. One approach for transferring the therapy into the everyday life of the patient is through the use of transitional objects. In psychology the concept of a “transitional object” or “comfort object” refers to an object used to channel feelings and emotions [1] [2]. A teddy bear, for instance, is a transitional object representing the mother at a pivotal time in a child’s life. Therapists use the same psychological effect by offering patients an object that represents the therapist, a person the patient trust, to be brought anywhere the patient goes. These objects often take on the form of something familiar to the patient. Commonly it may be an object of some sentimental value or something they like to hold or feel. In a qualitative study [2] Arthern et. al. document the use of cloth dolls, stones, pressed flowers, soft toys and jewellery, and discuss how these can work as transitional objects. In their study they further explore different ways the transitional object is subject to holding and what the holding of the object can represent in therapy.

The Helpstone is being designed to accommodate the properties of being an interactive transitional object.

It is well established that depression impacts memory performance [3]. This carries over to communication between patient and therapist. Because depression and other mental health issues can impair recollection, it can be difficult for the patient to give an accurate account of the events in the period since the last counseling which may lead to a reduced quality of the therapy. One way to address this issue can be to introduce some kind of logging device for the patient.

Typically, wristbands and other wearable devices [4] contain biometric and other sensors that can automatically log everything from movement to heart rate and perspiration. While there might be tight correlations between different psychological states such as stress and biometric indicators, such logs often require some kind of interpretation in order to be translated into psychological states.

In addition to the challenges of interpretation [5] and translation of these data, there is a risk of data overload and the generation of huge amounts of quite general data. The approach of using deliberate interaction with the wearable device or a mobile device (such as an interactive transitional object in the form of a stone), on the other hand, leads to challenges of how to design the interaction, and the need to attach a predefined meaning to the given interaction type. Deliberate interaction also requires some sort of attention and conscious manipulation from the user and this might be challenging in some cases, especially in stressful situations such as during anxiety attacks. The upside to this kind of deliberate interaction is that the data is easier to analyze and understand, and more manageable in that it is generated for a given purpose and given a predefined meaning.

DESIGN PROCESS

The Helpstone has undergone a design process in several steps. At the earliest stage we sought to verify the concept with professional therapists. We visited a regional health centre, Vestre Viken HF (VVHF) and had access to a panel of leading national experts in topics of drug abuse, youth-, adult -and severe mental health diagnoses.

A rough (but functional) prototype explaining the concept was presented. The prototype allowed squeezes of differing strength to be shown on a laptop screen. The panel evaluated and discussed the features, potential use and improvements before we attempted to refine the concept further.

Figure 2: A panel of experts at VVHF evaluating the initial prototype of the Helpstone. The highlighted section shows a ball of thick tape containing a sensor and electronics capable of transferring squeezes over USB to a laptop.

Based on the feedback from this discussion we formulated a set of design principles to guide the design of the next Helpstone prototypes.

This process has had an iterative evolution in aspects of materiality, functionality, form factor, technological constraints, practicality and usability in relation to these principles.

THE HELPSTONE - KEY PRINCIPLES

The design principle behind the Helpstone in general is to make it as easy to use and intuitive as possible. When designing the stone we have followed a few key principles.

- It should invite squeezing
- Everyone with hands, (gender and age independent) should be able to squeeze it with some force, and the stone should sense it
- It should be comfortable to squeeze, in the sense of traditional transitional objects
- It should not have any other complicating features

Figure 1 illustrates the basic components of the Helpstone conceptually.

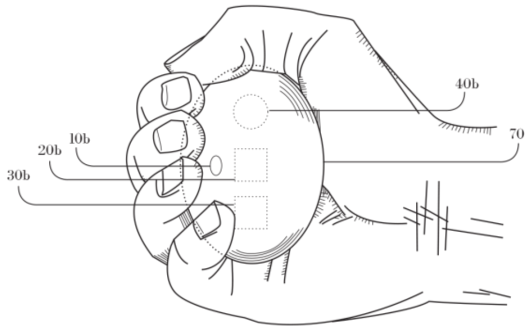

Figure 1: The components are (10b) - feedback-device, (20b) - battery, (30b) - controller unit, (40b) appropriate sensor - a casing (70b). The user simply holds it in its hand and squeezes, the length and at what time the user squeezed is stored.

Inviting squeezes

The casing for the electronics has undergone a design process (Figure 3) with the aim of capturing some key qualities of a stone (Figure 4) and what we call “squeezyness”. Shape and material type is essential in this regard. The weight of the object and how the stone feels in the hand has been important in the design process. We have experimented with different 3D printed materials (alumide, ceramics, sandstone and biodegradable plastic), vulcanized plastics and regular cut natural stones.

Additionally, different materials for seals (rubber, silicone, tape) have been tested to evaluate the overall squeezyness and properties for the casing.

Figure 3: Material prototyping - Left: Blade cut stones hollowed out with diamond tip. Right: Vulcanized plastics

Figure 4: A collection of stones used as inspiration, each with its own characteristics in regards to roughness, look and feel.

Universal access

Shape and hand strength is individual. Hence the shape of the stone should be comfortable to use for different hand sizes. Additionally, the sensor in stone should be able to sense and provide acceptable resolution of weak and strong squeezes (Figure 5). Low pass mechanical filters will allow us to use our sensor and calibrate it for users with exceptional weak hands.

Figure 5: Different sensors have been tested to experiment with how one can best capture a squeeze and still allow a simple design. This particular sensor (load-cell) was accurate, however it did not perform at par with other sensor types tested.

Comfortable

To make an impersonal object have the qualities of being experienced as comfortable is a difficult task. Achieving this will require a combination of design and therapist involvement. The therapist needs to describe the purpose of the stone to the user in such a manner that it takes on the properties of a traditional transitional object in this sense.

No other features

Perhaps the most important part of the design process was to resist adding in more features. It was tempting to add GPS, vibration/audio/light feedback more buttons and anything else one associate with life-logging devices. However, adding more features - we believe - would lead to negative user acceptance. The reasoning behind this is that the users should not be forced to understand anything besides “squeezes will be stored” everything else should be hidden from the user.

To truly hide technology we decided to go for a wireless solution in terms of both charging and transfer of data. The device should be able to work for a month and we will incorporate wireless charging and communication to eliminate connectors. Figure 6 shows an early (and discarded) breadboard prototype of the Helpstone, implementing wired communication while Figure 7 shows the latest prototype with wireless communication over Bluetooth Low Energy.

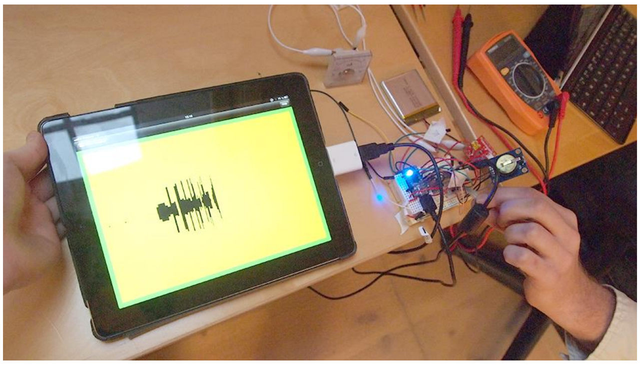

Figure 6: Wired prototype communicating with an iPad over the MIDI protocol.

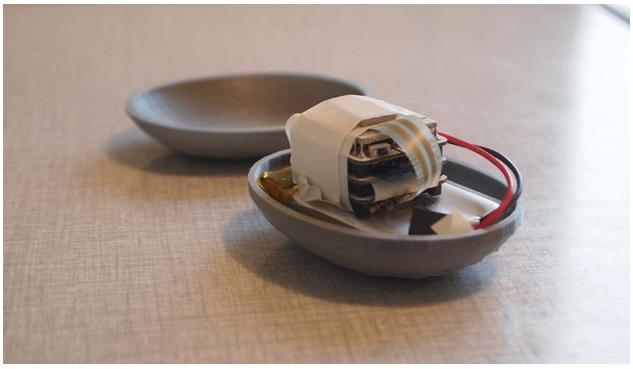

Figure 7: A late stage prototype for testing sensors, energy consumption and low power features in a small form factor.

USE CASE

In collaboration with a therapist a client is given a Helpstone to chart mental states. The therapist explains to the client that the stone stores how hard and how long it is squeezed (Figure 8). Together they agree that this week they will try to chart when the client feels anxiety so they can get a grasp of when and for how long these feelings occur. When anxiety appears- a light sqeueeze, stronger anxiety - hard squeeze, when it is overwhelming - harder still.

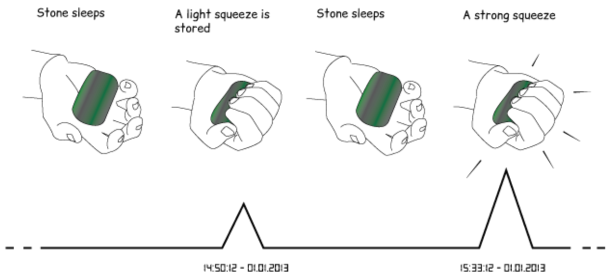

Figure 8: The interaction sequence required to effectively use the Helpstone.

When the client shows up for a therapy session the next week, these episodes appear as an understandable visualization on an iPad. This information provides the basis for discussing this week.

The end result is - we believe - that user gets an understanding of own therapy and the communication with the therapist will improve and be more fruitful.

CONCLUSION AND FUTURE RESEARCH

This position paper has described the design of what may be called an interactive transitional object. The prototyping stage of the design process is about to conclude and manufacturing of a collection of stones intended for real world application in a small municipality in Norway is about to commence. Parallel to this activity the software for visualizing and representing squeezes will be developed.

This brings about new questions that need to be answered. How can we represent squeezes in a therapeutic setting that will give meaning to patient and therapist? How should we proceed to evaluate the stones with regards to user experience and utility? Can the stone be incorporated in existing therapy or would it require a new approach to using transitional objects in therapy?

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Transforming Healthcare Delivery: ICT Design for Self-care of Type 2 Diabetes

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ABSTRACT
In this position paper we present an on-going case study where the aim is to design and implement mobile technologies for self-care for patients with type 2 diabetes. The main issue we are addressing in this paper is how to bridge clinical and non-clinical settings when designing self-care technologies. Usability, User Experience and Participatory Design are central aspects of our research approach. For designing with and for patients in home settings and everyday life situations, this approach has so far not been problematic. However, when it comes to designing with and for user groups located within a large healthcare organization, in a highly institutionalized clinical setting, the situation is different. We have recently introduced the Health Usability Maturity Model (UMM) to our project partners as a potential tool for bringing usability and participatory design issues to the fore as strategic assets for transforming healthcare delivery with ICT.

Author Keywords
Participatory Design; Usability; User Experience; mHealth; Self-care technologies; Type 2 diabetes; Usability Maturity Model

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION
In this position paper we present an on-going Swedish case study where the aim is to design and implement mobile self-care technologies for patients with type 2 diabetes. The case study is part of a three-year Indo-Swedish research and development (R&D) project, *Health in Hand – Transforming Healthcare Delivery*, where the overall aim is to contribute to transforming healthcare delivery through innovative mobile technologies which support and promote self-care. As the project started in 2014, we are still in the first round of an iterative process of mobilizing user involvement and mapping user needs, while simultaneously exploring existing self-care solutions for type 2 diabetes before deciding how to proceed with iterative prototyping.

The main issue we are addressing in this paper is how to bridge clinical and non-clinical settings when designing self-care technologies. Usability, User Experience and Participatory Design (PD) are central aspects of our research approach. Concerning design with and for patients in home settings and everyday life situations, our use-centered and situated approach has so far not been perceived as problematic. However, when it comes to design with and for important user groups in a clinical setting, i.e. healthcare professionals and hospital staff, who are expected to support and make effective and efficient use of the self-care technologies in their everyday work practice as part of their role in healthcare provision and delivery, the situation is different. It is proving to be a considerable challenge to bring usability and participatory design issues to the fore in a highly institutionalized clinical setting where work practices, legacy systems and traditional division of labor between different professional roles, as well as established ways of communicating with patients, all seem to pose formidable barriers to alternative ways of doing things with technology for supporting self-care. To meet this challenge and lever participatory design in clinical settings, we have introduced a conceptual management tool for bringing usability issues to the fore as strategic assets for transforming healthcare delivery with ICT: the Healthcare Information and Management Systems Society’s (HIMSS) Health Usability Maturity Model (UMM), which was developed by the HIMMS EHR Usability Task Force in 2011[1].

In the following, we present experiences so far from the Swedish case study. We then present the HIMSS UMM and how we plan to make use of it in our project. Finally, we conclude the position paper with a short list of questions we hope to be able to explore and discuss further during the workshop.

EXPERIENCES FROM THE SWEDISH CASE STUDY
The Swedish case study is being carried out in collaboration with the county council, one of the wards of the county hospital medical clinic, and with people living in the region who have been diagnosed with type 2 diabetes and who have volunteered to take part in the study. We are also collaborating with four industrial partners, of which three are small local enterprises. The fourth is a large consultancy

company in the ICT sector with the health sector as part of their customer base.

We are currently mapping out information and communication flows and work practices within the involved hospital ward and between the hospital and their patients with type 2 diabetes. The case study is focused on self-care technologies for type 2 diabetes. This includes supporting secure, effective and efficient communication between healthcare professionals and patients in ways that support good health for the patients, high quality healthcare provision as well as a manageable work situation for the healthcare teams.

Our field studies so far have raised issues about how to design for integrating self-care technologies into a clinical setting focused on hospital-based healthcare delivery. The Swedish county hospital we are collaborating with provides a work environment for its staff where legacy systems, firewalls and local ICT policies limit and restrict what is perceived as possible to change and what is possible to implement. This is not a unique situation in healthcare organizations today, even though the Swedish healthcare sector is in many ways considered to be at the forefront in using technology to enhance healthcare delivery.

Using ethnographic field-study methods (individual and group interviews, observations, shadowing), we are now mapping current work practice and communication flows from the healthcare provider's perspective within the ward of the medical clinic at the county hospital, in parallel with doing field-studies of everyday life for patients with type 2 diabetes. What we have discovered so far from our field-studies in a clinical setting at the county hospital is that there are many problems with the current technologies in use, and not least with the firewall in the hospital, which are causing great frustration among healthcare staff (see Figure 1).

Types of ICT problems encountered by staff
I. Problems related to IS log in and to ID card usage
II. Lack of IT support outside of office hours
III. Lack of integration between different systems, resulting in repeated updating of identical information
IV. Firewall regulations vs communication w patients

Figure 1. Problems with technologies in in-clinic everyday use

Just to give one example, which is particularly relevant to our specific case study; many patients are proficient with smart phones and e-mail, and could easily send their blood values etc. via a mobile app or a digital form attached to an e-mail. However, the fire wall and security regulations within the county hospital do not allow this. Instead, patients are expected to use a website which requires a digital ID (which many patients do not have and do not want to use, or find difficult and time-consuming to use). The designated web site does not allow for communication that includes attached files. This means that blood values etc. are sent in unformatted free text through the web site, resulting in difficulties for healthcare staff to interpret important and potentially health critical information correctly. This is just one of a number of usability issues with existing ICT in in-clinic use that we have encountered in our field studies and that could negatively impact self-care technologies. (Type IV according to our first rough draft of categorization of usability issues, see Figure 1).

Type I Problems related to IS log in and to ID card usage can be further divided into sub-categories, such as problems with having to log in to a multitude of different systems with different passwords repeatedly during every single day, despite the IT department having promised that the personal ID card which is mandatory in order to access the intranet would solve this problem. Another sub-category of Type 1 problems is related to the personal ID card itself: it is necessary to keep the card in the card reader while working with ICT. But healthcare staff are constantly on call, and it is easy to dash off, forgetting the card in the card reader. This is a security risk, as someone else could access the system while you are gone. But it is also a logistic problem, since the ID card functions as a personalized key to locked spaces all over the hospital, such as to different wards, to medicine cabinets and dressing rooms. If you forget your ID card in your card reader in your office, you cannot get through the doors to where you are going, which you often do not discover until you have run through a number of corridors and gone up and down in various elevators to reach where you were going, only to find you forgot your ID card and cannot get through the door. If you are lucky and someone is around who can let you through the door, you still cannot access the information system, should you need to do so, because your ID card – mandatory for logging in on the system, no matter where you are in the hospital – will still be in the card reader on your desk in your office.

The solution would seem to be not to forget one's ID card, i.e. to always keep it at hand. However, there is another subcategory of Type I, where this does not solve the problem. When you try to access the system from a location and a computer which you do not use very often, or instance from an emergency room when you are a doctor on emergency call, the log in process can take an extremely long time. This seems to have something to do with the individual work station rather than with the intranet. In an acute emergency situation, the slow "chewing" of the ID card log in before it allows access to the system could mean the difference between life and death for a patient. This is when you might try to call the IT support function for help. Which brings us to the Type II problem (see Figure 1)..

Type II Lack of IT support outside of office hours might seem like an unlikely problem to encounter in a large county council hospital saturated with expensive, high-tech ICT solutions, hundreds of employees working at all hours of the day and night and hundreds of hospitalized patients heavily dependent on the technologies in use. However, it is listed by the staff as a both serious and frustrating problem in everyday healthcare provision.

An example of type III problems (see Figure 1) is that identical information about a patient is updated manually in a number of different systems. Not only does this cause extra work and frustration, it is also a security risk in that the information may deviate across different systems.

It quickly became clear to us that if we simply brought in yet another stand-alone application to be tested in a clinical setting at the county hospital, we would be adding to the frustration and heavy work load of the healthcare professionals rather than supporting their work. Thus, we decided to "take a step back" and map the current obstacles and challenges to transformation of healthcare delivery with self-care technologies. We aim to document and discuss current usability issues, and possible solutions to at least a few of these, with the county council IT department before introducing a prototype for self-care of type 2 diabetes in the medical clinic. As one of our industry partners provides several of the central information systems currently in use in the county hospital, the aim is to initiate collaborative efforts towards improvement of the current situation through giving voice and visibility to some of the usability issues experienced in everyday work life by the healthcare professionals. By improving the current situation through one or two modest interventions, we hope to pave the way for user involvement in Participatory Design workshops with patients and healthcare professionals in the autumn of 2014. In this way, we aim to address the gap between clinical and non-clinical settings through participatory design of the first prototype of a self-care solution for patients with type 2 diabetes. In order to gain organizational support and acceptance within the county council for this approach, which is admittedly wider and more invasive in the clinical setting than we had initially planned, we have introduced the HIMSS UMM to our project steering committee and project partners as a tool for change.

INTRODUCING THE HIMSS HEALTH USABILITY MATURITY MODEL (UMM)

After the first interviews and workplace visits at the hospital ward, it became obvious that we needed added leverage for motivating and supporting change from within the healthcare organization itself. The American Health Information Management Systems Society (HIMSS) has recently presented an adapted Usability Maturity Model (UMM) [1, 2] for leveraging user experience to be a strategic asset in health organizations. One of the authors of this position paper has been visiting and collaborating with researchers in the U.S. who have been central in developing the UMM for health organizations and thus has gained insight in to how it is being applied on a large scale with the aim of "transforming health through IT". We therefore decided to test this model with our project steering committee as a shared model for moving ahead in the case study. The steering committee, which includes representatives of the public healthcare sector and IT and health service providers as well as of all the involved research disciplines, approved of the idea of using the health related UMM and focusing on usability and user experience as strategic assets in the continued work with defining problems, goals and requirements in the *Health in Hand* project. The service providers could clearly see the benefit of driving this development themselves in close collaboration with the county hospital and on-going research on innovative self-care technologies. On our side, we see the UMM as a potentially powerful lever for high-lighting Usability and User Experience on a strategic level in healthcare organizations and thus providing space and support for participatory design that can bridge clinical and non-clinical settings in our case study and beyond.

NEXT STEPS IN THE CASE STUDY

As one of the anonymous reviewers of our workshop paper pointed out, it would be interesting to explore the needs from the "outside in". How necessary is it for patients who are trying to manage their type 2 diabetes to have access to information which is currently locked in behind the firewall and only accessible for healthcare providers, and primarily, even for these professional users, only in clinical settings? That is actually part of what we plan to study in the next steps of the case study, when we will be doing field studies of patients' everyday lives and their perceived needs and requirements for mobile support for self-care.

TO DISCUSS AT THE WORKSHOP

Why do self-care technologies need to be designed to work in both non-clinical and clinical settings? Is it a good idea to mix patients and healthcare professionals in the same self-care technologies design workshop? Is the Health UMM a viable tool in a PD toolbox?

ACKNOWLEDGEMENTS

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Wellness Self-Management in Older Populations

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ABSTRACT
This position paper describes ongoing work in the design and evaluation of a self-care application for older adults to support general wellness. We report on findings from a 5-month field study with 7 participants, which provided rich insights and a greater understanding into older adults' attitudes and behaviours in relation to wellbeing self-management. We highlight case studies of two participants - one of whom embraced the application and continued to use it beyond the trial period, and one who dropped out of the trial early, indicating some reasons behind both.

Author Keywords
Older adults; wellness; self-care; health promotion

INTRODUCTION

Globally, human populations are ageing [6] and there is a significant cost element to the health care of older adults. Supporting older people where they live and in an environment that will adapt to their needs as they age by reducing hospital visits is a pressing need and represents a critical challenge to the health care system of the future.

Related to this, there is an increasing realization that health care for older adults needs to move beyond its current focus on disease management to a more holistic and preventative approach. Much of the literature around self-care technologies for older adults focuses on management of chronic illnesses, but ignores associated issues such as effects on mood, social wellbeing, sleep etc. [5, 9]. There is also little research on what might motivate older adults to look after their general wellness. While one might expect there to be higher levels of intrinsic motivation to self-care for chronic disease management, challenges exist around how to motivate older adults to look after general wellness, as part of a more preventative approach. Additional questions that need to be addressed include whether older adults are interested in technology-supported self-care; whether they want to view their own data, and whether educational advice is of benefit to them.

This paper reports on findings from a 5-month deployment of the application. Some results from this deployment were presented elsewhere [4]. However, this paper provides additional insights and reflections and in particular compares case studies of two participants – one of whom embraced the application and continued to use it beyond the trial period, and one who dropped out of the trial early.

THE YOURWELLNESS APPLICATION

YourWellness is an application that has been designed and developed to support older adults in self-reporting on their wellbeing and provide feedback to promote positive wellbeing management. While incidences of chronic illness are high in older adults, and while monitoring of physiological symptoms is important, what is often ignored are the associated health issues, such as effects on mood, social interactions, physical activity or sleep. YourWellness aims to provide a holistic approach to self-care.

YourWellness users can self-report on up to 6 aspects of wellbeing including, for example, sleep, mood, social interactions and nutrition. For each area of wellness, (1) a series of questions can be asked of the person and (2) a library of multimedia educational content exists that can be pushed to the user daily, in real-time. Figure 1 shows the main elements of the app. A feedback 'wheel' provides a quick-glance overview of wellbeing. The wheel is divided into segments, representing the parameters of wellness that are being monitored and uses the traffic light metaphor as a high level indicator of wellbeing status – green for good, orange for not so good etc. Clicking on a segment brings the user to a graph of their data. A personalised educational message is also delivered daily. YourWellness has been iteratively refined based on feedback from older adults [3].

Field Study

We deployed YourWellness to 7 older adults (5M, 2F), aged 65-77 and conducted an evaluation after 5 months of usage. These participants had not been involved in the design process. The purpose of this study was to examine long-term adherence to self-reporting in an older population, to gauge opinions on whether the application

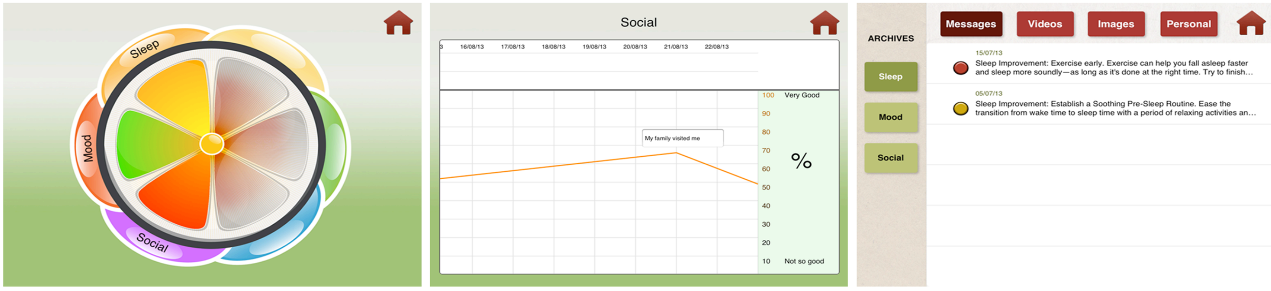

Figure 1. The YourWellness Application (a) Overview feedback wheel (b) Graph data for self-reported social interactions (c) Educational advice messages

increased awareness of one's wellbeing, whether it encouraged people to alter their behaviour in some way and whether people found the application, particularly the feedback provided, useful and usable. We informed participants that they would receive a set of questions daily, but that they should answer them whenever they wanted to or could. We also said the initial trial period was 2 months, but there would be an opportunity to continue using the application, if the participant chose to. We were interested in measuring 'real-world' adherence to self-reporting and usage, rather than forced usage. After 5 months, interviews were conducted with all participants, and participants filled out two questionnaires – the System Usability Scale (SUS) [1] and the Intrinsic Motivation Inventory (IMI) [2]. Further details on the application and the study are outlined in [4]. In this paper we outline some of the main findings from this study and provide additional insights beyond [4], in particular highlighting and contrasting the experiences of two participants, one of who's usage of the application led to a clinical diagnosis.

FINDINGS

In this section we discuss two case studies and provide an overall summary of our findings from the deployment of YourWellness. Figure 2 shows the daily percentage adherence of participants throughout the trial. Our case studies discuss *Brenda, who dropped out of the trial before the end of the 2-month study period and *John who continued to use the application beyond the 5-month trial.

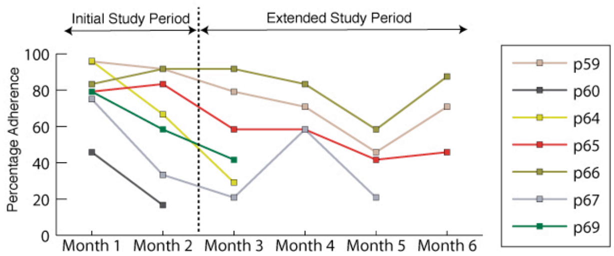

Figure 2. Daily adherence data for the trial period including data for John (p59) and Brenda (p60)

Case Studies

John's Experience

John is a 67-year old man who took part in our trial. Like the other participants, John was interviewed about his experience 5 months after first deployment of the application. However, 4 months after the exit interview, John phoned the lead researcher of the project. John had continued to use the application on his iPad following the end of the formal study. After about 8 months of usage, John noticed that his graphs were *"a little bit all over the place"*, meaning that one week he might be reporting good wellbeing, the next week reporting poor wellbeing. John said that reflecting on his data made him realize that something wasn't quite right. So John went to see his doctor and was eventually diagnosed with cancer.

	Success (*John p59)	**Failure (*Brenda p60)**
Age	67	69
Length of usage	> 8 months	< 2 months
Daily adherence	80.7%	31.5%
Usability score	90/100	75/100
IMI – Interest / Enjoyment	4.7/7	5/7
IMI – Perceived Competence	6.8/7	6/7
IMI – Pressure / Tension	1/1	1/1
IMI – Value / Usefulness	6.25/7	6.75/7
Understanding of design elements	Very good	Poor
Integration in to daily life	Very good	Poor

Table 1. Comparison of data for 2 participants

At this point, John agreed to take part in a follow-up interview with the researcher. He said that reflecting on the graphs on the YourWellness application had heightened his awareness that something wasn't quite right with his health. In his previous exit interview, John had talked about understanding what caused dips in his graphs: *"So one time I got a dip in sleep and I know why it was. I had to go to the airport at 5.30 in the morning to pick up my daughter. So I couldn't sleep that night in case I slept it out."* When he got to the point where he didn't understand the dips, he began to ask himself questions. He said it prompted him to visit his doctor.

In terms of John's experience of using the application throughout the trial, other factors that contributed his continued usage of it included its easy integration into his life as well as his understanding of the concept and design of the application. In terms of integration, John adapted usage to suit his own needs. John found answering the questions and viewing the graphs to be more useful than reading the messages. This may be partially due to the repetitive nature of the messages on which John commented: *"They're useful, and they're common sense. But when you get the same types of ones over again, you're not going to read them."* However, John also noted that the questions were also repetitive, yet he continued to answer them as he found the graphs his answers generated to be useful. The type of device also had an impact. John spoke about how the iPad was *"always on the coffee table. We'd* (John and his wife) *always have been people where the computer is in a separate room. I couldn't get over how much we both used it* (the iPad)*."*

In terms of design and usability, John found the application easy to use, scoring 90 out of 100 on the SUS. John was one of only 2 participants who understood the use of the traffic light metaphor to indicate current wellbeing status. While he rated the application low on the interest/enjoyment scale of the IMI, he rated it high for value/usefulness.

Brenda's Experience

In contrast to John, Brenda - a 69-year old woman who participated in the trial - dropped out of the trial early and furthermore, her adherence to self-reporting during the 2 months that she took part, was very low. Looking at Table 1, there are little differences between Brenda and John's IMI scores, but the usability scores differ somewhat. Furthermore, during Brenda's exit interview it became apparent that she didn't understand many of the design elements, such as the use of traffic light colours to depict wellness state, despite this having been explained when the application was first deployed. She commented: *"Would they* (the traffic light colours) *relate to your personality? Usually nice bright colours are associated with lively people."*

The main reason Brenda reported for dropping out of the trial was that the application, in particular the questions being asked, weren't currently relevant to her life. Some of the social wellbeing questions asked about satisfaction with interactions with neighbours. However, Brenda lived in a rural location and reported that she would rarely see her neighbours. Thus, she was unsure of how to answer this question, which on occasion caused frustration.

Brenda also thought that the purpose of the application was more medical than preventative wellness. She spoke about how she didn't need such a medical application as she was currently healthy: *"I think it could be useful at a certain stage. But not for me at the moment. That's not to say I wouldn't need it in twelve months"*. Brenda also felt that *"a medical check every 12 months or two years is enough."* She didn't see the benefit of it for someone who wasn't ill. A further question raised by Brenda concerned the trustworthiness of the wellness advice messages delivered through the application.

Summary of Other Findings

Further insights gained from the trial, as outlined in [4] are included in Table 2.

All 7 participants reported an interest in self-managing their wellness, but aspects that are important to them personally. There must be a gained benefit.
6 of the 7 participants said self-reporting encouraged reflection and therefore increased awareness of wellbeing. These participants viewed this as a positive thing. Research by Li supports this: he found that maintaining a diary alongside sensorised data collection of activity levels made participants more aware of their physical activity levels [17, Chapter 3].
Long-term adherence is likely going to be achieved by keeping the application personal and 'fresh' – i.e. ensuring questions and feedback are not repetitive, are engaging and introducing something new each day, such as an interesting quote, joke or trivia question. All participants commented on the repetitive nature of the application. 5 of the 7 participants rated interest/enjoyment of the application as average (only 2 rated it as high).
4 of the 7 participants made reference to 'clinically' worded questions causing confusion or having potential to stir up negative emotions.
Designing feedback that is easily interpretable is important. In the case of YourWellness, line graphs were easily understood and the preferred method of feedback for 5 of the 7 participants. Graphs allowed participants to 'dig deeper' into their wellbeing trends and to reflect on anomalies in their data.
Supporting the provision of context, through user annotations for example, is important to facilitate reflection on past events that might have caused a change in reported wellbeing. This was highlighted by 3 participants. The importance of context in supporting interpretation of anomalies in behaviour has been highlighted in previous studies [7].

Table 2. Additional Findings

DISCUSSION

Considering John and Brenda's experiences, and taking into account our other findings, we outline in this section some important things to consider when designing wellness self-care applications for older adults.

Re-thinking 'Adherence' for Preventative Wellness

At the outset of the trial, measuring adherence was one of our primary goals, as we wanted to learn how we might motivate future usage. The starkest contrast depicted in Table 1 is that of the vastly different adherence levels for Brenda and John, and reasons for this are outlined in the previous sections. However, it is also worth asking what defines 'adherence' to usage of such an application? There is little existing research to provide guidance on how often preventative applications should be used to ensure benefits to the person. Should participants report on their mood daily? Is once a week enough? How often should they view their feedback?

With current clinical practice, such questions around quality of life, satisfaction etc. are only asked at a clinical visit, which is often triggered by a health event. For example, a person has a fall, attends a GP or clinic, and a series of questionnaires will be completed. At this time, the clinician may also provide some advice on self-care, for example how to prevent a fall. However, in between such events, no wellness information is captured and no new education is being delivered to support self-care.

We argue that any additional information reported in between is useful, as it prompts reflection. Furthermore 'dipping in and out' is natural and ensures easier integration into one's life. This type of usage is often seen with many quantified-self technologies, such as Fitbit or Nike+, where usage patterns naturally change over time, particularly if the user has a busy period at work or is ill, for example. Therefore, it may not be necessary that wellness applications are used daily, or even weekly, but that they are used as much or as little as the person wishes. However, more research is required to determine how designers might motivate older adults to use self-care technologies that focus on prevention rather than management.

Personalised Wellness

Very closely related to the discussion on adherence, is motivation. In terms of managing chronic illnesses, motivating adherence is important and much design research for self-care technologies focuses on how best to motivate and encourage behaviour change [9, 10]. In such cases, there is an immediate benefit in self-care – you become more aware of your condition and how to manage it and you can ultimately prevent a health event from occurring. But how can we encourage a more holistic approach to self-care, making it appeal not only to those who have a condition to manage? How do we educate potential users that continuous as opposed to episodic monitoring is beneficial? As indicated by Brenda's exit interview, she didn't see the benefit of the application beyond what was provided by her yearly medical checks. However, she indicated if she could monitor her diet and nutrition, that this would be more appealing. Furthermore, John's experience provides a strong case of how things can change over a relatively short time period and why usage of such an application is important. Therefore, users of wellness applications should be able to tailor or personalize the application and its content to suit their needs.

CONCLUSION

Our findings have potential to contribute to a greater understanding of older adults' attitudes and behaviours in relation to wellbeing self-management that can facilitate the creation of new, personalized health and wellbeing interventions for this population. In future trials, we will evaluate health/wellness benefits through standard clinical questionnaires administered pre- and post- trial in addition to examining motivation and sustained behaviour change over time to determine guidelines around how to motivate preventative wellness management.

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