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The Healthy Elderly: Case Studies in Persuasive Design

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Abstract. Self-care and self-orchestration are focal points for transformations in health care and well-being in the Netherlands. Citizens should live healthily, be active every day and manage their own health. In this context, we explore how persuasive information technology may support older people in developing and maintaining healthy behavior. In two cases (in the Dutch cities Wijchen and Arnhem) we designed concepts of services in co-creation with professionals and citizens. These concepts were based on persuasive guidelines and positively tested with professionals and citizens. In this paper, we present these concepts and critically examine them in relation to existing literature on persuasive technology and personal informatics. We argue for backing persuasive interface with genuine support for user needs and for increasing the actionability of personal informatics solutions. The presented solutions also highlight how self-, family-, and professional care can be connected in the design of health support systems.

Keywords: self-care, persuasive computing, co-creation, behavior change, social computing

1 Introduction

Due to demographic changes in the Netherlands — in particular an aging population — concerns have been raised about the sustainability of Dutch health care in the near future. In response, three transformations 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 that provided by families [1,2]. A growing aging population is adapting to managing their own health and we can support them with applications that bolster their self-regulation and personal health agency. Designing such systems, however, first forces us to reconsider how we frame the users of these types of systems.

Peter Jones, for example, proposed replacing the notion of *patient* with that of *health-seeker* [3]. Health-seeking is a continuous process of taking steps towards better health. It is a *constant* and universal need, just like 'pleasure seeking' or 'status seeking.' The need for health-seeking is individual and relative: one does not have to be ill to aspire and act towards better health.

Inspiration for the design for health-seeking may be found in patient-driven health care developments. Swan identified three of them: *health social networks*, *consumer*

personalized medicine and *quantified self-tracking* [4]. For the context of this paper, health social networks and quantified self-tracking are important developments. *Health social networks* (such as 'patients like me'), which originally focused on providing emotional support and information sharing, now offer higher-level services such as access to reliable health information through physician question and answer sessions. Health social networks are a change agent in health care, because within these systems patients meet and self-organize to improve care. However, health social networks tend to be somewhat disconnected from regular health care as health agencies need to adjust their work processes to be able to incorporate such networks [3,4].

A second trend identified by Swan [4] is *quantified self-tracking*. Quantified-selfers use self-tracking technologies to meticulously measure and keep track of information about their lives. This group can be described as 'extreme users' who are willing to overcome the limitations of current technologies to reap the perceived benefits of self-tracking [5]. Choe et al. listed improving health as one of the most important motivations of quantified-selfers to engage in self-tracking [5]. Despite their level of organization and enthusiasm, this group of power users runs into challenges such as keeping track of too much information, failing to capture the context that allows them to make sense of the available information and applying insufficient scientific rigor to their tracking behaviors [5]. Such challenges are a hindrance to adoption by a broader audience. The development of quantified-self technologies could be valuable for a larger group of people and it may play a role in health related prevention if the tools can be made more accessible and better embedded in the social context of the health-seekers. Patient-driven health care gives an outlook towards the type of solutions that may support health-seekers if the disconnects between regular health care and such solutions can be resolved.

The work described in this paper fits into a line of work that targets the connection between health care and individual health-seekers. We partner with stakeholders in health care to explore the possibilities of designing apps and services that support and promote a healthy lifestyle and are tailored for a general audience. We follow a research through design approach, which aims at producing novel integrations of human-computer interaction (HCI) research in an attempt to bring about change, and at learning through critical reflection on the design [6]. We build on literature about persuasive interfaces [7] and personal informatics [8,9]. Our health care partners intend to implement the resulting applications. Therefore, we tackle the problems in their full everyday complexity, stay close to our stakeholders' needs and limit ourselves to solutions that can be implemented with off-the-shelf technology. The user-centered design cases in this paper have not yet been implemented and tested, but they offer an outlook on the opportunities that lie in the spaces between formal, informal and self-care, and between prevention and care. Moreover we offer a critical reflection and talk back to the existing literature: in particular, to work on persuasive interfaces and personal informatics.

The paper is structured as follows. We will first discuss strategies for the design of self-care applications in the literature. Next we will describe our general opportunity-oriented design approach, after which we will describe two design cases. Finally, we will discuss them in relation to existing literature.

2 Related Work

To address the challenges set by our health care partners, we turned to work in HCI on *persuasion* and *personal informatics*. The possibility of using technology to persuade people to change their lives for the better has ignited a substantial body of work in the past decade [7]. Part of this work is theoretical in nature. Some authors, such as Fogg [7] and Cialdini [10], have proposed generic heuristics for the design of persuasive interfaces, while others have tried to incorporate psychological models (e.g., the theory of planned behavior, the health belief model) into the design of persuasive systems [12]. Despite these apparently solid theoretical foundations, it appears to be difficult to use the mostly predictive social psychological theory as a generative starting point for design. Therefore a remaining challenge is to make this work actionable for designers [12,13].

A second strand of work in persuasion has an empirical character. Many studies have shown how relatively short-term highly targeted interventions can have positive effects on participants' behavior [14,15,16]. However behavior change is a complex, long-term process with high relapse rates [17], which raises questions about the ecological validity of some of the reported interventions. We may ask to what extent targeting isolated behaviors scales to the general problem of a healthy lifestyle [18] and how short-term interventions will scale to long-term behavior change [16]. Currently, few studies have met the gold standard of a long-term randomized trial with follow-up. Although the available evidence suggests a modest positive effect of some of these interventions, it remains a challenge to understand *why* successful persuasive technologies are effective, and consequently, *how* successful persuasive applications can be designed [17]. Recently this line of work has also been criticized for being overly 'modernistic.' Brynjarsdóttir et al. [19] identified the following weaknesses: (1) an overly strong focus on individuals and individual behavior, (2) predominantly treating people as rational actors who are swayed by information, (3) creating solutions too distanced from the complexities of everyday life and (4) insufficiently focusing on persuasive systems' dynamics and change over time. Indeed, some work on persuasion may have centralized the *persuasive act* rather than the needs of the *persuadee*.

It may be better to take health-seekers' needs around health management as a starting point and try to support those needs in a pleasurable, persuasive way. Running from an embodied interaction perspective [21], Bagalkot and Sokoler [22] identified three such needs in the context of physical rehabilitation that we consider relevant to our design case. They distinguished between *self-monitoring, self-articulation* and *social scaffolding*. *Self-monitoring* means recording, measuring and monitoring one's own behavior. For example, a health-seeker may use a step counter to keep track of movement levels. Apart from much work on the application of sensor technologies, there is a rising body of work in *personal informatics* on how to support users in making sense of, and reflecting on, personal statistics [8,9,11]. Making sense of tracking data is a central challenge, even for quantified-selfers [5], but from an embodied and action-oriented perspective much is missing. Bagalkot and Sokoler referred to *self-articulation* when patients are supported to take action on recorded data, such as presenting it to a therapist to

articulate one's position. Supporting self-articulation is the starting point of online health networks like 'hereismydata' [23], but it seems that the topic is under-explored in the HCI community. An exception is found in Doyle et al. who designed both for self-monitoring and articulation [20]. Finally, as a third strategy, Bagalkot and Sokoler identified *social scaffolding*: active engagement with family members and peers as resources for guidance and motivation. This topic has received much attention in the fields of awareness systems [24,25] and computer-supported cooperative work [26], although much of this early work shares two weaknesses. First, it tends to be information-oriented rather than action-oriented, which limits the possibilities for users to act upon the information presented in the system. In the context of health, several studies have highlighted the importance of including such action possibilities [1,22,27]. Second, most systems are primarily designed and evaluated from the needs of one participant — usually the older person in particular — and not so much from the needs of the social group who does the scaffolding. However, Jeurens et al. [1,2] presented steps in this direction. In conclusion, Bagalkot and Sokoler's framework appears to be a helpful source for generating design solutions that focus on the needs of health-seekers.

3 Case Studies

3.1 General Approach

We followed an opportunity-oriented design-research approach that centralizes the complexities of the interactions between health-seeking citizens and health care providers [3,18,26]. We assumed stakeholders have an incomplete view of their problems and needs, and that a structured, design-led participatory approach was needed to identify opportunities for innovative interfaces. For this we adopted the 1:10:100 approach [28]. The original intention of this approach has been to tackle the complexity of 'wicked' design problems, but it also turned out to be a helpful means for organizing requirement-oriented project conversations with heterogeneous groups of innovation partners [28]. The general idea behind the 1:10:100 approach is to do a project three times with increasing timespans of 1, 10 and 100 days (although, in practice, these durations and the number of iterations are adapted to the needs of each individual project).

The 1:10:100 approach is a meta-method: within each iteration, any type of user-centered design process can be followed. In the cases presented in this paper, we borrowed techniques from the field of Service Design [29] for our analysis and ideation. In particular, we chose to conceive our designs as a series of touch-points between the user and the system that combine into a 'customer journey' and a 'service blueprint.' We used standard user-research techniques within iterations, such as surveys, interviews and focus groups, although mostly informally and on a small scale. Since our user research tended to be lightweight (in particular in the 1 and 10 iterations), it was important to combine methods elegantly. For this method triangulation, we used Development Oriented Triangulation (the DOT-Framework)

[30,31], which identifies completeness vs. certainty, relevance vs. rigor and inspiration vs. data as the primary tradeoffs that should guide method triangulation. During each iteration, we planned to combine methods in such a way that method triangulation occurred across at least one, but preferably more, of these axes.

The most important type of evaluation in the 1:10:100 approach is the Quality Review Board (QRB). This is an expert evaluation session at the end of the first two iterations in which the project's lead designer presents provocative prototypes [32,33] to a diverse group of innovation partners, which are then discussed as if they were the end result of the project. Such expert evaluations can give valuable early feedback about the feasibility and desirability of aspects of the solution presented. During each QRB, the partners jointly set a new research and design focus for the next iteration. The advantage of this approach is that it leaves much space for discovery in the design and it supports the stakeholders in being open to more innovative solutions [28]. In the remainder of this section, we will focus on two cases that revolved around the idea of designing apps and services to persuade citizens older than 50 years of age to adopt a more active lifestyle: one with the municipality of Arnhem, the other with a health care organization and sports organization for senior citizens in Wijchen. For reasons of legibility, we will focus on the results of the '100' iterations and will not report on intermediate concepts and their evaluations. We will sketch each case and provide details about our approach, present the final concept, discuss the evaluation of the concept in the final QRB and provide our reflections on the projects (in a discussion section).

3.2 Case 1: Health-i

The Case

Our first case was carried out with the municipality of Arnhem, a mid-sized city in the Netherlands (150,000 inhabitants). We wanted to explore the possibility of stimulating its citizens — particularly those above the age of 60 — to engage in more physical exercise. In this project, users were involved through questionnaires and interviews and through a co-creation sessions in the 100 phase. The 27 participants, who were recruited at senior citizen centers in Arnhem, filled out a questionnairein-depth expert interviews were held with a lifestyle coach, a board member from a sports club for older people, a medical professional and employees of the municipality who were concerned with sports policy. The QRB, which met after the 1, 10 and 100 iterations, included representatives from the municipality and members of the target group. The project quickly took a *self-monitoring* direction, borrowing ideas from personal informatics [5,8,9,11] and quantified-self. The idea was to enable users to collect information about their own activity levels. This would allow the municipality to facilitate users who wanted to move more. A particular challenge was to find the right functionality and tone of voice for this target group.

The Concept

In the Health-i concept, the participants would buy a commercially available Fitbit [34] bracelet and wear it at all times to register their activity levels. The idea was to provide users with a personal dashboard through a dedicated app. The dashboard has four elements. First, there is a daily movement monitor that compares the user's

movement with the national movement norm. It features a tree that grows when the user moves more, and a status bar indicating the amount of movement compared to the norm (Figure 1, full circle, left). In addition, there are sections for achievements, the current activity status of friends (thus setting a social norm) and an activity suggestion provided by the municipality. Other screens allow the user to browse their movement history and see a more extensive overview of activities in the city.

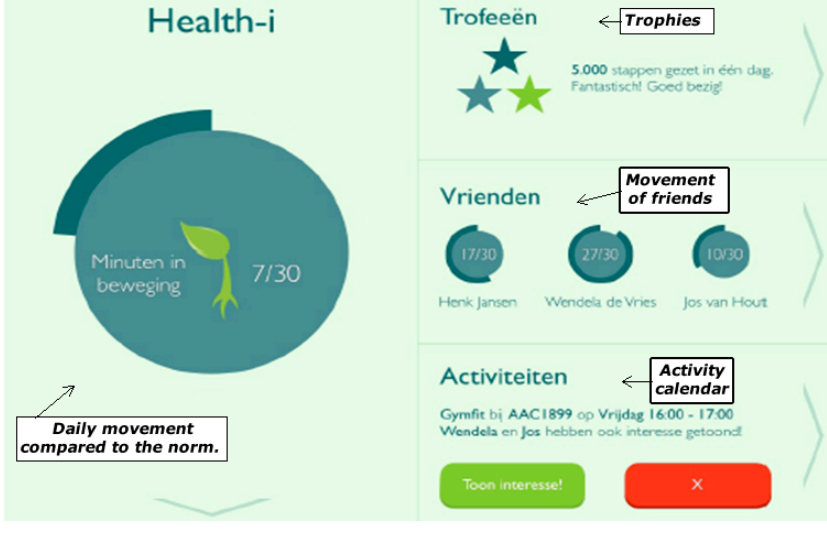

Figure 1: A screenshot of the Health-i dashboard.

Evaluation

The final concept was well received at the last QRB and the municipality is planning a follow-up to the project. They feel the concept has potential for older citizens and they value the facilitating role they can play as a municipality by filling the activity calendar. The potential users valued the concept's simplicity, the lowered focus on 'achievement' and the friendly language of the interface.

Discussion

One question in this project was to what extent the quantified-self movement provided a valuable starting point for supporting the *self-monitoring* of older citizens. Our user research showed that this target group is much less tech-savvy and values 'achieving' less than the early adopters of quantified-self solutions. However, by downplaying the measurement metaphors in the interface (such as those in related health [20] and existing quantified-self [6] solutions) and replacing them with warmer and more holistic displays, we managed to increase the acceptability of this self-monitoring support. Its simplicity and the lowered focus on achievement resonated with our target group in the last QRB.

For us, the application validates the idea that off-the-shelf solutions targeting quantified-self users can be appropriated for older people. The application seems to fill a niche between existing pedometers and apps for running and other sports that provide social and self-monitoring features, like those provided in this concept.

Although we managed to make self-monitoring more acceptable to this target group, *self-articulation* and *social scaffolding* may need improvement in future versions.

3.2 Case 2: Project Movere

The Case

Our second case was executed with ZZG Zorggroep de Meander, a healthcare organization in Wijchen (a small municipality near Nijmegen with about 33,000 inhabitants). They wanted to stimulate movement behavior in 'young seniors' (age 50 years or older). In particular, they wondered whether these people could be convinced to use a brand new fitness center specifically targeted towards their age group. As in the first case, we used a co-creative project with provocative prototypes using the 1:10:100 approach [28] to clearly define the problem and to find design opportunities. Users were involved in the 10 and 100 iterations. During the 100 iteration, 30 users were recruited at the local supermarket and filled out a questionnaire. They also took part in in-depth expert interviews with members and supervisors of a sports club for senior citizens. The QRB consisted of representatives from health care organizations, a local sports club for senior citizens, a design professional from our university and a health specialist from our university.

Although the health care organization originally asked us to design an app that would convince senior citizens who were not engaging in exercise at all to visit the sports center, during the project the scope broadened to moving in general and the target group to 'young elderly' (age 50+) in general. An opportunity was found in social support for seniors who exercise and in supporting the smooth transition from one type of activity to another (e.g., in the case of decreased fitness, whether temporary or permanent). User research showed that this was one of the problems that often resulted in longer periods of movement abstinence.

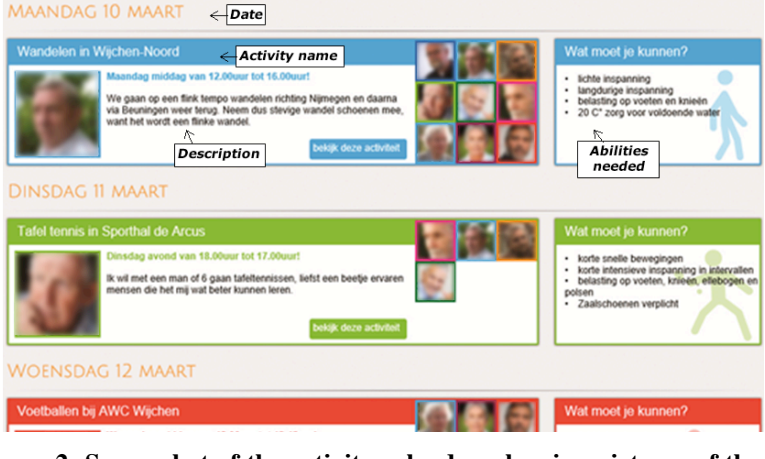

Figure 2: Screenshot of the activity calendar, showing pictures of the organizers, participants and meta-information about the type of activities.

The Concept

Central to the concept is an activity calendar, which provides an open system in which anyone, including the new fitness center, could create an activity (Figure 2). Creators would be required to specify the type of activity (e.g., 'light exercise', 'short duration') and experts could take an active role in the community by suggesting corrections of movement information to organizers. Users could subscribe to activities in the calendar, which would show who had already subscribed in the form of thumbnail pictures. This would provide users with a social motivation to participate in the activity. When a user participated in an activity, it would be shown on his or her 'activity chain,' which would provide a record of past movement behavior and could help in conversation when consulting a doctor. Figure 2 shows a screenshot of the *activity calendar* and Figure 3 shows a screenshot of the *activity chain*.

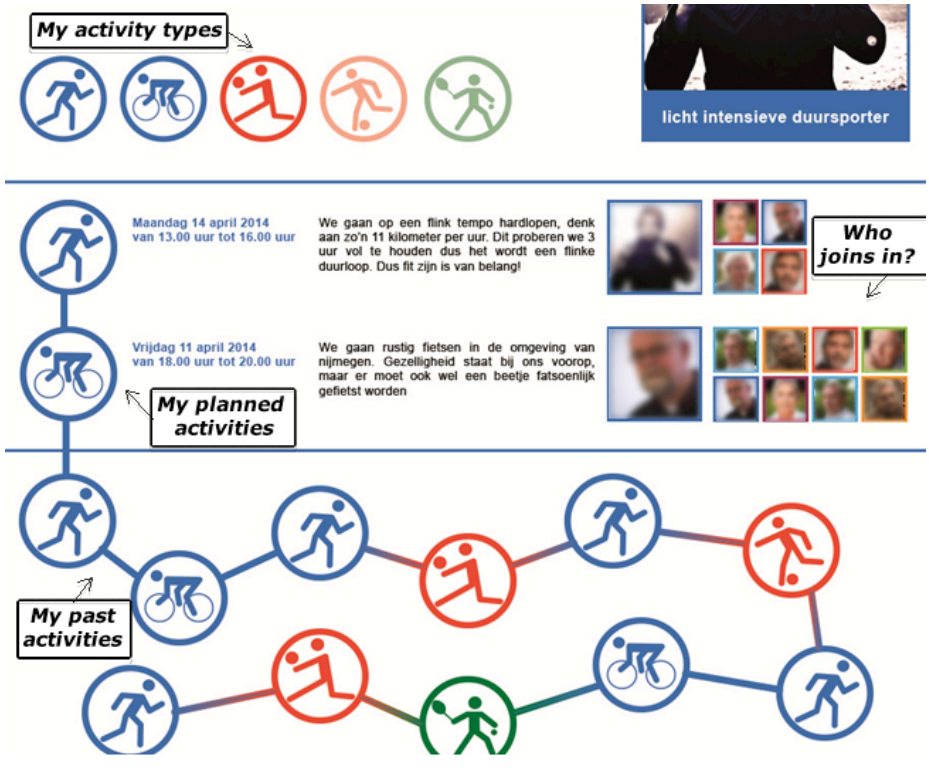

Figure 3: The personal activity chain shows past activities in a non-normative way and could help in discussions between the user and a health professional.

Figure 4 shows how the system could support changes in a user's movement pattern. Users would be assumed to already use the system when doing one type of sport. Once a crisis occurred for the user, there would be alternatives at hand and the user could easily choose an alternative sport. A consult with a professional who also participates in the system might be an extra motivation to do so.

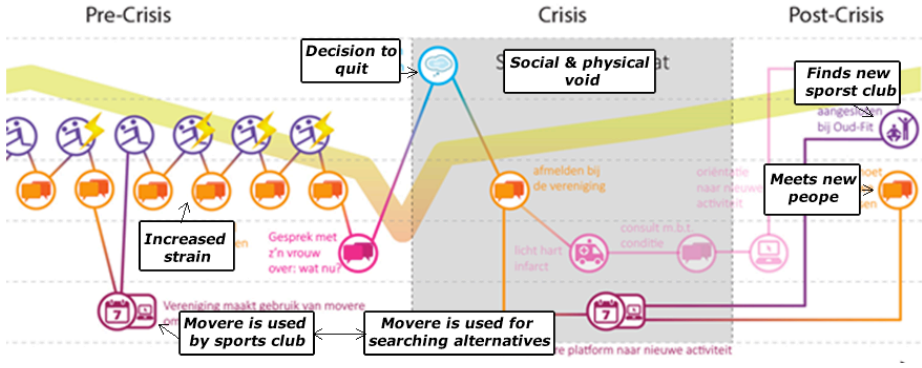

Figure 4: Customer journey depicting the trajectory of a user who had to quit playing volleyball because of physical strain. The crisis situation would be alleviated because of the activity calendar.

Evaluation

In the last QRB, the final concept was well received by the stakeholders and the project led to a large scale follow-up. The health organization involved valued the connection between bringing value for individual users in a community setting and creating possibilities for entrepreneurial citizens and professionals. Although these principles were valued, the health care organization felt that a lot had to be improved before the concept was ready to market, and the answer to the original question also remained unclear: how could a system like this support the marketing of the senior citizens' fitness space?

Discussion

As in the first project, we put substantial effort into finding a tone of voice for the interface that was simple and empowering. When designing for *self-monitoring*, it is non-trivial to find forms that do not target achievement as a value. In this respect, the 'activity chain' is an interesting idea because it does not quantify or imply a movement norm or target, while it can still serve as a motivator. Although the activity chain is also intended as a *self-articulation* interface, we have not yet validated this idea extensively with physicians, so opportunities for strengthening these functions may be found. Functionality and views may be added to support online and offline conversations about current and future movement. The system supports *social scaffolding* in several ways, but a particularly interesting aspect is that it is designed to offer several types of users (i.e., senior citizens, physicians, active citizens, sports clubs) their own roles within the system.

4 General Discussion

In this paper, we discussed two cases that tried to tackle the problem of supporting and promoting a healthy lifestyle among older citizens. The cases were designed with citizens and stakeholders in health care, who were enthusiastic about the solution

directions. Clearly, further work is necessary to see whether the proposed solutions would work in practice. Both concepts will form the basis of a follow-up project, which will include redesign, implementation and testing. To design these cases, we built on existing work about persuasive interfaces and quantified-self, and we used Bagalkot and Sokoler's notions of self-monitoring, self-articulation and social scaffolding as a generative design framework. In this section, we will discus our cases in relation to the exiting bodies of literature and we will discuss our case in relation to developments in care and self-care.

Backing Persuasion

Much work on persuasion in HCI presupposes the roles of persuader (for the technology) and persuadee (for the user). As such, it is common to centralize the *act* of persuasion (i.e., a specific target behavior that needs to be addressed) rather than the *needs* of the persuadee. We have outlined several existing critiques on this line of work: the approach may overlook much of the complexity of behavior change [17], it may focus too much on individual behavior [19], the solutions may be too distanced from everyday life [19] and they may not be focused enough on the dynamics of behavior change over time. By starting from Bagalkot & Sokoler's [22] framework of self-monitoring, self-articulation and social scaffolding, we addressed some of these concerns.

In both solutions we proposed, the client was not so much persuading the users though technology, but the technology would provide a persuasive infrastructure in which different stakeholders would be supported in self-monitoring and motivation and in which they could persuade each other. In this respect, project Movere presented the biggest step. This shift in focus does not render the literature on persuasion obsolete. These projects used guidelines laid out by Cialdini [10] and Fogg [7], for example, both for the functional design (e.g., choosing rewards and how to give them) and in the detailed screen design (e.g., choosing metaphors). It was a question of prioritizing goals; rather than isolating the goal of persuading senior citizens, we focused on Bagalkot and Sokoler's self-care goals and supported them with persuasive elements in the design. Persuasive interfaces can only be effective if they are backed by genuine support for user needs. Therefore designing the persuasive act should follow the support of needs for persuasion, not vice versa.

Acting on Personal Informatics

The field of personal informatics [5,8,9,11] is a fairly recent branch of HCI that focuses on supporting and making sense of personal statistics. However, much is needed to bring the potential benefits of self-tracking from a small group of power users to a broader population. In both the case studies presented in this paper, older users expressed willingness to engage in self-tracking. However design should not trigger the value 'achievement,' so metaphors related to competition (e.g., leaderboards) and precise measurement (e.g., graphs) need to be played down and embedded in a soft tone of voice in the overall interface. Given the design of the Health-i interface as a whole and the activity chain in the Movere concept, the participants expected to enjoy self-monitoring. One concern, which we touched upon but which needs to be addressed further, is the actionability of the information presented. If the system suggests concrete actions based on events in self-monitoring

(such as both concepts did in the activity calendar), there is stronger incentive to self-monitor and it could be more pleasurable and effective.

Embedding Self-Monitoring, Self-Articulation and Social Scaffolding

Bagalkot and Sokoler's notions of *self-monitoring*, *self-articulation* and *social scaffolding* proved useful as a frame of reference for our design cases. However, these notions are still very much focused on the individual. Self-care is not so much an individual activity but an activity in which the efforts of the health-seeker, family caregivers and professional caregivers need to be orchestrated [1,3,26]. In both cases, we identified even more stakeholders, such as voluntary organizations, local entrepreneurs and even other citizens. How can all these roles be accommodated?

One framework that may help in designing more subtle social self-care support systems could be Fisher's idea of meta-design and participation cultures [35]. Fisher put forward the notion of a *participation ecology* where many different types of stakeholders cooperate within a socio-technical system such as in open source communities or systems like Wikipedia. Each stakeholder can contribute to the system's overall goals by performing small tasks that are subsequently aggregated. A first effort to design persuasive participation ecologies — or *persuasion networks* — for healthcare is found in the dynamic collage [2] and our second case could also be seen as a step in this direction. We are currently extending this notion by adopting a novel design approach in the follow-up to the second design case [36]. We are focused on identifying the contact moments (i.e., edges) of people with different roles in the health-seekers' social networks, each of whom may influence health behavior. Once the most important edges of the persuasion network are drawn, we will try to create touch-points in the system that can support the contact moments by applying Bagalkot and Sokoler's three goals as design frames.

Developments in Health Care

In the introduction to this paper, we sketched developments in Dutch health care that force caregivers to rethink how they provide care. Although patient-centered movements such as online patient networks and quantified-self (identified by Swan [4]) are considered inspirational by our partners in care, there is a still a sense of disconnect between their practices and such self-organized patient communities. Moreover, the shift towards prevention, and thus the shift from catering to the patient to catering to the health-seeker in general, is considered to be a big leap. In our designs, we tried to find opportunities in the spaces between formal care, informal care and self-care, and between prevention and care, by tying our stakeholders (e.g., end-users, health care providers, medical staff, municipalities and system providers) together in new ways. The emerging persuasive infrastructures or persuasion networks may dissolve some of the currently felt disconnects. However, this implies focusing on, and redefining the connections between, health-seekers, family caregivers, professional caregivers and other health care stakeholders rather than treating them as separate target groups. In our experience, this requires a mental shift by all the stakeholders and leads to complexities that are not sufficiently covered in the literature. However, the cases as we presented them in this paper provide a starting point for thinking about how health-seeking, self-care and health care can be integrated.

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