PsychNology Journal, 2007
Volume 5, Number 2, pp. 105 – 132

Extended Television: A Study of How Investigations of Use Can Inform Design Processes in Nursing Homes

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ABSTRACT

This paper describes the shortcomings in the support that replaces the lost distributed cognition in older people who move to nursing homes and how artifacts can improve this by functioning as distributed cognition. The 30 older persons in the study were men and women of different backgrounds and ages (between 60 and 100 years), all of whom had some kind of functional limitation. The observations and analysis were carried out as a part of the iterative design phase of TV functions for the older people, and the analysis was based on distributed cognition theory and the FACE conceptual design tool. Poorly designed artifacts resulted in the older person's loss of control, and hindered the creation of distributed cognition. However, these aspects improved in the older persons' TV watching when individually adapted assistive technology was used.

Keywords: *Distributed cognition, older people, assistive devices, design, television.*

Paper received 29/03/2007; received in revised format 20/07/2007; accepted 03/08/2007.

1. Introduction

Distributed cognition describes how human acts or artifacts can mediate knowledge and memory (Hutchins, 1995a, 1995b; Norman, 1993), without people necessarily being aware of it (Norman, 1993, p. 143). Systems with distributed cognition can not be reduced to cognitive properties of individuals (Hutchins, 1995b, p. 355). Empirical investigations of the role of technology in collaboration and in distributed cognition in nursing homes are scarce. This is especially true for investigations with a focus on the older individuals.

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This paper discusses the memory aspects of distributed cognition. This means other aspects of distributed cognition, such as decision making, inference, reasoning and learning (Hutchins, 2001), are not analyzed. The term *distributed memory* is used to denote the segment of distributed cognition that concerns memory. Distributed memory processes are disrupted when older people move into nursing homes and need to be rebuilt there. The relocation results in new routines, changes in relations with relatives, new people to interact with and loss of old artifacts. The old artifacts that are kept in the one-room apartment in the nursing home can originate from several different rooms in the former home and from different places where the older person used to stay before the relocation, for instance, from an apartment or a summer cottage. New artifacts are introduced and new arrangements of these and old artifacts are made. Furthermore, this happens at a time in life where memory problems can arise without a disruption in the distributed memory. In the relocation, the older person's self-image can change from one of self reliance to one of becoming a burden (Svidén, Wikstrom, & Hjortsjö-Norberg, 2002), and older people with dementia can become confused and experience discomfort (Son, Therrien, & Whall, 2002). However, there are also older people who experience relief and security after the relocation to a nursing home (Lee, Woo, & Mackenzie, 2002).

The observations in this study were made as a part of the design of a suite of TV functions in a nursing home that are referred to as *Extended Television* (see section 4 for a description of the functionality). The overall research question is how the conceptual design tool FACE [Function, Attitude, Control, Enabling] (Anderberg, 2006) and distributed cognition analysis of the usage can contribute to the design process. Furthermore, the purpose of the article is to describe the shortcomings in the support that replaces the lost distributed memory of older people in nursing homes, and to understand how artifacts can strengthen the older person's actions and control, when they are a part of his or her distributed memory (meaning that they act as representations in distributed memory processes). The study also seeks to understand how this knowledge can be used in the design process. The focus is on the older persons, although care workers and relatives are included in the analysis.

The use of extended television is analyzed using distributed memory and FACE (Anderberg, 2006), which is a conceptual design tool to analyze perceived attitudes, the individuals' control, and enabling of the analyzed function, such as watching TV. The main contribution of this article is in the qualitative empirical study of older

people's use of extended television in a nursing home, and in the use of a combined FACE and distributed memory analysis in this context.

The design phase (which involved older persons, relatives and care workers) and usage of extended TV is described by Abdelmassih Waller, Östlund, and Jönsson (2007).

It is important to acknowledge that older people watch more television than other age groups, that the activity seems to increase over the adult life span and that this increase has been constant through time (Nordicom, 2006; Robinson & Skill, 1995). Television is poorly adapted to older people's social inclusion in their immediate surroundings, but is used by older people to support their own reflections (Östlund, 1995, p. 137, 147). These factors were an early inspiration in the design phase of extended television.

Some of the prerequisites of designing for older people in a nursing home are described in section 2, and in section 3 FACE and distributed memory are discussed in greater detail. Section 4 describes the settings and the participants, while section 5 is devoted to presenting the method used. Section 6 describes the use of extended television, as well as an analysis thereof. A concluding discussion is presented in section 7 and conclusions in section 8.

2. Design for Older People

In this section, general considerations on how to design for older people are discussed first, then how photos can strengthen communication with older people, and finally how older people's memory changes with age.

Familiarity with visible parts of technology increases the probability for acceptance of a "new" artifact by older people (Östlund, 1995, pp. 234-235). In addition to this, poor health, unsatisfactory contact with others, and high education can contribute to older people's acceptance of new technology that enhances the quality of life (Zimmer & Chapell, 1999). The need to minimize physical and mental efforts probably influences "their choice of technology and their willingness to learn." Furthermore, older people "tend to accept technology that saves energy and makes life easier" (Östlund, 2005, p. 38), and it is important that new devices are constructed so that the older person is in control (Anderberg, 2006; Norman, 1999, p. 174; Orpwood, Bjørneby, Hagen, Mäki, Faulkner, & Topo, 2004). There is also a design recommendation to change as little as

possible, and to design for the older person's own actions (Jönsson, 2003, p. 11). This can mean that the older person would like to keep a familiar artifact, but also that there is a familiar function that the older person wishes to keep. Furthermore, to design for the older person's own actions does not necessarily mean that the older person should be physically active; it could also be a design facilitating the older person's reflections on the past.

For people with dementia it can be advantageous if new features are included imperceptibly, so that the new device (that looks like equipment that existed in their home) operates just like the ones they are used to (Orpwood et al., 2004; Orpwood, Gibbs, Adlam, Faulkner, & Meegahawatte, 2005). Such devices are not necessarily a part of compensatory memory aids that are consciously used by older persons, such as those discussed by Caprani, Greaney, and Porter (2006). The importance of adapting the artifact to past experiences and utilizing external cues as well as environmental ones is also stressed by Gamberini, Alcaniz, Barresi, Fabregat, Ibanez, and Prontu (2006).

Human support can be valuable, among other things, for its assistance in adapting to a changing environment; however, the supported person's loss of control is always a problem. Well-adapted technology, on the other hand, can be an extension of the individual's own wishes (Anderberg, 2006). However, a study by Drageset (2004) indicates that help from care workers in performing activities of daily living can counteract feelings of loneliness.

In order for care workers to provide quality care, their actions should preferably be based on a mental image of the older person that includes the time before living at a nursing home. One possible consequence of lack of knowledge is a spiral of increasing dissociation of the older person and the care worker. In this situation the care worker can feel stressed, and come to believe that he or she carries the entire responsibility (Rahm Hallberg, 2002, p. 48). Beck-Friis states that people with dementia need a trail blazed down to their memory, such as a scent, a melody or a photo. She states that this is important to consider in the care of people with dementia, and that support is to be given in order to *"*help to bring forth the mental images that are still there/that still exist*."* (Beck-Friis, 2000, p. 41)

2.1 Using Photos for Communication

Technical support in the form of digital and printed photos has proven to be a valuable communication and memory tool. An example of this is the extensive use of

personal photos by adults with developmental disabilities as described by Plato and Jönsson (2001). They report that photos

> "support and confirm memory as well as working as a written language. In addition, they are a source of inspiration for conversation, that is, they work as a spoken language or support to such as a written language" (Plato & Jönsson, 2001, p. 7).

The personal photos were much better suited for these purposes than non-personal, symbolic, photos (Jönsson, Philipson, & Svensk, 1998). A photo can be experienced as personal if the concerned individuals have memories associated with it. In this way, photos can act as representations of memories to individuals in processes with distributed memory. A photo that only one person has memories tied to can be used for communication; however, a photo works better as a conversation support if both persons have memories tied to it. Furthermore, memory books with sentences described by either personal photos or general sketches have been found to augment the communication between care workers and older people with dementia (Allen-Burge, Burgio, Bourgeois, Sims, & Nunnikhoven, 2001; Bourgeois, Dijkstra, Burgio, & Allen-Burge, 2001). Multimedia solutions for older people with dementia using photos and music have also shown positive results (Cohene, Baecker, Marziali, & Mindy, 2007; Topo et al., 2004).

2.2 Memory and Familiarity

Human implicit memory categorizes the effects of prior experience without conscious recollection thereof. This means that unconscious procedural skills such as bicycling and combing hair are included in implicit memory. Furthermore, the usage of implicit memory can give a feeling of familiarity (Son et al., 2002). The performance of explicit memory tasks, such as conscious recall, often becomes poorer with age, but implicit memory is often unaffected (Fisher, 1998, and as summarized in Caprani et al., 2006) or is only slightly affected (Woodruff-Pak & Lemieux, 2001). This deficit in explicit memory is observable among older people with dementia, and it is recommended that new interventions should use aspects of prior familiar environments including objects and pictures "to maximize functional ability in elders with dementia" (Son et al., 2002, p. 266).

Investigation of how older people with dementia, who have a working implicit memory but poor explicit memory, use technology could shed light on design issues for older people in general as well as older people with dementia. Their poor explicit memory

means that they have difficulties with conscious learning. Consequently, artifacts that the older person with dementia does not use but wants to use become indicators of what is difficult to learn. People with a working explicit memory can consciously compensate for poorly designed artifacts, while older people with dementia are unable to do so. Strengths in the implicit memory of people with dementia can be used to design artifacts that give a feeling of familiarity and may also be appreciated by a wider range of older people.

3. Theory

This section provides a theoretical background for the distributed cognition and FACE analysis. Distributed cognition is described first, and discussed from the viewpoint of activity theory and situated action. Thereafter, distributed cognition is discussed from the perspective of aging, and finally FACE is described.

3.1 Distributed Cognition

Distributed cognition is one of the conceptual frameworks that can be used to analyze the use of extended television in its context. Examples of other possible frameworks are activity theory and situated action (Johansson & Gärdenfors 2005; Kaptelinin et al., 2003). These frameworks all focus on both users and context. As stated earlier, this paper uses the memory aspects of the distributed cognition framework to analyze the use of extended television. This non-reductionist analysis treats complete processes, such as watching TV. The analysis shows how memory in a process is represented in the different steps needed to carry out the process. For instance, the idea of watching a certain TV program can be presented orally by a relative, and later the presence of the TV acts as a reminder to watch the program. In this example, the idea of watching TV was first represented by the relative and later by the TV. This transformation of different representations of memory is also treated by Hutchins (1995a).

A disrupted distributed memory can result in the loss of representations needed to carry out one or several of the steps in a process, thus making the activity difficult or impossible to perform. Consequently, a distributed memory analysis can find the missing representations needed for the older people and discuss how to assure the existence of such representations.

The theory of distributed cognition (Hutchins, 1995b) is symmetric, meaning that both artifacts and humans can be thought of as cognitive representations. This is different from activity theory, which distinguishes between the user (subject) and the artifact (object) (Nardi, 1996, p. 73). Distributed cognition can be used to analyze processes where the user plays a significant role without necessarily being aware of it (Norman, 1993, p. 143), while activity theory focuses on intentional actions. In fact, activity theory "seeks to understand the unity of consciousness and activity" (Kaptelinin & Nardi, 2006, p. 8). In the design of extended television, it has been important to analyze situations where people's intent has been unclear due to difficulties of interviewing people with dementia. Furthermore, it has been necessary to use a framework that highlights the role of artifacts. This is a frequently used and acknowledged property of distributed cognition (Nardi, 1996, p. 85). However, there is a risk that human intentionality and creativity can be neglected with a symmetric analysis like distributed cognition (Kaptelinin & Nardi, 2006, p. 241).

Suchman points out that situated action stresses the uniqueness of human action, compared to machine operation. Furthermore, she thinks that in order to make a situated analysis of human action, it is necessary to consider the "unique, unrepresented circumstances in which action in every instance and invariably occurs" (Suchman, 1987, p. 189). This means that human improvisation is emphasized (Nardi, 1996, p. 85).

The design in this project draws on the user's earlier experience with television and on familiar patterns of actions concerning TV viewing. It seeks to limit the learning needed to use extended television, especially due to possible deficits in the explicit memory among older people. This means that the designed artifacts should well suit the implicit memory in which routine actions are stored. This makes distributed cognition a suitable framework of analysis, with consideration taken to human preferences.

3.2 Distributed Cognition and Aging

Distributed cognition, as mentioned in the introduction, can not be reduced to cognitive properties of individuals. This presents opportunities to support older people's cognitive processes through adapting the environment to the mental processes of the individual. Such a procedure has been proposed by Palen and Aaløkke (2006). They made a study of how older people in a Danish home nursing setting remembered their intake of medications by how they were spatially arranged.

This arrangement was in accordance with the routines they normally carried out. For instance, one older person placed midnight medications on the nightstand. Furthermore, it was found that the spatial arrangement of medications was used in the communication between care workers and older people. Recommendations were made that a computer supported medication management system should take its starting point in the personalized, spatially distributed systems that the older person is already using.

In this way, the cognitive processes of the individual and the uniqueness of the human actors are taken into consideration by using a distributed cognition approach.

Older people's social networks and routines may have changed before the relocation due to fewer relatives or physical constraints (Östlund, 2005, p. 29). This means that the distributed cognition can have started to change before the relocation to the nursing home. As mentioned in the introduction, the relocation to a nursing home can cause a serious disruption in distributed memory. Furthermore, it is reported in medical literature that the relocation to a nursing home can cause much stress for the older person (as summarized in Manion and Rantz, 1995). Feelings of loneliness, sadness and crying can occur after relocation. However, this can be decreased if the older persons' decision making and contact with relatives is supported, and also if there are familiar artifacts in the apartment (Wilson, 1997). The need for contact with relatives and for familiar artifacts emphasizes the importance of designing in a way that retains the distributed memory that the older person had before the relocation. In other words, to change as little as possible.

3.3 Function, Attitude, Control, Enabling (FACE)

FACE is a conceptual design tool for analyzing individual functions and functional support, including support from both technology and other persons. According to Peter Anderberg, who developed the tool, functions are the activities we carry out in everyday living such as reading, telephoning, going to work or school, and meeting friends and co-workers. The chosen function is analyzed in the framework of the following three factors: attitude, control and enabling. "Attitude" means the social response to the function; how the user himself as well as others perceive it in the setting where it is used. "Control" involves how much the user, who is the owner of the function, has the power and right to define it and carry it out. "Enabling" deals with how the function support (the technological solution or artifact) is constructed and

implemented. FACE can be used to compare the suitability of different function supports (Anderberg, 2005; Anderberg, 2006).

4. Setting and Participants

This section describes the setting, influx of older people, care workers, and the selection of participants to the project. In addition to this the older persons who will exemplify the use of extended television is described.

In a newly built nursing home for older people in the south of Sweden there are 53 apartments, common day rooms and TV rooms. The 53 apartments are distributed over three floors and five divisions, where the first floor is a short-term division that is excluded from the analysis and further description of the settings due to its late inauguration. In each of the apartments there was a 32” wall-mounted LCD TV screen. Both the number of older residents that were involved and the number of employed care workers increased during the period of observations, since the apartments were gradually becoming occupied. Floors two and three were filled to 40% capacity by May 2006, 80% at the end of August 2006 and 90% at the end of December 2006. The older persons that moved into the nursing home did so because they could not manage on their own, even if they had home nursing. A regional ethical vetting board scrutinized the project before the older people moved into the nursing home. The board found no obstacles to proceeding with the research project.

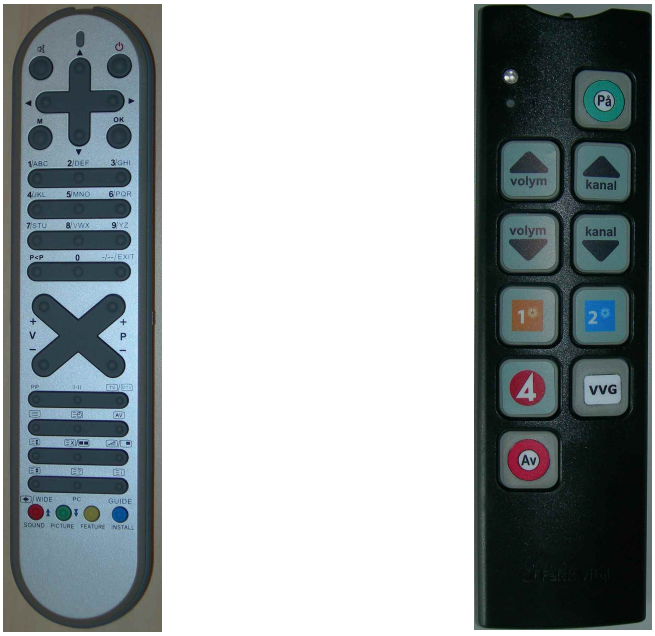
The unpredictable influx of older people and final adjustments of the nursing home made it impossible, at the outset, to find a static group of older persons who were using and evaluating the extended television. Instead, I included any of the older people who became acquainted with extended television, either because they themselves expressed a wish to use it, or because relatives or care workers expressed such a wish. Also the few older people who deliberately refrained from using extended television were included in the study. In total, 30 older persons were included. They were men and women of different backgrounds (fisherman, singer, engineer, athlete, care worker, etc.) and ages (between 60 and 100 years). They all had some kind of functional limitation due to, for instance, different kinds of dementia, physical disabilities caused by rheumatism or cancer, and stroke-related conditions such as aphasia or memory loss. Actually, the majority of the people living at the nursing home had some kind of memory loss.

All of the permanently employed care workers had traditional health care training, and several of them also had other training that was especially valuable at the nursing home, such as computer skills, painting, pottery, baking, hairdressing, etc. There are care workers present at the nursing home, ready to help the older persons, around the clock. Each older resident has a contact person among the care workers who has additional responsibility to assure proper care of the older person.

The apartment TVs were delivered with a remote control, denoted in this paper as “original remote control”, which had approximately 40 grey buttons, several with multiple functions, see Figure 1a. In some apartments this remote control was exchanged for a universal remote control with ten buttons, see Figure 1b.

There is also an internal TV channel at the nursing home, showing movies and photos that the care workers have taken using digital cameras. The photos were taken of events at the nursing home such as the Midsummer Eve dinner, Christmas, bingo, visits to the nursing home, etc. A code of ethics was adopted. This meant that no photos were taken inside apartments or in situations that could be experienced as embarrassing by the older people. Two media centers were present in the nursing home in one day room and in one TV room. It was possible to view photo CDs, movies from the open archive at Swedish Television, DVDs, etc., using the media centers. They consisted of PCs connected to the Internet and the TV.

Of the older people who used the internal TV channel in their own apartment (at least 8 older people), Anna was chosen to exemplify the use. Anna was 90 years old and had memory deficits due to stroke and a brain tumor. However she did not have dementia. Her reaction to the photos in the internal TV channel is representative for most of the older people who watched the internal TV channel (including those who only watched it in the day rooms). Of the four older persons who had a universal remote control in their apartment, Marie was chosen to exemplify the use. However, her use can not be seen as representative since she was the only one with dementia. Marie was 92 years old and had a diagnosis of vascular dementia.



(a) (b)

Figure 1. The “original remote control” (to the left) and the universal remote control (to the right).

One older person, Berit, had a personal TV photo album installed in her TV. She had significant short-term memory loss due to mid-stage Alzheimer’s disease, and was almost 90 years old. The TV photo album was filled with scanned photos from her old photo albums and controlled by a special remote control in the shape of a photo frame, see Figure 2 in section 6.2.2. The decision to let Berit try a personal TV photo album was based on her interest in photo albums, and her relatives’ strong involvement in the design process.

In general the relatives included in this study were selected on the basis of two criteria. First, their older relative must participate in the usage of extended television, and secondly, they should have a great deal of contact with the nursing home.

5. Method

This section describes data gathering techniques, my presence at the nursing home and the treatment of data. The section also discusses measures to increase the validity of the results.

This project was action oriented, since the research persons' actions were analyzed and since I, as a researcher, also acted. Hence, and because the project sought to arrive at improvements, the project can be called action research (Robson, 2002, pp. 215-216). The action research approach was combined with participatory observation (Ely, Friedman, Gardner, & McCormack Steinmetz, 1993, p. 49), which is in line with Hutchins' suggestion of being situated through the use of cognitive ethnography to make a distributed cognition analysis (Hutchins, 1995b, p. 371). I was present at the nursing home about 15 hours a week between June 2006 and January 2007. However, during installation of technology and during observations of Berit's use of her photo album, my presence was considerably higher, up to 30 hours a week.

During my presence at the nursing home, I participated in the usage of all the functions of the extended television, routinely visited all the day rooms to listen to complaints or comments, conducted interviews with older people, relatives and care workers. I did not prepare questionnaires, but knew which areas of knowledge I was seeking to understand and concentrated of those during the interviews, as described in (Ely et al., 1993, p. 67). I wanted to know which functions a person used, how, why and when. In conversations with the older people, I had to take special care not to point out gaps in their memory, since this could risk upsetting them. I mostly scheduled the interviews with the care workers since they did not have time during working hours; however, interviews with older people and relatives were carried out on the spot as the opportunity came up. The care workers who were interviewed were either a contact person for an older person who used extended television, used it together with the older person, had ideas about usage or was a member of the TV team.

I also trained potential older users, relatives and four care workers in a TV team. The TV team used the functionality of extended television together with the older people, gave feedback to me and trained other care workers.

In addition to the design of extended television I helped out with everyday technical problems, which made me known and integrated in the research environment. In this role I visited more than 50 % of the older persons (mostly older people without dementia).

The design process was carried out in cycles containing data gathering, analysis, and manipulation of artifacts. I continuously wrote notes about observations and interviews. The notes were stored digitally on securely stored USB memory sticks, and never edited using an online computer, to avoid uncontrolled dissemination of the material. The notes were analyzed by posing questions like "Does she always react in this way

to this photo?" or by utilizing analytical frameworks as in this article. The outcome of this analysis fuelled further changes in the design of extended television, with the aim of improving and adapting its functionality. I constantly sought after data that would be divergent from my interpretations of the data or would falsify conclusions, and I always used multiple sources of information. I also consulted research articles during the design process, in order to confirm or reject interpretations. This approach strengthens the validity of the method (Figueiredo & Cunha, 2007).

In accordance with the democratic motives of action research (Brydon-Miller, Greenwood, & Maguire, 2003), the different functions of extended television were evaluated by the older people, relatives and care workers, since they gave their continuous feedback in the project to me or to members of the TV team.

I interacted with all of the 30 older persons included in the study, but I spent significantly more time with Berit than with the other individuals. This is due to the detailed analysis needed to design the TV photo album. Hence, after Berit agreed to participate in the project, informed consents were signed by her trustee, involved relatives and care workers.

6. The Use of Extended TV

This section describes the usage and analysis of extended TV. The usage is divided into two categories: "Marie watching TV alone" and "with others in front of the TV"; the second category includes Anna's reaction to the internal TV channel, Berit's use of her TV photo album and the use of the media centers.

The analysis is divided into two parts, the FACE analysis and the distributed memory analysis. The FACE analysis is made separately for Marie, Berit and Anna, while the distributed memory analysis is divided into the categories of distributed memory in artifacts and together in front of the TV.

6.1 Marie Watching TV Alone

Marie is slightly over 90 years old and used to live in an apartment next to one of her daughters. She has been an avid viewer of national ice hockey competitions on TV for forty years. Before Marie moved into the nursing home, her daughter used to suggest programs for her to watch, and Marie was able to operate the TV herself. She knew that the TV was there and could come up with the idea of watching TV herself. She

was told to always switch off the TV using the button on the TV set that made the red light go out. When Marie moved into the nursing home she had a diagnosis of dementia. The new TV was installed in her room with the “original remote control”, see Figure 1a. Marie could not handle this remote control, and most often forgot that there even was a TV in her apartment. Her daughter was unable to help her by telephone since the remote control was too difficult to use, and thus there was no point in suggesting a program to watch over the phone. The relatives who visited her on almost a daily basis suggested she have a universal remote control, and she was provided with one, see Figure 1b. Now it became possible for Marie’s daughter to call her to remind her of an ice hockey game on TV and guide her in using the remote control. Marie would then watch TV for hours, and she was able to change the channels herself, since she recognized the channel logotypes placed on the buttons on the universal remote control. Marie stated that she tried different buttons to find the right one. She could also turn off the TV; however, on several occasions the TV was unplugged. Marie probably did this to be sure that the red light went out. She did not remember this, however, when the TV was to be switched on again.

In one instance, a care worker came into her apartment as she was watching ice hockey. The care worker wondered if this was what she really wanted to see and the answer was positive. The care worker was surprised to find out that Marie liked to watch ice hockey. Later the care workers also understood that she liked to watch figure skating. After this, it seemed that the care workers remembered to turn on Marie’s TV if ice hockey was showing.

To sum up, after the relocation Marie could not operate the TV without assistance of care workers or relatives being physically present, and not all care workers knew about her TV watching habits. When Marie was handed the universal remote control, it became possible for her daughter to assist her in watching TV, an arrangement that had also existed before the relocation.

6.2 Together in Front of the TV

There are many different constellations of where, who and what people watch together. Three cases are described here: Anna’s reaction to the internal TV channel, Berit using her photo album, and viewing photos using a media center. The importance of the involved people having memories to share became evident in the following.

6.2.1 Anna's Reaction to the Internal TV Channel

One of the older resident's of the nursing home and the care workers told me that Anna, another resident who did not have a diagnosis of dementia, wanted to watch the internal TV channel in her apartment, and that her grandchildren where asking for this. Anna had earlier only been fond of watching SVT1 and SVT2 (the two oldest terrestrial broadcast channels in Sweden). I tuned Anna's TV to the internal TV channel and she was very happy to see the photos from her floor of the nursing home. She recognized many people, related things about them, and about what had happened as the photos where taken. She said, *"It is the Christmas celebrations,"* and, *"Look at that handsome man!"* She did not speak much if she did not recognize the event in the photo, and she thought she looked old in some photos. As I was about to leave, she raised her voice and pointed at the screen saying, *"Look!"* Shortly thereafter a care worker entered the apartment, and asked about the names of the people in the photos. The care worker corrected Anna when she said the wrong name of a neighbor shown on a photo. Anna mentioned that it is *"So good with these photos."* It was time for afternoon tea and the TV was turned off. A few days after this event, Anna did not remember that she had the internal TV channel, but she was happy to watch it when it was turned on.

To sum up, Anna's interest in viewing photos from the nursing home was not noted by the care workers until they watched the photos on the internal TV channel together with her. The photos made it possible for Anna to express her thoughts and for the care workers to communicate with her in a way not possible prior to the existence of the internal TV channel.

6.2.2 Berit's Photo Album

Berit had short-term memory loss and Alzheimer's disease, and was almost 90 years old. She did not take the initiative to look at her old photo albums, even if they were left visible. Berit was given and trained in using a universal remote control to watch TV programs, but she always had to be reminded to push the buttons on the remote control. The selection of photos for the TV photo album was made carefully, and required that Berit look through all her photos and that I learn the pattern of which photos she recognized. Berit could browse through the TV photo album if she were handed the photo frame, see Figure 2.

Figure 2. The photo frame remote control used with Berit's personal TV photo album.

However, there was no evidence that she did this alone or took the initiative to do so. The contact person did not have much time to sit down with Berit, but turned on the photo album, leaving a picture visible on the screen during the day. On the occasions when she sat down with Berit to discuss the contents of the photos, Berit mostly wanted to hand over the control to her. However, Berit became more of an individual to the contact person as she saw glimpses of her life. As Berit viewed the photos in my presence, she wanted to browse for herself, imitating how I did it. The relatives found that Berit became happy as she browsed among the photos. They noticed a considerable positive change in Berit's health and memory, a change that the contact person did not recognize. Berit reacted positively several times to a totally black image that was included in the TV photo album. She interpreted this as the end, which made it possible for her to interrupt the photo album activity. This could otherwise be difficult, as she sometimes forgot which pictures she had already seen.

Berit's understanding of which decade it is, or where she is, depends on where in the nursing home she is, or with whom she is interacting. As she sits in her room with me, she most often thinks that she still lives with her deceased husband, while with her relatives she is more aware of the present situation. Her understanding of where she is, is probably also affected by the photos she views.

To sum up, when Berit came to the nursing home the conversations were often guided by care workers or relatives, but Berit could guide the conversations with her relatives when the TV photo album was installed. Furthermore, Berit became more of

an individual to the contact person, meaning that more of Berit's preferences and capabilities became visible to the contact person.

6.2.3 Viewing Photos Using the Media Centers

At first, the author was the only one who used the media centre to show photos taken inside the nursing home and from the surroundings. The care workers took on the task enthusiastically when they received written instructions on how to do so. They reported that the older people watching reacted positively.

Months later, one of the older persons with dementia still pointed at the media center in the day room when she saw me and said, *"When will you play?"*

On several occasions, relatives brought CDs with family photos, which they watched together with their older relative, either in the day room or in the TV room. This seemed to be a compensation for not having a personal media center in the older relative's room. The comments on photos by relatives and older people were interrupted by the automatic change of photos, and both groups proposed a manual browsing system.

6.3 FACE Analysis

The care workers support the older residents in many of their daily routines, resulting in their having less control than when they lived independently. The following sections analyze the usage of extended TV by means of FACE. The care workers and older residents both desire that the older residents have more control, and, to a certain extent, *extended TV* became a means of transferring some of this control. The media centers were not evaluated. It was clear, however, that the older person should have more control over the photo browsing function. First Marie's TV watching is analyzed, then the usage of Berit's photo album, and finally Anna's reaction to the internal TV channel.

6.3.1 Marie Watching TV Alone

The function to be evaluated is Marie's TV watching. She watched TV by herself before moving into the nursing home, and has used the universal remote control and watched TV for hours in her apartment at the nursing home. Hence, it is assumed that she is interested in watching TV.

Before Marie used the universal remote control, it was necessary for relatives or care workers to remind her to watch TV, operate the remote control, choose channels and

switch the set off. The enabling aspect of this was low, and Marie's control was limited to reacting to others' initiative. The "original remote control" strengthened the attitude that older people need help and cannot be in control, and her relatives wanted Marie to have a universal remote control.

When Marie was given the universal remote control, she could change TV channels and turn off the TV. The enabling and Marie's control were higher than with the "original remote control"; however, she still relied on others to remind her to watch TV. Marie's attitude is difficult to assess, but her description of her trial and error handling of the universal remote control was made without seeing it as a problem. The care worker who understood Marie's interest in ice hockey was positively surprised, and the relatives thought the new remote control was a great improvement. The universal remote control strengthened the attitude of Marie as an individual with her own will.

To sum up, before Marie had a universal remote control the assistance given by care workers and relatives strengthened the conception that older people are helpless. However, the control Marie gained with the universal remote control proved this wrong.

6.3.2 Berit's Photo Album

The function to be evaluated is watching the TV photo album. Berit's interest in old photo albums and her comments while viewing her photos on the TV show that she is interested in having this function.

The technology did enable her to change photos, but she still needed to be reminded about the possibility of watching them. This was also the case with the old photo albums. She had control over what photo to watch, and it gave her influence over the discussions with her relatives. The black photo empowered Berit to end the viewing session if she was tired. Her relatives see the TV photo album as an improvement, and it mediated the message that Berit is an individual with a living history who can contribute constructively to a conversation.

On the other hand, Berit's use of the universal remote control to watch TV programs did not become enabling, since she always needed someone else to tell her to push the buttons. This made her control of the TV low, and she did not really accept the remote control as hers. This conveyed a message of a person being in need of assistance to make a decision.

To sum up, the universal remote control did not drastically alter the situation for Berit; her TV watching was still in need of human assistance in most aspects. This is in

contrast to her use of the TV photo album. The difference between these two outcomes stresses the importance of individually designed artifacts.

6.3.3 Anna's Reaction to the Internal TV Channel

The function to be evaluated is talking about memories by using the internal TV channel. Anna's positive reactions to the photos and the reminders from her neighbors indicate that Anna desires this function.

The presence of photos with content to talk about enabled Anna to discuss her memories. Her control was low, since it was the older persons at the nursing home, care workers and relatives who reminded her to watch the internal TV channel. However, she could operate the remote control by herself. Anna was very positive about the internal TV channel, and a care worker used it to train her memory. Anna's need of reminders conveys a message of being in need of assistance; however Anna's reaction to the images shows that she has knowledge to share, and enjoys talking about her memories.

To sum up, it is clear that the presence of the internal TV channel enabled memory training that could not have taken place without it, and that care workers took the opportunity to use it.

6.4 Distributed Memory Analysis

The distributed memory analysis is divided into two parts. First the artifacts are analyzed and then the processes taking placing while watching together with Anna and Berit are analyzed.

6.4.1 Distributed Memory in Artifacts

Both Marie and Berit had memory loss, and actually both of them had problems coming up with the idea of watching TV programs. However, both of them could get the idea of turning off the TV. The activity of watching TV probably reminded them of this, but without this activity it is not certain that they would remember that the TV was there. If they were to turn the TV on or off, they occasionally looked for a button on the TV, as on their old TV. This button was missing, and the red light that came on when the TV was switched off was confusing, which resulted in their unplugging the TV set.

For Marie, the universal remote control worked well in several processes with distributed memory. Her relatives assisted her by telephone (thus enabling an arrangement of assistance that existed before the relocation); the care workers

understood her interests; and she could operate the TV by understanding the logotypes on the remote control. For Berit, the universal remote control did not represent any memories that supported her TV watching. However, the black photo represented a memory since it gave her the information that she had watched all the photos and that the album had come to its end.

6.4.2 Together in Front of the TV

The photos in the internal TV channel, Berit's personal photo album, and the family photos shown using the media centers all made situations arise where the older person could contribute to the interaction. However, the interaction seemed to be most lively from all involved parties if everyone had shared memories concerning the photos. Otherwise, it was more of a situation where one party was telling and the other was asking questions. Older people and their relatives had shared memories or associations with the family photos shown at the media centers, in photos from the internal TV channel in which they had been present, and in Berit's personal photo album. The older person and the care workers had shared memories of the photos shown in the internal TV channel.

This means that the interaction was most lively if the memory was distributed between the older person, the photos and the relative or care worker. However, the relatives also expressed an interest in other photos in the internal TV channel than those they had experienced.

One of the care workers described the use of the internal TV channel as "an aid for gaining an understanding of what their [the older people] view is, and of what they apprehend." This care worker, who used the internal TV channel to ask the older people without dementia about its contents, also mentioned that it provided memory training for the older people. Her use of the photos in this way is possible because she knew what had happened as the photos were taken. She could easily compare the apprehension of the older person with her own mental image. It was observed that both people with dementia and people without learned the names of neighbors at the nursing home after they had repeatedly watched the internal TV channel.

Berit's use of her photo album depends on with whom she viewed it. With her contact person, she insisted on handing over the remote control, but with me she browsed more independently, and her relatives noticed a considerable change in Berit's memory, vitality and health. The relatives also noted that they always had enjoyable times when they met Berit to browse through the photos and that she participated

constructively in the dialogues that took place. This can be because the selection of photos was made to reflect what Berit remembered, and furthermore she guided the conversation by changing photos. Probably the discussions came to focus on topics that Berit could contribute to, and that the relatives had associations with. This is different from the photos on the internal TV channel to which Berit did not have much to contribute, even if she was told about the contents.

7. Discussion

It is clear that some artifacts do not become involved in the intended use, for instance, poorly designed remote controls. However, the everyday problem solving attitudes among older people, relatives and care workers can break such barriers in innovative ways through distributed memory processes, although there are barriers that can be broken more easily if the "right" artifact is introduced or iteratively designed. It is also clear that TV watching at the nursing home exploits distributed memory, where the outcome cannot be solely attributed to the memory of individuals.

7.1 Designing for Distributed Memory

Marie's use of the universal remote control, Berit's use of the TV photo frame, the significance of Berit's TV photo album for the interaction between her and her relatives and Anna's interaction with care workers are examples of situations where the older person took an initiative. These examples show that it is important that the artifacts of *extended TV* are parts of the users' distributed memory, meaning that they should represent memories to the individual that can be used in processes with distributed memory. This gives them greater opportunities to be in control and to choose what to do. In fact, this gives more freedom to the older person.

Furthermore, in cases where the older person enjoys a functionality, for example viewing photos, the designer should see the older person as the main user, asking questions such as, "How can the older person maintain control?" and "How can the older individual's desired interaction with others be maximized?" A designer should not start with the thought, "Let's make a simple interface; the functions that are too difficult for the older person to operate are for the care workers to handle."

With a different approach, the care workers and relatives can better understand where their human support is needed. This means that their support becomes more

individualized in nature. Furthermore, to design systems in this empowering way makes the older person's wishes visible, and thus the care workers and relatives can learn more about them. The preferences of the older person may change with time, and a deteriorating health status can indicate the need for more human assistance; hence the need for more memory functions distributed to care workers and other individuals.

One example of this design approach is an individualized TV channel, which shows all the programs the older person normally watches on the same channel. The selection of TV programs will be a direct translation from the older person, relatives and care workers to an artifact. Furthermore, browsing among channels should be possible through a trial and error method. This means that it should be impossible to end up in modes that the older person is unable to handle.

It can also be worth considering whether the older person's TV should accompany them into the nursing home to increase familiarity in the new setting. This could influence the distributed memory and draw on the older person's earlier experiences of operating the TV. However, if the TV is old, one can argue that it should be exchanged for a new one due to fire hazards and the space occupied.

Empirical findings suggest that assistive technology can reduce the need for the personal assistance given to older people (Hoenig, Taylor, & Sloan, 2003). As earlier mentioned, personal assistance can be of vital importance in lowering the feelings of loneliness among older people at a nursing home (Drageset, 2004). Hence, there is a danger that individually adapted technical solutions may leave older people lonelier than before, even if that was not the case in this study. In addition, the heightened level of social contact for the older people due to the interest shown by me as a researcher can have affected the results in a positive direction, since it undoubtedly also counteracted their loneliness. This can, of course, be very significant during periods of stress after relocations. However, Berit, Anna and Marie did not show clear symptoms of relocation stress.

7.2 Method

The design method for extended TV is described, analyzed and commented on in (Abdelmassih Waller et al., 2007). Especially, the considerations taken to include older people with dementia in the design process are commented. Hence the discussion here is limited to discussing the use of distributed memory and FACE as tools in the design process. The results indicate that the artifacts support the older people if the

artifacts act as representations in distributed memory processes. This interpretation was used to suggest modifications during the design process, but has been made more explicit in this article. The design process would most probably benefit from using a distributed memory analysis as well as a FACE analysis during the ongoing collection of data.

The lack of analysis of creativity and intentionality in this article suggests that this analysis should be combined with another type of scrutiny, perhaps by the use of situated action or activity theory. Indications of this need are Berit's lack of spontaneous use of her TV photo album, Anna's need to be reminded about the internal TV channel and Marie's problems of remembering the existence of her TV. This all concerns design for situations were the older person does not have a plan to use extended television. However, my belief is that a distributed cognition analysis directs the designer towards consistent structures that act as cognitive contours (Svensk, 2001, p. 51). These contours increases the older person's understanding of what to do, when to do it and what to expect. This is vital for the easy of use of a device (Norman, 1999, p. 174) and can be expected to be important for older people with dementia, since they have difficulties in compensating for badly designed artifacts. Furthermore, such contours can also support creative activities (Jönsson et al., 2006, p. 175).

7.3 Validity, Reliability, and Generalization

Here I define validity as the degree to which I have identified the correct causal links and explanations. This can also be called internal validity (Yin, 2003, p. 34). Action research obtains much of its validity from testing improvements in action by most at-risk stakeholders. This can give action research, in some regards, strong validity as compared to conventional social science (Brydon-Miller et al., 2003). There are, however, several threats to the validity of the conclusions drawn. These threats can be reduced by adding rigor to the research process (Figueiredo & Cunha 2007, p. 89). However, I have not, as recommended, used a theoretical framework from the beginning. Furthermore, I have not challenged the analysis using competing theoretical frameworks as suggested by Robson (2002, p. 174).

The reliability of action research projects, in the sense that it should be possible to repeat them, is generally low due to the uniqueness of each intervention. However, by using the analytical frameworks in this article (FACE and distributed memory), my interventions have given rise to recommendations that are consistent to literature on

older peoples' memory and literature on how to design for older people. This makes it possible to generalize from the research setting.

8. Conclusions

The shortcomings in the support that replaces the lost distributed memory (the memory aspects of distributed cognition) of older people moving to nursing homes were described, and it was shown, by using distributed memory analysis and FACE analysis, how artifacts can strengthen the older person's actions and control when they are a part of his or her distributed memory. It was found benificiary if the artifacts represented memories to the individual that could be used in processes with distributed memory. In addition, it was shown that used analysis, can be useful for the design processes for extended television in nursing homes, in order to provide cognitive contours. However, design processes would benefit from being combined with an analytical framework that takes human creativity and intentionality into account. Further research is recommended.

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