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Challenges and Opportunities for Collaborative Technologies for Home Care Work

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Abstract. This article offers an exploration of home care work and the design of computational devices in support of such work. We present findings from a field study and four participatory design workshops. Themes emerging from the findings suggest that home care work may be highly cooperative in nature and requires substantial articulation work among the actors, such as family members and care workers engaged in providing care for older adults. Although they provide home care for older adults in cooperation, family members and care workers harbour diverging attitudes and values towards their joint efforts. The themes emerging are used to elicit a number of design implications and to promote some illustrative design concepts for new devices in support of cooperative home care work.

Introduction

Asia and Europe may be singled out as the two regions where a significant number of countries face severe population ageing in the near future. In these regions within twenty years many countries will face a situation where the largest population cohort will be those over 65 and the average age will be approaching 50. Most of the developed world (with the notable exception of the United States) now has sub-replacement fertility levels, and population growth now depends largely on immigration together with population momentum that arises from

previous large generations now enjoying longer life expectancy (Gesano et al. 2009).

An aging population means that the health care sector becomes under increased pressure and it becomes a growing concern how to for example support elderly people in a manner that allows them to continue a quasi-independent lifestyle in their own homes rather than moving to some sort of institutional care - allowing the elderly people to stay longer in their own home makes sense seen from the elderly persons point of view as well as from the point of view of the economy of the welfare state (Gesano et al. 2009).[1]

This paper is concerned with an understanding of home care work and the design of associated technologies that may enable older adults to stay longer in their own homes for the benefit of the elderly as well as society at large. More precisely, an attempt is made to achieve a better understanding of how family members and care workers in concert contribute to the care of older adults living in their own homes and how this cooperative home care work may be supported with new information technology.

Family members and care workers in distinct yet complementary ways contribute to the care of older adults. That is, there is something akin to a division of labour in place where the relatives handle one type of tasks and the professional caregivers handle another set of tasks. In this manner the role of the relatives as caregivers for older adults is partly constituted as complementary to the role of the professional caregivers, and vice versa. The different roles or positions of family members and care workers in relation to taking care of older adults make for pronounced differences in the attitudes and values that they may harbour in regard to taking care of older adults. We hold that such issues are worth considering, as they may have ramifications for the design of new information technology. By considering these issues a greater understanding of how to design for the diverse ensemble of actors taking care of older adults might be reached.

The paper is based on ethnographic fieldwork (including interviews) as well as a series of design workshops - the main setting for the fieldwork where the home of the elderly persons receiving home care.

We will proceed in the following manner: First we will discuss related work and the methods of the study. Secondly, we will describe how family members and care workers are part of the care of older adults. Third, we will explore the values and attitudes of family members and care workers respectively. Finally, we will discuss design implications and describe two concrete design concepts.

[1] Institutional care of older adults is in general significantly more resource demanding than home care.

Related work

A wide range of publications exists in relation to home-care, coordination of care and the role of the different actors involved (e.g. the elderly person, family members and professional caregivers) as well as the role technology can take in a home-care scenario. For example, Mynatt (Mynatt et al. 2001) propose that part of the solution to the challenge of supporting 'aging in place', is to promote awareness among family members of senior adults' day-to-day activities through information technology i.e. ‘digital family portraits’. Consolvo et al (Consolvo et al. 2004) discusses the care network and how to support it. The article introduces an augmented picture frame inspired by Mynatt et al (Mynatt et al. 2001). Through miniature sensors and machine learning the frame can be updated with information to be used locally by the care network. Wittenberg-Lyles et al. (Wittenberg-Lyles et al. 2010) discuss how video technology can be used to include family caregivers in staff meetings at a Hospice. This work includes another setting, but points out how beneficial a dialogue is for both private and professional caregivers. Another article, Abowd et al. (Abowd et al. 2006), discusses how automated systems can be used to support the elderly and the care network. The article mentions e.g. ‘Monitoring’ as a key issue with elder care and care networks. Morris et al. (Morris et al. 2003) puts the focus on the elderly person and how to support an everyday life through different sensors and sensor data. This idea is also shared by e.g. Le et al. (Le et al. 2007). Demiris (Demiris 2009) discuss shared decision making where older adults gets involved in their healthcare planning. The article points out the benefits of the inclusion, but also identifies challenges when for example an older patient for different reasons has problems to participate as an equal partner in the decision process. Petrakou (2008) provides an ethnographic account of the use of a paper binder for communication between family members and care workers in relation to home care work while Rook (1987) is concerned with the emotional health of caregivers.

This paper, then, relates to both general studies of home care work (Kahn 1993; Lindley et al. 2008; Petrakou 2007; Rook 1987) as well as literature with an explicit focus on the design of technology to support elderly in the home setting (Abowd et al. 2006; Mynatt et al. 2001; Rowan and Mynatt 2005).

In relation to other ethnographic accounts of home care work this paper makes a contribution as it takes a special interest in not only the division of labour between family members and professional caregivers as they perform home care work but also the diverging values and attitudes held by the various participants. For example, whereas a number of previous studies have focused solely on the practices of the care workers (Petrakou 2007), the interest here is as indicated to explore how family members and care workers actively and in cooperation

engage in the practicalities of taking care of older adults (an interest partly shared with e.g. (Rook 1987; Spitze and Gallant 2004)).

In regard to the literature focused on the design of technology to support the elderly in the home setting this paper diverges from other papers on the subject as it aims to support *articulation work* among the network of actors that support the elderly, rather than support e.g. *awareness practices* (Mynatt et al. 2001; Rowan and Mynatt 2005) or monitoring of the elderly (Abowd et al. 2006) or the collection of senor data (Morris et al. 2003).

Methods

This paper is based on ethnographic fieldwork as well as participatory design work carried out in the course of five months in relation to home care work. That is, the authors participated in home care work observing and following home care workers as well as family members of the elderly people. The main setting for the fieldwork was the homes of the elderly recipients of home care. As part of the fieldwork, twelve semi-structured interviews where held with fourteen people (5 men, 9 women, aged 30-75) seven where family members of the elderly and seven where home care workers.

Subsequent to the fieldwork, four participatory design workshop where held, one with three family members of the elderly, another with five care workers, and finally two joint workshop with three family members and five care workers were held. Each participatory design workshop lasted between three and four hours.

Cooperative home care work

As indicated above, according to Mynatt (Mynatt et al. 2001) part of the solution to the challenge of supporting 'aging in place', is to promote awareness among family members of senior adults' day-to-day activities. The concrete suggestion that Mynatt and associates make is to provide peace of mind through 'digital family portraits' that may provide qualitative visualizations of an adult's daily life. They designed a family household object, that is, a digital portrait frame populated with iconic imagery that summarize the last 28 days of the elderly person, with the aim of providing a means for the family to remain aware of the day-to-day activities of a distant elderly relative. Although this approach may be part of the solution, there are a number of practices which awareness support alone does not address. Obviously, it does not support the ongoing communication between family members and care workers regarding the coordination of care tasks. There is far more to taking care of an elderly person, from a family member's (as well as a care worker's) point of view, than simply

being aware of how she is doing by looking at for instance icons appearing on a picture frame.

Many family members are far more than mere spectators to the lives of their elderly kin. More to the point, there is a *de facto* division of labour between professional caregivers and family members. Where the professionals, simply put, handle what may be dubbed ordinary tasks (e.g. personal care and food preparation, and etc) and the family members handle what is beyond the job description of the professionals, what is deemed extraordinary (e.g. social events and light maintenance). That is, the role of the relatives as caregivers for older adults are partly constituted as complementary to the role of the professional caregivers, and *vice versa*. We will now turn to describe this state of affairs through the example of the case of Elisabeth.

The case of Elisabeth

Elisabeth is 92 years old when we meet her. She uses a wheelchair due to partial paralysis in her left side - the effects of a stroke she suffered some ten years ago. Due to her physical condition she requires comprehensive care, day and night, including help with getting dressed, getting a bath and generally getting around. She lives alone in her own home in a senior residential area. She has regular as well as 'on call' support from caregivers employed by the municipality. That is, a team of home care workers provide Elisabeth with round the clock care. This ads up to seven daily visits, including one in the morning (getting breakfast and getting dressed), one in the evening (getting to bed), four in between (mostly meals and brief fluid intake visits) and finally a visit in the middle of the night (check up and shifting Elisabeth's sleeping position). In this manner the home care providers take care of many of the basic necessities of Elisabeth's life, including clothing, bathing, cooking, medicine, cleaning, and so on. However, there are a number of tasks that the professional caregivers employed by Elisabeth's municipality do not perform as it is not part of their job description. As a matter of principle, the local caregivers, for example, do not perform tasks perceived as directly related to participation in social events such as Christmas or birthdays. Consequently, when Elisabeth is invited to social events such as a birthday party, it is her daughter Ann who lives some 100 km away who prepares her wardrobe, irons the clothes etc. Furthermore, on the day of such an event Ann or another family member has to remind the local caregivers to dress Elisabeth in the clothes prepared for the event, otherwise they may easily forget to do so. Elisabeth does not remember such things herself.

Furthermore, Elisabeth usually spends Christmas Eve at Ann's house, some 100 km away in the city. She has done so for the past 10 years. Such a trip involves family members organizing transportation in a special wheelchair friendly taxi-bus. It also involves notifying the municipal caregivers, so Elisabeth

can receive professional care as she travels out of her own municipality and spends the holidays at her daughter's house. The latter notification is handled by Elisabeth's home municipality, her daughter merely has to call them up on the phone to make sure that they have been notified and that they are coming on the right dates.

In addition, Elisabeth's local caregivers do not handle maintenance work (again, this is not part of their job description). Included in the category of maintenance work is for example the replacement of a broken light bulb. Consequently, if a light bulb needs to be replaced, this requires the help of friends or relatives - since Elisabeth is not physically able to perform such a task herself (she is confined to a wheelchair after all). Elisabeth used to call the local electrician and have him send an apprentice over to replace the bulb. However, she cannot manage to perform this kind of phone calls any more, and may simply sit in the dark until a family member or a friend discovers that the bulb is broken and replaces it for her. In this manner the daughter for instance is involved in the care of Elisabeth if not on a daily basis then on a weekly basis.

In addition to task performance per se (e.g. ironing and replacing light bulbs) family members also assist the elderly person in her contact with the professional caregivers. That is, the family members play an active role in the coordination of the care of the elderly person. For example, Elisabeth had out-clinic cataract surgery on both eyes recently and in connection with this procedure, her daughter Ann arranged the wheelchair friendly transportation back and forth between the clinic and the home. That is, Ann made the arrangements with a local cab company. After the surgery a nurse gave Elisabeth some eye drops and told her to administer them two times a day for two weeks. However, Elisabeth frequently forgets to take her medicine and consequently Ann had to make sure that the professional caregivers who frequented Elisabeth's home received and understood this message. Ann called them and gave them instructions regarding the eye drops, as she does not herself visit her mother every day. Note how the performance of surgery on an elderly person and the subsequent related care required the involvement of not only professionals but family members as well.

In regard to Elisabeth's own efforts we may say that she does everything that she can. However due to her physical condition this is more or less limited to making gestures such as offering cookies and the opportunity for visitors to brew their own coffee in her kitchen. That is, Elisabeth is very dependent on the help that she receives.

We may say that family members and care workers collaborate and have different roles in relation to taking care of older adults. Family members, typically sons and daughters, take care of their older adults whereas care workers provide care in a professional capacity i.e. as part of their occupation. That is, family members typically care for just the one aging mother or father, whereas a professional home care provider may tend to as many as ten different elderly

individuals in the course of a week (this number easily quadruples during the course of a year). Furthermore, family members may provide care in accord with varying obligations elsewhere, whereas the team of homes care providers provides care for older adults every day.

As indicated above, there is a *de facto* division of labour between professional caregivers and family members (and not only in the case of Elisabeth). Where the professionals, simply put, handle what may be dubbed ordinary tasks (e.g. personal care and food preparation, and etc) and the family members handle what is beyond the job description of the professionals, what is deemed extraordinary (e.g. social events and light maintenance). Strauss' point is that 'in any division of labour' there is articulation work - indeed that is part of what we have described in the case concerning Elisabeth. Recall, for example, how Ann had to call the caregivers in regard to the eye drops and the wardrobe for the birthday. How do we support such articulation work involving professional caregivers and family members (as well as the older adults themselves)?

What does articulation work entail? In the words of Strauss, articulation work is a kind of supra-type work in any division of labour, done by the various actors concerning the meshing and integration of interdependent cooperative work tasks (Strauss 1985, p.8).

At this juncture we may note that the concept of articulation work has been used extensively within CSCW. A series of focused, in-depth field studies have been undertaken with the specific purpose of investigating how the distributed activities of cooperative work arrangements are articulated and, in particular, how prescribed artifacts are devised, appropriated and used for these purposes (e.g. Bardram and Bossen 2005; Carstensen and Sørensen 1996; Schmidt and Bannon 1992; Schmidt and Simone 1996). Below we will consider articulation work in the context of home care work.

At present articulation work involving family members and care workers is mainly handled through the exchange of written messages placed in a paper binder as well as the *ad hoc* use of telephones. Such a binder is for example situated in the kitchen of Elisabeth. The binder includes the nursing and care plan, specifications for medicine intake, food and liquid intake forms, as well as sheets of blank paper to write messages on. The idea is that this binder should facilitate the exchange of messages in the context of the collaboration between care workers and family members (see also e.g. (Petrakou 2007; Rook 1987)). That is, the envisioned purpose of the binder is to facilitate the coordination of cooperative home care work. However, in our experience especially care workers find the binder cumbersome to use. They are hard pressed to find the time to read and write messages in the binder, and family members find it unreassuring that there is no way of telling whether a message have been read by the care workers or not. The present form of the binder may be said to fall somewhat short of its

objective and there is certainly scope for improvement (we shall return to this below).

On the face of it, it seems as if all we designers have to do is to computer support articulation work in home care work by e.g. changing and improving the binder with information technology. This is precisely part of what we shall suggest. However, before we do so we shall attempt to deepen our understanding of the actors involved in providing home care. Concretely, we shall consider the values and attitudes that they hold in relation to home care work.

Values and attitudes

In this section, we shall explore the attitudes of family members and professional care workers towards taking care of older adults. We hold that these attitudes are worth considering, as they may have ramifications for the design concept. That is, by considering these issues, a greater understanding of how to design for the diverse ensemble of actors may be reached.

On the attitudes of family members

We will now turn to consider the attitudes of family members towards taking care of their aging relatives.

Generally speaking, family members are emotionally invested in the care of their aging relatives. That is, they are emotionally invested in the tasks that they themselves perform as well as the tasks performed by others most notably the care workers. This state of affairs may come as no great surprise, although we could ask what sort of description we are giving when we say of someone that he or she is emotional or emotionally invested? According to Ryle (Ryle 1949), being emotional is to *react* in some vaguely describable, thought easily recognizable, ways whenever certain junctures or circumstances arise. We may say that family members are emotionally invested in the care of their elderly in the sense that they are frequently e.g. glad, distraught or flustered when faced with the various circumstances pertaining to the care of their loved ones. We shall now turn to a few examples of this.

During an interview, the son of an elderly woman reports with joy how a treasured care worker handles the care of his mother with great consideration and attention to detail:

"*Joanne [the care worker] is very considerate. In the morning, she always remembers to put two lumps of sugar and lots of milk in my mother's coffee - just as she likes it. And for her weekly walk, my mother is dressed in her beige dress and her black shoes – Joanna makes sure of that. She is a gem, that Joanne!*"

Note how a great deal of joy and praise seems to be derived from the fact that the elderly woman receives her coffee in a certain way or is dressed in a particular

manner before she leaves the home for a weekly walk. Of course most people would welcome this level of attention to detail in the care of older adults. However, not everybody would react upon witnessing it as next of kin often does i.e. with joy and even elation. However, as we shall see other parts of the emotional spectrum are also at play.

In addition to joyous feelings, family members may be in a fluster or state of uneasy confusion in regard to the care that their elderly relative receives. For example, the daughter of an elderly man states that:

"My father is suffering from dementia, so he cannot really tell us much of anything about the care that he receives. I can for example ask him if he had his visits [i.e. from the care workers] and he will tell me 'no'. He will tell me that nobody has been there all day ... When I talk to the manager [of the care workers] he says that of course my father has had his three visits that day. My father probably just forgot."

In a similar vein a family member reports that there is no telling when an elderly relative last had a shower in the sense that nobody seems to be able to fully account for that. That is, neither the elderly person nor the many different care workers who frequent the home seem to have a firm sense of it. Conflicting reports or vague assertions may leave the family members in a fluster. Sometimes such uneasy confusion may give way to agitated frustration and even outright anger, as we shall see next.

Family members may express anger or become frustrated especially with what is perceived as an inability to change the manner in which care workers perform their tasks. In the words of the daughter of an elderly woman:

"*My mother does not drink enough water and this makes her dehydrate. They [the care workers] have to sit with my mother when she is served something to drink otherwise she forgets to drink it. However, more often than not they don't. I have told the manager this again and again - but nothing changes. This is serious ... one evening my mother isn't answering her phone and I drive up there to find her on the floor dehydrated. I had to call an ambulance."*

In our experience, it is common when family members describe their dealings with care workers and their managers that frustration, flustering and even anger colour their narratives. Especially what is perceived as an inability to get the message through, to change the manner in which care workers perform their tasks, seems to lead to a state of agitated frustration. Perhaps this is not surprising considering the heavy emotional investment that family member may have in the care of their elderly relatives.

The strong emotional investment in the care of e.g. an aging mother or father makes for less than perfect 'peace of mind'. We found that worry, uneasiness, concern and distress are, more or less pronounced, part of what it means to be a caring and involved relative. Is my mother in good health? Has she eaten today? Is my father in good spirits, does he get out of the house or is he just sitting there

all alone? In addition, joy and elation may be pronounced when things are in perfect order. We are so lucky that mom is so well cared for! What a great job they are doing!

Of course not every individual family member is heavily emotionally invested in the care and wellbeing of their aging relatives. Just as there are those who are engaged, there are those that are not. Indeed some family members are quite passive and have disengaged themselves from the care of their elderly family members on an emotional as well as a practical level for various reasons that we shall not get into here.

On the attitudes of care workers

We will now turn to consider the values and attitudes of care workers towards providing care for older adults.

Burnout stemming from emotional stress is a significant liability for workers in service industries (Ashforth and Humphrey 1993; Rafaeli and Sutton 1989), especially those employed in care giving professions (Kahn 1993). Care workers are often forced to manage their emotions when dealing with clients and family members. In this process they may adopt what could be described as a detached stance or attitude towards their professional work in order to safeguard their own emotional health. As such their engagement with elderly persons, compared to that of family members, is of a different nature. We may say, then, that care workers attempt *not* to become as emotionally invested as family members in the care of older adults. We shall now turn to a few examples of this.

Care workers may detach themselves from what they regard as undesirable emotional involvement by contrasting their own role with that of the family members. For example, an experienced care worker states that:

"You cannot allow yourself to get involved as if it where your own family – you have to learn to keep a certain distance."

The care worker continues and emphasise that:

"You are not some sort of spare son or daughter and you should not act like one."

As mentioned above, care workers may strive to detach or distance themselves from the emotional pressures of everyday care work. The rationale for this, according to one care worker, is that the job would become intolerable if she had to worry constantly about the wellbeing of all her many aging clients.

Care workers describe it as especially challenging and emotionally taxing to provide care for mentally unstable clients. That is, caring for elderly persons that suffer from depression with associated pronounced apathy is experienced as especially taxing. In contrast, providing intimate personal care such as washing the private parts of a client or dealing with blood, vomit, feces or urine is not regarded as demanding and being squeamish about it is portrayed as

unprofessional. The care workers see it as part of their job to set aside any personal qualms in the performance of such tasks. As one care worker express it:

"You don't have to like it [e.g. washing the private parts of a client], you just have to do it."

Turning to interactions with family members, these may also be experienced as emotionally taxing the care workers. Recall that family members may be highly emotionally invested in the care of their elderly relatives and consequently easily distraught, flustered or even angry when faced with the various circumstances pertaining to the care of their loved ones. This can at times make for highly charged interactions between care workers and family members.

Another source of tension between care workers and family members is when the relatives of the elderly person treat the care workers as something akin to servants. According to several care workers some relatives may mistake the care workers for domestic help. A care worker reports how some family members are under the impression that its is the care worker's duty to for example clear the table and do the dishes after a family dinner. Contrary to this (mis)conception several care workers emphasise that they are there to provide care and services for the elderly person rather than for the relatives of the elderly person. The care workers are generally keen to avoid being labelled or treated as 'servants' and prefer to be regarded as simply care workers.

Although it seems that care workers strive to adopt a detached attitude towards taking care of older adults, we find that this attitude is not completely dominating and of course it varies across the many relationships that the care workers enter into during the course of their work life.

Design implications

The findings outlined above can be used to draw a number of implications regarding how computer technologies might be designed to support the network of actors taking care of older adults. The main challenge is to support their articulation work in a manner that pays heed of the heterogeneous nature of the network of actors, including the division of labour and the range of attitudes towards care work that we have described.

Although as already indicated, the purpose of this paper is to support the network of actors caring for older adults, rather than older adults *per se*, it is important to remain sensitive to the issue that some elderly may feel that their personal autonomy and dignity is compromised by being e.g. the object of communication between family member and care workers.

Seen from the family members' point of view it is important to have a secure and reliable means of communicating with those care workers that frequent the home of the elderly. It is important to feel confident that the individual care worker in fact receives a message as intended. This is related to the high level of

emotional investment many family members have in the care of their elderly relatives. Furthermore, family members seem to prefer receiving messages at all times, at home or at work, concerning the wellbeing of their aging relative. Again, this preference may be seen as connected to the strong emotional investment that family members may have in the care and wellbeing of their aging relatives. Indications are that good reliable exchange of messages may provide some measure of peace of mind for family members.

Care workers seem to prefer unobtrusive communication when engaging with family members. That is, seen form the care workers' point of view receiving messages from what may be emotional family members at all hours of the day is something to be avoided or at least curbed. Messages may well have to wait until there is time and energy to deal with them. This preference could be seen as connected to the emotionally detached stance or attitude that care workers may strive for in order to safeguard their own emotional health.

Design concepts

We will now present and discuss two designs in an attempt to address the challenges described above to support cooperative home care work. As mentioned, a number of participatory design workshops were held with the authors as well as three family members and five care workers. The large number of ideas generated in these workshops were evaluated against the design implications, before a smaller selection of the ideas were refined. Two of the resulting designs are presented here as a means of illustrating some of our findings and highlighting the questions that they raise. Neither of the two designs is meant to supplant existing technology practices based on e.g. telephones. The designs provide complementary exchange of messages, while attempting to take into consideration the division of labour, the attitudes and the preferences of the diverse ensemble of actors described above.

We may note that the designs do share similar backgrounds and findings with many of the articles mentioned above in the ‘related work’ section. However, our designs are not pro-active ubiquitous or smart home systems. Furthermore, our designs do not try to empower the elderly people themselves, as this is most often not possible due to their frail condition. Instead, we aim to empower the care network surrounding the elderly person. Hence, our technology is primarily intended for the care network, and not for the elderly person him/herself. Our designs stands out by not providing automated data gathering that can provide data input in ‘the background’. As proposed by Rogers (Rogers 2006), our designs support proactive people rather than proactive systems.

Our two designs support active collaboration and communication through the designs, rather than introducing an automated sensor system that provides data that can be discussed among care network members. Our work supports creation

of data in place, by humans and through interaction between humans. This communication is supported by our described prototypes. Being rather open-ended designs, our prototypes open up for emergent, non-foreseen situations and use. Our systems do not offer monitoring of the elderly, they do not offer a safety alarm or other health status events that can be monitored, but rather facilitate the human-to-human communication (articulation work) within the care-network through technology (our prototypes).

The two design concepts currently undergo evaluation together with all members of the care network.

Augmented binder

As described above in the context of the case of Elisabeth, one intention with the (original) paper binder is to facilitate the exchange of messages and provide written information in the context of collaboration between care workers and family members. However, especially care workers find the binder cumbersome to use in its present form and are hard pressed to find the time to read and write messages in it, and the family members find it unreassuring that there is no way of telling whether a message has been read by its intended recipient or not. In its original form, there is no need to actually open the binder at each visit e.g. by the care workers, nor is there a way to signal for new information. One has to read through the whole binder to ensure that no new data is available. Indeed, our studies have shown a very diverse and sparse use of the binder in its current form. The Augmented binder design attempts to address these issues.

In the proposed augmented binder (see figure 1), messages are written with the Anoto pen and paper (Anoto 2011). The Anoto digital pen is a combination of ordinary ink pen and a digital camera (as well as supporting hardware) designed to digitally record everything written with the pen. The pen works by recognizing a special non-repeating dot pattern that is printed on the paper. The non-repeating nature of the pattern means that the pen is able to determine which page is being written on, and where on the page the pen is. The main purpose of the Anoto pen and paper is to capture and digitize what the actors engaged in care work write in the augmented binder. Furthermore, Light Emitting Diodes (LEDs) are incorporated into the binder cover and on the register tabs inside the binder in order to indicate the status of messages, and a network connection is available for propagation of information to the actors. The Anoto system has previously been used in other care and therapeutic contexts. One such example is the system Abaris that supports collaborative decision making in the care of children with autism (Kientz et al. 2006). Augmented binder is a tool for collaboration and information exchange including a range of different professional and non-professional care providers, in contradiction to Abaris that focus on different professional actors.

Figure 1. The augmented binder employs a pen for the digital capture of messages, and provide notifications of new messages employing RFID technology.

The Augmented binder is composed by three layers: (1) A physical layer (i.e. the written notes on paper), (2) a logical layer (e.g. indicators when new information is available) and finally, (3) a networked layer that support mirroring of the physical layer (the written notes) to a server for documentation and traceability as well as distribution and propagation of the logical level (e.g. status updates). As such, the network layer propagates the locally created and available functionality (layer 1 and 2) to the actors. We shall now turn to describe a use scenario in an effort to cast some light on the workings of the proposed design.

Imagine that a care worker, Sarah, comes into the kitchen where the Augmented binder is located. The Augmented binder identifies Sarah's RFID[2] badge as she enters the kitchen and signals through the LEDs on its cover that new information is now available for her i.e. the 'care-worker'. Notified by the LED light, Sarah goes to the binder, opens it up and immediately she can see where new information has been entered or updated as this is indicated on the register tabs. Once read, Sarah can close the binder or write a reply. In comparison, looking at the old binder Sarah cannot perceive when new, updated information of relevance has been entered for her to read.

Furthermore, we may note that when closing a page where new text is written for the current user, the text is logically tagged as 'read' and does not turn on the indicator LED's again for the same care worker. However, through the personal

[2] RFID is an acronym for Radio Frequency Identification and denotes any identification system in which electronic devices occur that use radio waves fields to communicate with identification units fastened to objects.

RFID tags another care worker will still receive information about what for him or her is new and unread messages in the binder.

In the same way as Sarah received a message from a family member (also equipped with a RFID tag), she can write a message to a family member (or e.g. a colleague on the night shift) to report something relevant, e.g. the need to buy new clothes for the client or inform about a shift in the clients mood. The message is tagged with the destination, in this case: 'family'. The LED on the binder's' front cover indicating a new message for the family members will be turned on the next time a family member (and his or her RFID tag) gets close to the binder. That new messages are available or that they have been read is status events that also can be forwarded to a user via the Internet. This mechanism allows the different actors to write and address messages to each other, with a notification when the different messages have been read.

Furthermore, in the binder there are sheets with boxes to check - one for each day. A checked box indicates that 'all is well' at the time the box was checked. At each visit the care worker is prompted to open the binder and assess the elderly person's situation and check any of the free boxes with the Anoto pen according to the clients status. This action, together with the RFID tag will indicate when a care worker was attending the elderly person and if all was well. If the care worker does not check the box, this results in one of three outcomes: (1) all is not OK and someone must act upon this (this can also be documented as text in the binder), (2) the person forgot or did not care to check the box and hence someone will remind the person about this and (3) no-one has visited the referred person which of course also should initiate an activity.

All information written in the binder is made available in digital form (through the use of the Anoto pen) and hence supports the documentation activity related to each referred person. Today, this is handled by some of the care workers at their office, at specific scheduled 'documentation time slots'. Here the use of a smart paper system will combine the two separate, parallel documentation activities into one and hence make the use of the binder more attractive for the care workers, since it removes redundant, time consuming and not directly care related tasks. A part from propagation of documentation data to an administrative system, only status notifications and not the messages themselves propagate to for example next of kin. The binder is intended for local use, to discuss and elaborate on issues related to the care of the older adult *in situ*. Augmented Binder supports local collaboration with the elderly person in focus, extending the original binders functionality while still being mainly a local tool for information exchange and documentation.

PressToTalk

We will now describe a design concept, called PressToTalk, for on-location exchange of voice messages between family members and care workers.

The concept PressToTalk breaks with the written form of both the original binder and the augmented binder as it relies exclusively on the exchange of voice messages. It is designed for placement in the hallway of the home of the elderly person - for everyone to pass entering or leaving. In regard to the design of the device we may initially note that it is an assembly of several units that may be combined and recombined according to the demands of the situation. Central is an indispensable base unit[3] for the play back of messages, the reminder of the units can be described as each hosting a large push button made to initiate the recording of messages for pre-defined distinct groups of actors such as 'family members' or 'care workers'. These latter units may be attached freely to the base and each other (see figure 2). In addition to these units the system includes a number of active RFID tags to be distributed among the users of the system for (unique) identification and access control. We shall now turn to describe a use scenario in an effort to cast some light on the workings of the proposed design.

Consider a PressToTalk device, placed in the home of an elderly person named Elisabeth, comprised of a base unit with a button hosting a 'play' symbol, and two auxiliary units with ‘record’ symbols where one is labelled 'Family' and another 'Care Worker'. Now imagine that a care worker presses the record button on the unit labelled 'Family’ and records a message for family members: "*Elisabeth does not drink enough water and this makes her dehydrate*". Subsequently, when a family member enters the home an RFID reader on the base unit identify an RFID badge carried by the individual relative of the elderly person and notify that there are 'new' messages. That is, the device makes a soft sound and the LCD display lights up with an indication that there is a new message for family members to playback. The LCD display is necessary in order to indicate the intended recipient in the event that more RFID badges are present in the vicinity of the device. Upon being notified, the family members may press the playback button on the base unit and hear the message. Subsequently, the family member can press the record button on the unit labelled ‘Care Worker' and record a message for the care workers: "*please observe that you have to sit with my mother when she is served something to drink otherwise she forgets to drink it - perhaps you could have a soft drink yourself, she likes the company*". This voice message may then be played back by a care worker that enters the home, etc. This is very simple and fast in use: just press a button in the hallway, state your message, and be on your

[3] The base unit hosts a microphone, a recording device, a loudspeaker, and a radio frequency identification (RFID) reader, a small LCD display and a push button with a ‘play’ symbol.

way. Subsequently, when the intended recipient enters the home, the messages may be played back at the recipient's leisure.

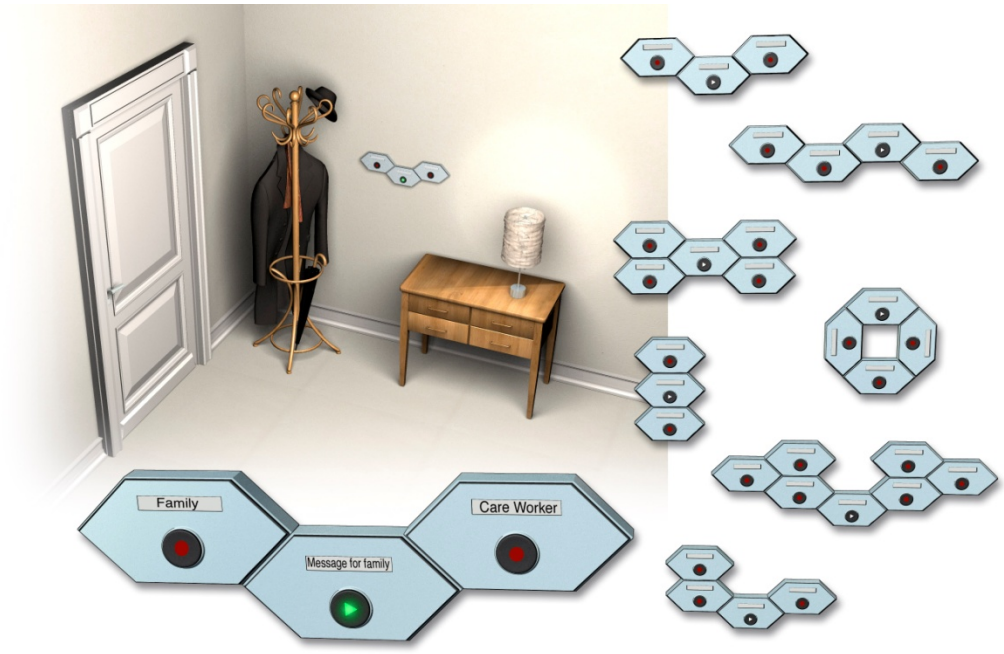

Figure 2. The PressToTalk device is placed in the hallway of the home. It is an assembly of several units (minimum one playback unit and 1-to-many recorder-units, one per user (category)) that may be combined and recombined according to the demands of the situation. The physical shapes as such are irrelevant for the functionality but allow for aesthetical considerations and make the system more adaptable and therefore more easily enters in hallways with little space, 'bending' around a picture or a coat hanger for example.

In the scenario above only two units for the recording of messages for two groups of actors, namely 'Family' and 'Care Worker' respectively, were envisioned as attached to the base unit. However, the design is open in the sense that in a future scenario more units for the recording of messages for additional groups of actors such as for example 'volunteers' and 'home care nurses' may be added if needed. This is the rationale for making the design modular. Furthermore, note that successful delivery of messages is virtually guaranteed. Unless you are hard of hearing, there is no avoiding receiving a message as the intended recipients trigger the audio indication that there are new messages for playback immediately upon entering the hallway of the home (assuming that the actors do carry their RFID badges as stipulated). If not taken into consideration, the 'new message' notification will play every time the user enters the hallway until the 'play messages' functionality is activated. This addresses the need for a reliable means of message delivery as sought after by family members and care workers alike.

In addition, note that the actors can only record messages in the home of the elderly person. Of course it would be tempting to provide the opportunity to

remotely place messages over a network, but this functionality was disregarded, as especially the care workers were concerned that it could lead to an inflation of the amount of messages. The care workers prefer to mainly interact with family members that frequent the home on a regular basis and the restriction to limit the recording to the local setting must also been seen in this light.

Furthermore, only someone carrying an RFID badge may actually gain access to recorded messages, this provides a measure of privacy not included in the binder were anyone could flip the pages and read a message. Only family members can play back messages intended for family members, and only care workers can play back those for care workers.

In addition to the part of the system immediately visible in the home of the elderly person, there is a backend server connected to the device with a network connection that allows the system to e.g. send notifications to family members via email or phone text when there are new messages for them or in the event that messages have been played back by the care workers. This service was envisioned in order to accommodate family members' preference for being in contact and receiving messages continuously. This service of remote notification is not envisioned as being used by the care workers as they tend to find such services intruding and overwhelming as mentioned above.

Finally, although the system is mainly targeted for the group of actors taking care of older adults, older adults themselves may actually use the system to create reminders to the people visiting them (and to themselves). This may be of use considering that some senior citizens may be challenged when it comes to remembering.

Conclusion and perspectives

This article has explored home care work with the aim of understanding how this might be supported with computer technology. Findings suggest that home care work may be highly cooperative in nature and require substantial coordination or articulation work among the actors, such as family members and care workers, engaged in providing care for older adults. Although they jointly provide home care for older adults, family members and care workers harbour diverse attitudes towards their joint efforts. Family members may be highly emotionally invested in the care of their aging relatives. In comparison, care workers may adopt what could be described as an emotionally detached stance or attitude towards their professional work in order to safeguard their own emotional health.

The impression of these differences in attitudes and values are further reinforced by the fact that family members seem to prefer receiving messages at all times, at home or at work, concerning the wellbeing of their aging relative, whereas care workers regard receiving messages from what may be emotional

family members at all hours of the day as something to be avoided or at least curbed.

Two design concepts were presented. The designs are centred on supporting articulation work i.e. the exchange of messages for the coordination of cooperative home care work. The first concept, namely the 'augmented binder', relies on the augmentation of an existing paper binder for the exchange of written messages between family members and care workers. The second concept, namely PressToTalk, breaks with the written form as it relies solely on the exchange of voice messages. The design concepts are presented as a means of illustrating some of our findings and highlighting the questions that they raise.

The challenge for CSCW emerging from this study is related not only to the fact that home care work is highly cooperative in nature but also to the fact that it is carried out by a work ensemble comprised of professional actors (the care workers) as well as non-professional ones (the family members). How can we with information technology reduce the cost and increase the reliability of this distributed process of coordinating and integrating of cooperative home care work while remaining sensitive to the highly diverse sensibilities, values and attitudes of the actors? The designs above offer our preliminary suggestion.

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