



COGKNOW

D1.7.1

Human Factors Impact Analysis,
field test #3

Version 1.0

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Abbreviations

COGKNOW	Project title COGKNOW; helping people with mild dementia navigate their day
WP	Work Package
MMSE	Mini-Mental State Examination
GDS	Global Deterioration Scale
PwD	Person with Dementia
CDN	COGKNOW Day Navigator
CS	COGKNOW Server
CHH	COGKNOW Home Hub
CCA	COGKNOW Cognitive Assistant
CSH	COGKNOW Sensorised Home
Carer	Partner, relative or friend who supports the person with dementia (not the professional carer, unless explicitly stated)

1. Summary

Work package 1 of the COGKNOW project delivers a Human Factors Impact Analysis of the COGKNOW Day Navigator, devices and services to support persons with dementia (PwDs) and their carers. The three field tests in the project test increasingly complex levels of functionality. The two first field tests had a focus on user-friendliness and usefulness, while the third field test also focused on the impact of the device on the PwDs' autonomy and quality of life. Each field test is carried out at three test sites, Sweden, the Netherlands, and Northern Ireland, with a total of 12-18 user-dyads consisting of PwDs and their informal carers.

This deliverable, D1.7.1, reports on the Human Factors Impact Analysis of field test #3 that was carried out in the homes of 12 persons with dementia living near Amsterdam, Belfast and Luleå. The test period of field test #3 was scheduled to have a duration of two months from 23 March until 23 May 2009. The methods used for the analysis and the work plans of the field test are described in detail in D4.5.1. The evaluation used a mixed method with data collection through (pretest) interviews, semi-structured interviews with, and observations of, the PwD, semi-structured interviews with the carer, follow-up telephone and individual home interviews, diary reported on by the carer, and logged in-situ measurements on the use of the COGKNOW Day Navigator during the test period. The mixed method included the perspective of the PwDs, the perspective of the informal carer and observations made by the researchers. The analysis was first made for each method and perspective separately, and thereafter joined in a comprehensive analysis of user-friendliness and usefulness of the tested functions at all test sites. Before, during and after the field test, dementia experts were also asked about their opinion on the user-friendliness and usefulness of the system. The impact of the system on the autonomy and quality of life of the PwD was measured through several semi-structured questions and standard questionnaires. Finally, conclusions, discussion and recommendations are presented based on a final overall Human Factors Impact Analysis of the three field tests.

The field test #3 results of the overall evaluation of *user-friendliness* indicated that the PwDs and carers were positive about the design of the stationary device: the size and sensitivity of the touch screen were found appropriate. On the stationary device, the day and time indicator was considered user-friendly, as was the reminding function, picture dialling for social support, and the radio and the music function. The help button, agenda, 'find mobile' service and the quarter-hour clock were less clear. The PwDs were able to learn and understand the device with some additional support. The reminder functionality was not used towards the end of the test period due to some instabilities in the system and technical problems. Most suggestions were related to the instability of the system and for the radio and music function to offer a larger variety of choices. The design of the mobile was also appreciated by the PwDs and carers, only the mobile was found too large and too heavy to carry around. The battery life of the mobile was perceived as problematic. The help button and music button on the mobile were not clear. Due to technical problems, the mobile was tested by fewer PwDs than the stationary device. The duration of the test period varied between 5 and 58 days. The possibility to personalise the system was seen as user-friendly by all interviewed dementia experts.

The field test #3 results of the overall evaluation of *usefulness* showed that the carers were dissatisfied towards the end of the test period with the stationary device as well as with the mobile devices, mainly because of the instability of the system. The usefulness of the different functions was related to the personal preferences and needs of the PwDs. The carers considered the time and day indication, the reminders and the picture dialling useful

for the PwDs. From the experts opinions on usefulness, it appeared that the experts in Belfast felt that the CDN may be useful for PwDs with very mild dementia, but only when the system was very simple. According to a dementia expert in Amsterdam, the system may also be useful for other patient groups besides persons with dementia.

The field test #3 results of the overall evaluation of the *impact of the system on the autonomy and quality of life* of the PwDs, showed that there were hardly any differences in the functioning of the PwDs at the end of the field test as compared to the beginning, as experienced by the PwDs themselves and as judged by their carers. The instability and technical problems need to be resolved before an impact of the system may be observed on the quality of the PwDs' and carers' life.

The main recommendation from the Human Factors Impact Analysis is that the technical problems of the COGKNOW device must be resolved. The device must have a technically stable performance before it can be tested again in the target group, as technical instability easily causes irritation and stress in these vulnerable people with dementia and their (already burdened) carers. The charging problems of the mobile device must be resolved and charging must last for at least 24 hours of normal use; the mobile device should be lighter and the touch screen less sensitive. The user-friendliness of a number of functions should be improved, e.g. the quarter-hour clock and the help button. A larger variety of music and/or radio channels may be offered. The Take-me-home function should be further developed. It is further recommended to perform an impact study within the target group only when the system is considered stable and to make use of a randomised controlled design in a larger study population.

2. Introduction

2.1. The Human Factors Impact Analysis

During the third year of the project, April and May 2009, a third prototype test was carried out (in Work Package 4 (WP4)). The third prototype resulted from further development and fine-tuning of the second prototype that was developed and tested in the second year of the project, based on field testing of a first prototype that was developed in the first project year. In this report the results of the Human Factors Impact Analysis of field test #3 as well as the final Human Factors Impact Analysis, based on the three field tests, are described.

The emphasis of the field testing in field test #1, #2 and #3 was on user-friendliness and usefulness of the system. Additionally, in field test #3, we explored the impact of the developed system on the actual and perceived autonomy and quality of life of persons with dementia (PwD) that used the COGKNOW Day Navigator for a longer period of time (1 to 2 months) and on the burden of their informal carers. The Human Factors Impact Analysis was carried out to give feedback to the technical developers within COGKNOW with the aim to further improve user-friendliness and usefulness of the prototype, but also to inform future technical developers who are interested to prepare the COGKNOW Day Navigator for the commercial public market. The main results presented in this report will be summarised in D5.6.1 Evaluation of field test #3. The conclusions and recommendations from the final Human Factors Impact analysis (see Chapter 7) will be summarised in D5.7.1: Final Evaluation report.

The Human Factors Impact Analysis is part of the user-participatory design method that is applied within COGKNOW. Based on user needs inventories in three project cycles, the literature and technical feasibility, priorities were set for functional requirements of the system and different prototypes were evaluated in three successive evaluation cycles. The analysis is based on data collected by qualified research teams at three test sites, VU University medical center in Amsterdam (The Netherlands), Belfast City Hospital in Belfast (Northern Ireland) and Center for Distance-spanning Health care in Luleå (Sweden).

The evaluation process of the third evaluation cycle involved initial needs inquiry workshops in February 2009 with PwDs and carers (see 3.2.1) in which the second version of the COGKNOW Day Navigator (CDN) was demonstrated. The aim of the workshops was to capture additional perceptions on usability and user-friendliness of the COGKNOW device. Also, additional needs and wishes of (new) users were inventoried to improve the user-friendliness and usefulness of the prototype. The collected information from the workshops, and the information from the second evaluation cycle, was then fed into the development of a new functional requirement list (reported in deliverable D1.4.3). The updated functional requirement list was the basis for the design of the third COGKNOW prototype to be tested in field test #3. Before the field test was carried out, two pre-test interviews were conducted with participating PwDs and carers. They were informed about the procedures of the test and data were collected regarding background characteristics, contextual information (e.g. on their physical living environment) and baseline data on several impact measures (e.g. experienced autonomy and quality of life). Also preferences for configuration of the devices (e.g. background colours of the screen, number of persons in the picture dialling address book, music files) were inventoried. During the field test, data were collected by means of (semi-structured) interviews and observations, in-between interviews, diaries and in-situ logging based on the research questions of field test #3 (see Annex A). In this deliverable the tested prototype, the applied evaluation methods as well as the results from the data analysis in field test #3 are presented.

Furthermore, the results of the final overall Human Factors Impact Analysis, based on the three field tests within the COGKNOW project, are described.

The evaluation and design process of the three COGKNOW prototypes have been user-participatory with contributions of PwDs and carers in all stages of the process. A basic presumption of the COGKNOW project is that the design is built on state of the art technology (hardware and software). Our informants' needs and priorities have been investigated within this framework. The key informants in the evaluation process were PwDs and their carers. The carer is not a professional carer, but a spouse, son/daughter or close friend, who regularly supports the PwD. During the field test period, the third prototype was also evaluated and tested by several dementia experts at the three test sites to get their opinion on the user-friendliness and usefulness of the system.

In this chapter, we present the aim of WP1 (2.2) and the research questions (2.5). Furthermore, the context information of WP1 is provided (2.3) together with a description of the tested device (2.4). In chapter 3 the methods are described of the pre-test evaluation activities and the field testing. Procedures during data collection and installations are also described. Chapter 4 describes the opinions of experts on user-friendliness and usefulness and in chapter 5 the view of the users is presented; the results of the field test are presented for the overall CDN and for each support area of the COGKNOW device. In chapter 6 the results of the impact on daily life of the CDN are presented (the overall impact and for each functionality separately). In chapter 7, the conclusions and discussion of the overall Human Factors Impact Analysis are described. Finally, in chapter 8 recommendations are given.

The following definition of needs, wants and demands is used (Kotler, 1980): 'A *need* is a felt state of deprivation (including basic needs, social and individual needs)'. For example, when someone says he lacks companionship, then this implies a need for social contact. Needs can be communicated as 'met needs' (I enjoy the company of my children) or as 'unmet needs' (I miss the company of my children). A *want* is the expression of a need, as shaped by a person's culture and individual development (I need someone to talk to). A *demand* is a preferred specific solution for a person to fulfil his or her need (I would prefer to talk with a professional carer) (this is also dependent on available personal resources, such as money).

2.2. Aim of Work Package 1

The COGKNOW project aims to develop a functional, user-validated cognitive prosthetic device which addresses the needs of people with mild forms of dementia living in Europe (approximately 1.9 Million people). The vision of the project is to assist these persons to navigate through their day by providing technological support for cognitive reinforcement.

WP1 of the COGKNOW project intends to ascertain the functionality and performance which the COGKNOW Day Navigator needs to fulfil in order for the service to be user-friendly, useful and adequate for testing.

The objectives of WP1 are:

- To obtain more insight into the needs and priorities of users of the COGKNOW Day Navigator, with an emphasis on the key areas remembering and reminding, supporting social contact, performing activities in daily living, and enhancing feelings of safety.
- To contribute to the user friendliness and applicability of the COGKNOW device.
- To evaluate the impact of the COGKNOW system on perceived autonomy and quality of life.

2.3. Tasks, roles and deliverables

The deliverables of WP1 report on the different tasks in the evaluation process of each evaluation cycle. For each task one of the research groups is responsible (see Table 1). The tasks include initial needs assessment, development of functional requirements and evaluation of tested prototypes. During the 3-year time period of the project the evaluation and design process is divided into three separate iterative cycles.

Table 1. Tasks, roles and deliverables in Work Package 1

WP1		Human Factors Impact Analysis	Task leader	Deliverable
	T1.1	Detailed work plan	CDH	
	T1.2	Informational and needs inquiry workshops	VUmc	
	T1.3	Needs analysis and storyboards	VUmc	
	T1.4	Iteration between User needs and Technical providers	TI	D1.4.1 D1.4.2
	T1.5	Human Factors Impact Analysis (Test #1)	NST	D1.5.1
	T1.6	Human Factors Impact Analysis (Test #2)	CDH/LTU	D1.6.1
	T1.7	Human Factors Impact Analysis (Test #3)	VUmc	D1.7.1

2.4. The COGKNOW Day Navigator, tested prototype in field test #3

The CDN tested in field test #3 consisted of the COGKNOW Home Hub (CHH), the COGKNOW Cognitive Assistant (CCA), the COGKNOW Sensorised Home (CSH) and the COGKNOW Server (CS). In this section a brief description of the prototype is provided. For more detailed information on technical aspects of the device, see the deliverables D4.5.1 and D5.6.1.

The CHH is a stationary device with a touch screen, including several functions to support the PwD in the following four areas.

- *Reminding*: a date, a day and time indication, an agenda with quarter-hour clock and pop-up reminders for appointments and activities (remotely configurable with audible signal and extended repetition), and a find-mobile device function (see Figure 1 and 2);
- *Social contacts*: picture dialling function (Figure 3);
- *Daily activities*: a device control (radio on/off, or lamp on/off), a music-player (media play back) function to support recreational activities, and an activity support service (e.g. to support in making coffee) (Figure 1);
- *Enhance feelings of safety*: a help function and pop-ups of safety warnings (household appliances warning, e.g. when the fridge door is left open (Figure 4); an extra offered function was the sensorised night lamp.

The functions on the CHH were represented by on-screen buttons with an icon and text indicating the button's function. The user could touch the button on the screen to (de-) activate the corresponding function. The reminders for a task (e.g. to have lunch, to go to a meeting centre, call a relative) had to be confirmed by touching the screen. If they were not

confirmed by the user, they were repeated during a preconfigured time period. The CHH was the central hub of the CDN and communicated with the CS, the CSH and the CCA directly.



Figure 1. The CHH main menu and find-mobile device screen



Figure 2. The CHH reminders to brush teeth and to have lunch



Figure 3. The CHH picture dialling phone book and emergency contact screen

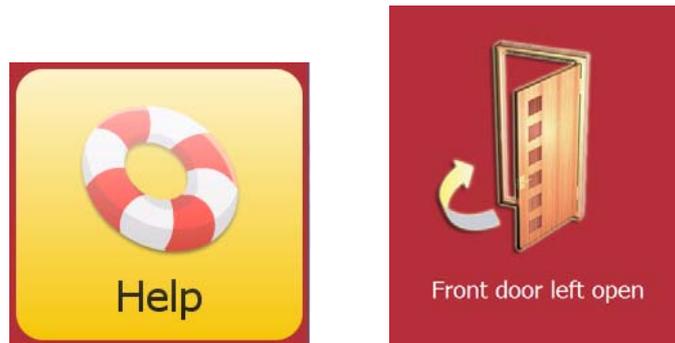


Figure 4. The help function and safety warning

The **CCA** is a mobile device with a touch screen PDA (personal digital assistant, HTC P3650, see Figure 5). Most functions on the home hub are also represented on the mobile device, except for the agenda with quarter-hour clock, the find mobile device, and the safety warnings. To support PwDs in feelings of safety when being outdoors, the CCA has a navigation function to find the way back home. The first shown screen of the CCA only indicates the time (digital and analogue), the day and the date (Figure 5, left). By touching this screen, the user arrives at the main menu, where several on-screen buttons are shown (Figure 5, right). Just as on the CHH, these buttons are icons representing the different functions of the CCA: musical notes (music-player function), a radio (radio function), a life-belt (safety function), and a home icon (the Take-me-home/navigation function).



Figure 5. CCA (mobile device HTC P3650) main menu and analogue clock screen

The **CSH** consists of sensors that can detect both open and closed states and can be placed on items in a home environment such as doors. The sensor communicates with the CHH when a change of state is detected by the sensor. When the door is left open, the sensor sends a signal to the CHH which activates a timer; the timing can be configured for a day or night time setting. When the door remains in the open state for more than the configured time period, a safety warning is issued to the touch screen. At this point the user has two options: they can either take positive action and close the door, which disables the warning message,

or they can dismiss the warning by touching the message on the screen. Disabling the warning message via the touch screen, however, only restarts the timer. As long as the door remains open, the warning message will be fired repeatedly. The message can only be stopped by closing the door.

In field test #3 (and #2) the **CS** was located in Malta as a single host. The CS was responsible for managing multiple logins at a single point of entry and for storing the day/week schedules of the participating PwDs. All information stored on the server was anonymous. During the test the user interface was configured with personalised reminders, allowing customized text and images based on the wishes of the PwD and the carers.

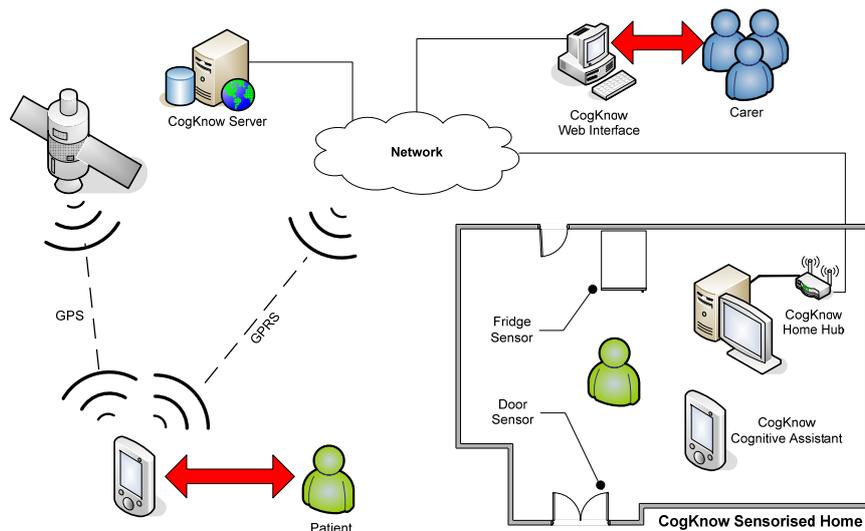


Figure 6. Overview of the infrastructure of the COGKNOW system

2.5. Human factors research questions

In field test #3, the focus of the evaluation was on user-friendliness and usefulness of the stationary and mobile devices, and on the impact of the COGKNOW system on perceived autonomy and quality of life.

The general questions on user-friendliness were:

- Are people with dementia able to use the device independently?
- What are the obstacles to independent use?

These questions were complemented with in-depth questions on general aspects of the user-friendliness of the stationary and mobile device and with questions on the different functionalities. These questions included, among other things, aspects of interaction, design, and learnability.

The general question on usability/usefulness was:

- Do the users value the functionalities of the device as supportive in their daily living?

This question was complemented with in-depth questions on usefulness for the general use of the stationary and mobile device and for the different functionalities.

The general question on impact of daily life was:

- What is the impact of the developed system on actual and perceived autonomy and quality of life of the participating PwDs and the burden of carers?

Questions included are: do people think their life have changed since they use the CDN? Do they experience a difference regarding their autonomy, mood or quality of life? Several questions were asked based on (sub)scales of existing questionnaires to measure autonomy and quality of life in this target group.

In Annex A, a complete list is provided of the formulated research questions. For each question, the method of data collection is given, which Work Package/Partner was responsible for the data collection, and also, whether the questions could be answered or not based on the data collected in the field test.

3. Methods

The research questions on user-friendliness and usefulness of the system for field test #3 were composed by the research teams in a collaborative effort. They were answered through an evaluation process. To measure the impact of the system on the autonomy and quality of life of the PwD, several semi-structured questions and standard questionnaires were used. In this process different types of data, reflecting the perspectives of the PwD, the carer, dementia experts and the researchers, were collected at the three test sites, Amsterdam, Belfast and Luleå (see 3.1.). The different types of data were first analysed separately, followed by an integrated, comprehensive, analysis. Data collection methods included (pre-test) interviews, semi-structured interviews with, and observations of, the PwD, semi-structured interviews with the carer, follow-up telephone and face-to-face interviews, diary forms on which usability and technical problems that occurred during the tests could be reported on by the carer, and in-situ logging on the use of the COGKNOW Day Navigator during the test.(see 3.3.-3.6.). The test period was scheduled to have a duration of two months, starting from 23 March 2009. Before, during and after the field test, dementia experts were asked about their opinion on the user-friendliness and usefulness of the system.

3.1. Participants and settings

The participants were recruited at three test sites, Amsterdam, Belfast and Luleå. The inclusion criteria were: a confirmed (probable) diagnosis of Alzheimer's disease (DSM IV-TR), having mild cognitive impairment (Global Deterioration Scale (GDS) stage 3 or 4 and/or Mini Mental State Examination (MMSE, 30 items) scores 17-25), and willingness to participate in the study. During the recruitment process, an effort was made to include PwDs with different backgrounds (e.g. gender, age and living conditions) to cover a variety of experiences. Informed consent forms (see Annex C) were signed by all participants in field test #3. In Table 2, characteristics of the participants are described based on the information collected during the pre-test interviews.

In Amsterdam seven PwDs and their carers were considered to take part in the field test. Three PwDs and/or their carers did not want to continue with the project after participation in the workshops: one of the PwDs said that he still functioned well and there was no need yet for him to use the system, the other PwDs had no further interest to participate. In all, four PwDs and their carers took part in both the first and the second evaluation session (at the beginning and end of the field test).

In Belfast four PwDs met the inclusion criteria and were considered for participation in the test. In all, four PwDs and their carers took part in field test #3, but one dropped out prior to completion, and one PwD and carer ended their participation earlier; three dyads took part in the first and second evaluation, while one only took part in the first evaluation session.

In Luleå four PwDs and their carers met the inclusion criteria and agreed to participate in the field test. One of the PwDs and carer ended their participation earlier, because of technical problems with the system. In all, four PwDs and their carers took part in the first evaluation and three in the second evaluation session.

Table 2. Characteristics of the participants in field test #3

Characteristics	Amsterdam (n=4)	Belfast (n=4)	Luleå (n=4)	Total (n=12)
Persons with Dementia				
Age PwD, mean \pm sd	70.8 \pm	73.5 \pm 5.00	78.5 \pm 4.04	74.3 \pm 7.58
Range	11.33 57-81	68-80	75-84	57-84
Sex, n (%)				
male	2 (50)	1 (25)	2 (50)	5 (42)
female	2 (50)	3 (75)	2 (50)	7 (58)
MMSE, mean \pm sd score 0-30	22.0 \pm 2.58	21.0 \pm 1.41	22.0 \pm 1.63	21.7 \pm 1.84
Living situation, n (%)				
together	4 (100)	4 (100)	3 (75)	11 (92)
alone			1 (25)	1 (8)
Type of housing, n (%)				
house				
apartment	3 (75) 1 (25)	4 (100)	3 (75) 1 (25)	10 (83) 2 (17)
Living area, n (%)				
town/city	3 (75)	4 (100)	1 (25)	8 (67)
village/ countryside	1 (25)		3 (75)	4 (33)
Computer facilities with internet/email, n (%)				
yes	4 (100)	0 (0)	1 (25)	5 (52)
weekly used	1	-	0	
seldom/never	3	-	1	
Mobile phone, n (%)				
yes	2 (50)	0 (0)	2 (50)	4 (33)
weekly used	2		1	
seldom/never	0		1	
Carers				
Age Carer, mean \pm sd	67 \pm 12.46	74.3 \pm 1.89	70.8 \pm 10.60	70.7 \pm 9.14
Range	53-78	73-77	55-77	53-78
Sex, n (%)				
male	2 (50)	3 (75)	2 (50)	7 (58)
female	2 (50)	1 (25)	2 (50)	5 (42)
Relation PwD/Carer, n (%)				
Partner	4 (100)	4 (100)	3 (75)	11 (92)
Other (son of sister and home help)			1 (25)	1 (8)

3.2. Data collection

3.2.1. Pre-test workshops

The pre-test workshops, that had common guidelines, were conducted with the participating PwDs and carers in February 2009. The aim of the workshops was to ask the PwDs, carers and professional carers about their opinion on perceived user-friendliness and usefulness of the COGKNOW Day Navigator and to make an inventory of any additional needs and wishes with regard to the four COGKNOW areas: reminding, social contact, daily activities and feelings of safety.

Not all participants were able or willing to participate in the group workshops and therefore different procedures were followed within and between sites: besides group workshops, individual interviews were conducted (see Table 3). During the workshops/interviews the COGKNOW Day Navigator version 3 was demonstrated and the possibilities were shown for personalising the COGKNOW device (e.g. background colours, type of buttons, and a quarter-hour clock for reminders).

During the workshops and interviews, an observer took notes. In all sites, a prestructured form was used to make notes of observations and remarks on personalisation features of the COGKNOW Day Navigator and its functionalities.

Table 3. Overview of different types of workshops and their participants

Methods	Netherlands	Sweden	United Kingdom
Workshop PwDs	3 PwDs 1 carer Age PwD 57, 66, 87 All living together with spouse MMSE 19, 23, (1 MMSE unknown)	1 PwD Age 75 MMSE 22 Living together with spouse	1 PwD 1 carer Age PwD 77 Living together with spouse MMSE 21
Workshop carers	4 Informal carers	1 Informal carer	7 Professional carers
Individual workshop Interviews	2 PwDs 2 carers Age PwD 79, 81 All living together with spouse MMSE 21, 25	4 PwDs Age 75, 76, 79, 84 3 Living together with spouse 1 living alone MMSE 20, 22, 22, 24	3 PwDs 3 carers Age PwD 68, 72, 75, 80 All living together with spouse MMSE 20, 20, 23

The results of the workshops gave additional information on user-friendliness and usefulness of the stationary and the mobile device. Additionally, some needs were reconfirmed (e.g. the importance of the date and clock and reminders), and a number of new needs were identified, such as: larger text under buttons; a voice telling the day and time when the clock icon is touched; and a visual/text indication on the screen which shows what part of the day it is (morning/afternoon/evening).

3.2.2. Pre-test interviews

Two pre-test interviews were conducted with all participants willing to participate in the field test. The interviews were done with PwDs and their carers in their own homes. During the first interview the procedure was explained and the informed consent procedure was completed. An information booklet with a brief description of the project was also provided (see Annex C). The interviews consisted of questions regarding background characteristics, baseline questions and questionnaires on impact measures and context information. If necessary, the cognitive status of the person with dementia was assessed with the MMSE to determine if they fulfilled the inclusion criteria.

During the second interview, they were asked if they were still prepared to participate in the field test and a tentative plan for their participation was agreed upon. Possible changes in background and context variables of the person with dementia and the carer were checked.

To personalise some of the functions and features of the COGKNOW device several questions were asked regarding their preferred functions. This consisted of information about persons to be included in the picture phone directory, and preferences on safety warnings and reminders and appearance of the interface (colour, icons). In addition, the position of the device in the home was discussed, taking into account the participants normal habits, the available space, and technical preferences. Information about the access of Internet connection was collected.

3.2.3. Field test interview and observation of PwD and carer

At the beginning (shortly after installation of the device) and at the end of the field test period evaluation sessions were held in which interviews and observations were conducted based on forms that were especially developed for field test #3. The forms were slightly different for the PwD and the carer. The PwD forms had (semi-)open questions for each function of the device and observation items, while the carer form contained besides (semi-)open also structured questions. The questions and observation items were developed based on the specific research questions for each area of functions (see Annex A). The questions focused on assessing user-friendliness and usefulness.

At each evaluation session prescribed tasks were performed by the PwD. These prescribed tasks covered key aspects of interacting with different functionalities of the COGKNOW device. This included general use of both the stationary and the mobile device in all individual function areas of the devices. The prescribed task list ensured that the different aspects of user-friendliness and usefulness outlined in the interview and observations forms could be answered during the field test. Some of the questions in the semi-structured interview on the PwDs form were designed to be used while performing a prescribed task and others were intended to be asked just after the tasks had been performed. The questions in the form for the carer were intended to be asked afterwards only, independent of the tasks.

In field test #3, questions were also added in the semi-structured interviews relating to the impact of the system on (experienced) autonomy and quality of life in the selected domains of daily life of the PwD. For this purpose, also several standard questionnaires were used: The Experienced Autonomy Questionnaire (Meiland & Dröes, 2006), based on the Mastery scale of Pearlin & Schooler (1978) and an adaptation of some questions from the WHOQOL-100 (WHO, 1998); the QoL-AD (Logsdon et al., 1999, 2002; Dutch translation by Bosboom, 1999); the subsections Daily activities, Memory, Unintended danger to oneself and Company of the Camberwell assessment of need for the elderly (CANE, Reynolds et al., 2000; Dutch translation by Dröes et al., 2004); and the Dementia Coping Questionnaire (Reinersmann et al. 2006). For the carer we used the following questionnaires: the Short Sense of Competence Questionnaire (SSCQ; Vernooij-Dassen, 1999); the CANE, subsection Psycho-

logical distress; the QoL-AD (family version; Logsdon et al., 2002), and an overall judgement on quality of life of the carer. Finally, to check for changes during the test period that may influence the impact of the system, at both evaluation sessions information on the use of care and welfare services was collected with the Use of Services list (Dröes & Meiland, 2006). For the same reason the MMSE was carried out again during the second evaluation session at the end of the field test.

3.2.4. Diary and in-between interviews

At the start of the field test PwDs and carers received a diary where they could write down their experiences when using the COGKNOW devices during the test. This included general experiences of usage and problems occurring. In Amsterdam, the diary was used as intended, while in Luleå and Belfast the information was collected by the researchers through regular interviews with users. Besides the diaries, bi-weekly home visits and telephone calls were used to collect several types of information from the PwDs and carers during the field test, such as: experiences on the use of the system and on possible problems (bottlenecks); occurrences of important life events; and/or changes in medication.

3.2.5. Logged digital in-situ measurement

Logged in-situ data were collected throughout the entire duration of the field test with a specifically designed computer program called the SeniorXensor, a version of the Xensor System that was extended and adapted for COGKNOW. Data were collected for the stationary and the mobile device.

On the stationary device, data were collected with a Xensor module covering functions such as: basic operation of the device, usage of reminders, use of picture dialling, use of the help function, and use of activity support. On the mobile device, data were collected with various Xensor modules covering functions such as: the performance of the battery, the location of the mobile device through a GPS function, events related to general usage and usage of the navigation support. In addition several other modules were in use, collecting data about the proper operation of SeniorXensor itself.

Due to instability of the system and technical problems during field test #3 at all test sites, the data gathered with the SeniorXensor proved to be unreliable and we had to abort the original plan of analysis of the in-situ measurements. Therefore no in-situ measurements results could be included in chapter 5 on the results of the user-friendliness and usefulness of the COGKNOW DAY Navigator in field test #3.

3.2.6. Expert evaluation

To further assist the technical development of the COGKNOW Day Navigator, the user-friendliness and usefulness of the system was tested and evaluated by dementia experts at the three sites before or after the field test. The expert evaluation was supported by a demonstration of the different functionalities. Interfaces intended for the PwD were assessed by the experts following a prestructured framework. Notes were taken of the feedback expressed by the dementia expert. Results were reported on a common template in Amsterdam and Luleå, and in Belfast on the workshop report form.

In Amsterdam two experts participated: One professor in Geriatric Psychiatry (specialised in dementia) reviewed the COGKNOW DayNavigator before the start of the field tests and one Social Geriatrician reviewed the system after the field test period. Both reviewed the system at the Dept. of Psychiatry of the VU University medical center in Amsterdam.

In Belfast seven experts participated during workshop sessions in the Belfast City Hospital before the field test period. The experts worked all in the field of dementia care and consisted of two nurses, one registrar, one Ophthalmic Surgeon, two Consultant Physicians, and one Pharmacist.

In Luleå two experts reviewed the COGKNOW Day Navigator before the start of the field test. Both experts worked in the field of dementia care: one had an education in Psychology and one in Occupational Therapy.

3.3. Procedures

The procedures used for recruitment and participation of PwDs and their carers in the field test were based on the ethical guidelines developed for the project (see Project Management Handbook, Annex C.3). The field test included persons with dementia, and their vulnerability was considered through a rigorous process of informed consent involving both the PwDs and their carers. The process followed the national ethical approvals for the project at all three test sites. A consent form was signed by all participants in field test #3 (see Annex C). The consent agreement stated that personal data were anonymised, stored in secure places, and only transferred encoded between trained researchers. All those with access to data were bound by the same ethical standards and principles of confidentiality and privacy. Special attention was given to the aspect that participation was voluntary and that the participants could withdraw from participation in the test at any time. The test was carried out at all three test sites by research teams that had been trained to follow the ethical guidelines of the project. All PwDs who were included in the field test met the inclusion criteria for informants during the spring of 2009. The consent form was signed by the PwDs and carers during the pre-test interviews.

Logged in-situ data, collected by the SeniorXensor software was first stored on the mobile and stationary devices in an encrypted form (based on a public encryption key that was specific for this study). Each night, the encrypted data that had not yet been uploaded were uploaded via a web service to a central, secure server hosted by Novay (the formerly Telematica Institute), across a line secured with SSL-technology (<https://xensor.telin.nl>). The server could decrypt the data with help of the personal code of participants in the study, but only provide access to unencrypted data to properly authenticated and authorised researchers via a website, also hosted at <https://xensor.telin.nl>. The username and password combinations for the authorised researchers were sent to them by SMS, to ensure highest standard of security. As was already mentioned in 3.2.5, the data collected by the SeniorXensor were not analysed. The measurements proveded unreliable due to instability and technical problems of the system during field test #3.

Installation of the COGKNOW Day Navigator took place between March and June 2009; for the 12 participants, the test period lasted between 5 and 58 days (see Table 4). Semi-structured interviews and observations were conducted on two different occasions with each participant, the first at the start of the test and the second at the end of the test period (one participant completed only the first evaluation). The evaluation was conducted by trained senior and junior researchers. These researchers worked under direct supervision of the responsible test-site clinical managers to ensure that proper practice was followed and all identified ethical issues were addressed.

The timing and duration of the field test at the different sites, Amsterdam, Belfast and Luleå, depended on the delivery of the COGKNOW devices. Due to delays in the technical development of the stationary and mobile device and delivery of the technical equipment at the three sites, the test period was delayed for one to two weeks from the initial starting date

of 23 March 2009, depending on the site. Though the test period was originally intended to last 2 months until 23 May 2009, due to further technical problems before or after home installation of the system, the test periods varied at the different sites, and lasted approximately between one week (minimum) to eight weeks (maximum). The test period in Amsterdam started on 9 April, lasting until 26 May in Belfast the test lasted from 30 March until 4 June; and in Luleå from 19 May until 15 June. Not all functions could be tested according to plan.

The tests started in *Amsterdam* on 9 April despite technical problems with some of the functions. The main reason for this was that the test could not be postponed anymore due to time constraints of the project, restricted availability of participants and research personnel. The installation of the technical equipment was carried out on the same day as the first evaluation session. The second evaluation session was carried out at the end of the test period after 26 to 48 days. All participants were given a manual in their local language to facilitate the use of the equipment during the field test period.

In *Belfast* the field tests were carried out between 30 March and 4th June. The technical equipment was installed on the day prior to the first evaluation session. On this day the PwDs and carers were introduced to the equipment and the different functions. The second evaluation was carried out between 9 to 58 days later.

In *Luleå* the tests were postponed due to technical problems and instability of the system. The field test started on 19 May and continued until 15 June. Installation in the home of the PwDs was done one or two days before the day of the first semi-structured interview and observation. The interviews were preceded by an introductory session where the researchers explained the functionalities of the stationary and mobile device to the PwD and the carer and encouraged them to use it as much as possible before the first evaluation session. The second evaluation session was carried out between 5 and 27 days later (see Table 4).

Table 4. Date and duration of the tests

Site	Pre-trial interviews	Site Tests (equipment and software)	User Tests	Duration of User Tests
Amsterdam	15 January – 17 February	March	14 April - 25 May	42 days
			23 April - 19 May	26 days
			14 April - 25 May	42 days
			9 April - 26 May	48 days
Belfast	30 March – 7 April	February – March	30 March - 9 April	9 days
			30 March -27 May	58 days
			7 April - 4 June	58 days
Luleå	25 March – 21 April	January – 18 May	7 April - 3 June	57 days
			19 May - 10 June	22 days
			19 May - 15 June	27 days
			20 May - 25 May	5 days
			20 May - 10 June	22 days

The main functions of the COGKNOW stationary and the mobile device were tested at all three test sites. A number of functions, e.g. the GPS system for the Take-me-home function and the Activity Assistant, were tested only at the Amsterdam site. In Amsterdam, Luleå and Belfast two researchers conducted the interviews and observations. The sessions lasted for

about three to four hours at both the first and second evaluation. The field-test interviewing and observations were completed within a duration of approximately two hours.

At each site, the technical staff was responsible for the system setup, pre-trial and on-site installation and de-installation. The system was left in the users home for about one to eight weeks. A helpdesk was organised, consisting of first line contacts (human factors researchers and local technical staff) and second line contacts (technical specialists on the different CDN functions from a number of the technical COGKNOW partners). The latter were to be contacted by the first line contact persons, if necessary. A helpdesk manual consisted of procedures to be followed when remotely configuring the system or trouble shooting problems. All telephone numbers, e-mail and Skype addresses of the first and second line contacts were listed in the manual (see D4.5.1.).

3.4. Data storage and analysis

At each test site, approval from the national ethical committee was obtained before any data collection took place. All data were anonymised to ensure confidentiality. Before any computer storage, a personal key was applied, and the key safely locked. The quantitative data were coded according to a common scheme for all sites and stored in a format suitable for SPSS analysis. Only anonymous data were exchanged between sites. The qualitative data were coded according to a common scheme for all sites using the NVIVO software. Only anonymised data were exchanged. All persons with access to data were bound by the same ethical standards and principles of confidentiality and privacy. Special training on communication skills, ethics and data protection was therefore provided to personnel at the three test sites.

The data analysis focused on answering questions about user-friendliness and perceived usefulness of the device. Descriptive analysis was conducted on the overall quantitative data as well as, for some general questions, on the data of each test site by means of SPSS. The reason for analysing some data on a site level was the researchers' interest into possible differences and variations in users' opinions on user-friendliness and usefulness of the COGKNOW Day Navigator between the sites in the three countries. Regarding the possible impact of the CDN on autonomy and quality of life non-parametric tests were conducted (Wilcoxon matched pairs signed ranks test, Chi2-tests) on the pretest and posttest data collected by standard questionnaires. The analysis of the qualitative data collected by the field test observations were analysed using NVivo. The qualitative data collected by means of the diary and in-between home interviews and telephone calls were summarised in written reports from each test site.

4. Experts opinions on user-friendliness and usefulness

The results of the expert reviews at the three test sites are summarised below. The detailed reports on the usability tests with experts are included in Annex B2.

4.1. Overall user-friendliness of the COGKNOW Day Navigator – v3

The possibility to personalise the system is seen as user-friendly by all interviewed experts. The experts in Luleå were glad that the buttons could be adjusted according to people's own wishes. The experts in Amsterdam also appreciate the fact that functions are modular, and thus can be removed or added according to persons' preferences and abilities. One expert in Amsterdam did, however, stress that all the possibilities on offer for PwDs to personalise their system need to be first screened on basic usability conditions, like colour contrast, size of icons, etc. Also the similarity in design for the stationary and the mobile device was seen as important. The stationary screen of the CDN was seen as clear with readable text and good icons by the experts in Luleå. They stressed the importance of text beneath the icons with an uppercase letter followed by lowercase letters, like in Radio. They also suggested the idea of a screen saver during the night and a detector which will start the screen when the PwD is detected in the room.

In Amsterdam one expert expressed some doubts about the sufficiency of one training session to explain the system to PwDs and carers.

4.2. Overall usefulness of the COGKNOW Day Navigator - v3

Professionals in Belfast thought the COGKNOW Day Navigator might be useful for PwDs with very mild dementia, but they stressed that it is important to have a simple system. According to one of the experts in Amsterdam the CDN is not only potentially helpful for Alzheimer patients, but also for people with CVA or Vascular dementia.

4.3. Reminding functionality

4.3.1. User-friendliness of the reminding functionality

The reminding function was considered 'very convenient' by one expert in Amsterdam. Both experts in Amsterdam liked the possibility of receiving multimodal reminders (text, sound, voice). Also, the possibility to choose to receive text messages in case a PwD does not acknowledge a reminder was appreciated.

In Luleå the multimodality of the reminders was also positively rated. The experts preferred to include a voice that is familiar to the PwD, or at least a friendly voice, since PwD's are very sensitive to voices. According to the professionals it would also be a good idea to check if the PwD actually responded to the reminder by executing the activity of which they were reminded.

One expert in Amsterdam was not sure if the day and time indication clock would still be understandable for PwD's, the other expert suggested to make the clock clearer. This could be done by changing the needles in size and perhaps even in colour. According to this expert the digital clock on the mobile will not be understandable for PwDs, the step to touch the little clock to enlarge the analogue clock is also too difficult, according to this expert.

According to the professionals in Luleå the quarter-hour clock should not change from green to red (indicating that there are only a few minutes left before the reminded activity needs to be executed). They expected that most PwDs would not recognise the abstract notion of the red colour indicating urgency. Instead, the experts suggested to always use a red colour for this indication, since for a person with dementia any event within the next hour would create a big concern to be ready for it. One of the experts in Amsterdam also pointed out that PwDs will have problems with the abstraction level of the concept of the quarter-hour clock. The other expert in Amsterdam liked the quarter-hour clock and thought it would be a good visual supplement.

The fact that the reminders can be set remotely by the carers was very much appreciated by one of the experts in Amsterdam, but he stressed the need for very simple data entry. Also the possibility to personalise the reminders e.g. by adding a picture of the person whose birthday it is, in case of a birthday reminder, or by adding pictures of a breakfast when reminded to have breakfast, to stimulate the feeling of hunger, was appreciated.

4.3.2. Usefulness of the reminding functionality

One professional in Amsterdam pointed out that the reminders would be beneficial to help persons with dementia to structure their day. Another expert on dementia in Amsterdam mentioned that there shouldn't be more than three reminders a day in the CDN. More reminders would be too stressful for persons with dementia.

The experts of Luleå and Amsterdam liked the analogue clock with day and time indication instead of a digital one. To improve the day and time indication the experts from Luleå suggested to show whether it was day or night in the clock as well .

The quarter-hour clock was seen as too difficult by one expert in Amsterdam, but since PwDs do need help with their time orientation, he suggested it might be good to have a count down with numbers.

4.4. Social contact functionality

4.4.1. User-friendliness of the social contact functionality

One professional in Belfast was impressed by the picture dialling function. Others thought that the traditional method of making calls would be more familiar for PwDs and thus more easy to perform. The experts in Luleå and in Amsterdam found the picture dialling helpful since the facial recognition by most PwD's is often intact, unlike the ability to remember names or numbers. It was seen as supportive that the names of contacts were written under the pictures. The fact that you can make a call within only a few steps is also appreciated by the professionals. Both the experts from Luleå and from Amsterdam, however, expressed some concern about the PwDs calling easily to relatives in the middle of the night with help of the CDN. Therefore they advised to configure a context-dependent rule that triggers a certain action, if a PwD wants to make a call at night. In Luleå one expert suggested a voice that would say: "Now it is night time, you will be connected to the service centre". In Amsterdam an expert suggested to program the CDN in such a way that the help button would be always available, while the picture dialling would not be visible during night time. This expert also

thought it would be better if the system would not allow calling the same person more than 6 times in a row, since persons with dementia can lose the concept of what constitutes an acceptable number of calls.

In Amsterdam one expert found the size of the pictures too small and the number of persons (8) too much. He advised that it would be better to use a traditional telephone handset, especially for people with apraxia problems. The phone that is used now can easily be put down the wrong way (upside down).

In Amsterdam one professional would have liked to see an integrated webcam with the CDN picture dialling. This way people could see the person they are talking to. This would have surplus value, because a lot of communicative information is transferred nonverbally. For people with dementia this could be an extra support in their communication. However, the expert also pointed out the fact that when the dementia progresses, a PwD might develop difficulties in detecting the difference between what is real and what not. In case someone starts to experience these problems, e.g. when a person thinks that someone actually comes out of the screen, it would be indicated to remove this function, and to reinstall the regular audio picture dialling.

The picture dialling function on the mobile was also evaluated. The experts in Luleå liked that it was the same system as the picture dialling on the stationary device. A professional from Amsterdam expressed that elderly people with cognitive intact capacities already experience problems with mobile devices, and that this could be too difficult to handle for people with dementia. He also disliked the lack of name-picture combination, as seen on the stationary device.

4.4.2. Usefulness of the social contact functionality

The experts in Amsterdam and Luleå, as well as one expert in Belfast, judged the picture dialling as helpful. There were no further comments on the usefulness of the social contact functionality.

4.5. Activity functionality

4.5.1. User-friendliness of the activity functionality

Since people with mild dementia often still use their own sound systems for listening to music or the radio, three experts in Belfast were afraid that the extra radio and music play back function on the CDN would be confusing for PwDs. The experts in Luleå, however, thought that people who appreciate music will appreciate the easy music play back function on the CDN. The possibility to personalise this function with the PwDs' favourite music was also appreciated. Both the expert in Luleå and in Amsterdam found the buttons easy to work with. The fact that the button enlarges and changes colour makes it user-friendly according to one of the experts in Amsterdam. One professional in Amsterdam said he missed a volume button, but understood the risk of confusion by adding another button. He advised to adjust the volume only one time (during installation) and to make it impossible to alter it afterwards. He was afraid for the negative consequence the neighbours might experience when the music was turned on too loud.

The experts in Luleå were afraid that the activity assistance was too abstract for PwDs to understand since it has too many steps. The experts in Amsterdam saw the potential benefit of the activity assistance, but only when it was cut into understandable steps. Some steps could be too complicated when there is planning and organising involved. A voice that

advises you what to do would be preferred. The experts advised to include an occupational therapist in the research on the activity assistance.

One expert in Amsterdam liked the idea to use the device control function for the TV, but he immediately saw problems with switching between channels.

4.5.2. Usefulness of the activity functionality

Three experts in Belfast stressed that PwDs are still able to use their own systems and they therefore did not think that the radio function and/or media playback function would enhance the performance of daily activities for the PwDs.

4.6. Safety functionality

4.6.1. User-friendliness of the safety functionality

One expert in Amsterdam was afraid that the Take-me-home function would be too difficult to use: “PwDs are already disorientated in their own home. When they are outside and have to remember to use the button and understand all the hints from the Take-me-home function, I think that it would be too much for them. “

The loud signal that is produced when the ‘find mobile’ button is touched was appreciated by the experts in Luleå. In Amsterdam the experts had doubts if PwDs would understand this function.

There were a lot of opinions on the ‘help’ button. According to the experts in Luleå the best combination would be a picture of the carer and the text HELP written beneath it. In Amsterdam an expert felt that the icon for help on the stationary device was not as clear as the icon for help on the mobile. One expert in Amsterdam found the help function useful, his advice was however to leave the button out of the centre of the screen and to give the background of the icon the colour red. The icon could be kept as it was, although in his opinion the symbolics of the icons would not be very well understood anymore by a PwD, it could be seen as extra support. The icon should be combined with the written word HELP beneath the icon. He warned that if a picture of a carer was used there would be extra burden on the carer.

4.6.2. Usefulness of the safety functionality

All experts in Belfast agreed that the door sensors would create a feeling of safety for PwDs and carers. They added that it might be valuable to send also a text warning message to carers on their mobile phone. One professional in Belfast, however, was concerned that this might cause added anxiety in PwDs. One expert in Amsterdam also especially liked the front door warning. He liked the idea of sending a message to the carer if the door still was left open even after several warnings. Two experts in Luleå and two experts in Amsterdam rated the fridge warning as helpful. A professional from Amsterdam suggested to also use a safety warning to tell the PwD to turn off the cooker when it is left on, since PwDs expressed that they were not sure whether they did or didn’t and it would improve their feeling of safety. According to the expert in Amsterdam there really is a need for something that can switch off the gas for PwD. This function and the “Open Door” warning were felt to be very important.

During the evaluation of the Take-me-home function, one expert in Amsterdam suggested that it would be very helpful if it was possible to see the home address of the PwD at the top of the screen immediately after touching the Take-me-home button. This way people can see

their address and also ask bystanders to help them (point the way) home. According to this expert this would increase their feeling of safety.

The finding item function, using RFID tags, was explained to the professionals. In Luleå they liked the function and noted that if the PwD was not able to use this anymore, a carer could use it for the things the PwD lost. In Amsterdam especially the find keys and find wallet were found helpful. In Amsterdam two experts felt that the availability of the help button would enhance the feeling of safety. In Luleå the experts found the sensorised night light useful to those that do get up during the night.

4.7. Conclusions on experts opinions field test #3

From the opinions expressed by the experts in this field test we can conclude the following:

- The availability of different functions, colours and buttons are important to *personalise* the device according to peoples' own wishes and preferences and their state of the disease. However all options should be met by basic conditions to make sure that the COGKNOW Day Navigator can be used optimally.
- *Multimodal presentation* of stimuli is also seen as an important issue to make sure the PwD is aware of a safety warning/reminder/call etc.
- The *reminder functionality* is seen as a convenient way to structure the day of PwD and be aware of the things they have to do on a day. However it is advised not to use too many reminders, because it will confuse and induce stress to the PwD. The configuration of reminders and warnings needs to be manageable by (in) formal carers and therefore the reminder configuration interface may need simplification for elderly. The quarter-hour clock is seen as too abstract to be beneficial for people with dementia. Nevertheless it is stressed that there is a need for support in the matter of time orientation. The clock is seen as a supportive function, although it might be bigger and clearer.
- The *picture dialling function* is seen as a helpful method to get into contact with others, but it should be taken into account that people could use this function in a way that will increase the burden on carers. Experts advise to program the CDN in such way that the function can be used by PwDs, but prohibit the PwDs to misuse it.
- To support *daily activities*, the music and radio functionalities are seen as helpful by the experts, but only for those who enjoy music and cannot make use of their own sound system anymore. For further development of the activity assistance it could be advantageous to consult an occupational therapist.
- The *help function* and *the safety warnings* are seen as a way to increase the feeling of safety for people with dementia. Especially the front door warning and the gas or cooker warning are seen as useful.

5. Results on Human Factors Impact Analysis in field test #3: user-friendliness and usefulness

The results on user-friendliness and usefulness of the CDN are presented in an integrated and comprehensive way, including data from all three test sites and the results of analysis of different types of data. An overview of the quantitative results on the main research questions is presented in Annex B1.

5.1. Overall user-friendliness of the COGKNOW Day Navigator – v3

The results are presented separately from three perspectives: the PwDs, their carers and the researchers. For each perspective the results of the different type of data are presented.

5.1.1. The experiences of the PwD

CDN

The quantitative data show that almost all participating PwDs were able to learn how to use the CDN: 33% acted adequately directly after the first demonstration at the start of the test, and of the others all but one PwDs acted adequately after repeated demonstration (58%). As one PwD commented in the qualitative data on how he experienced using the device: “Good, the moment you see the screen, you already have an idea where it is going to be about”. All but one (out of 12) PwDs needed support in using the device at the start of the field test. At the end of the test period (after one to eight weeks) two (out of 10) PwDs did not need support anymore. 58% fully agreed with the statement that they needed little support when using the device, but this number decreased to 30% at the end of the test period using the CDN.

Stationary device

The majority of the PwDs considered the stationary device of the appropriate size (58% at the start of the field test, 60% at the end). Almost all PwDs showed no difficulty reading the text on the screen. The button size was appropriate for all PwDs (at the start and end of the field test). At the start of the field test choosing the right button caused some difficulty in 42% of the PwDs and a lot of difficulty in 8%, while at the end, 56% had some difficulty and the other PwDs had no difficulty. The sensitivity of the touch screen was considered appropriate by nearly all PwDs (8 out of 12 at the start and all at the end). 46% of the PwDs did not find it inconvenient or stressful to have the stationary device in their home, the majority, however, found it a little bit inconvenient (36%) or a lot more inconvenient or stressful (18%). At the end of the field test, the amount of PwDs that found the device not inconvenient in their home had increased to 60%, while those who found it a little bit more inconvenient (20%) of very inconvenient (20%) in their home had decreased. The majority of the PwDs were satisfied with the location of the stationary device in their home (67% at the start and 80% at the end of the field test).

From the results of the quantitative data it also became clear that the PwDs were positive and enthusiastic about the design of the stationary device, most of them recognised and understood the icons. However some also had less positive opinions: At the start one PwD did remark that “It is too big in the room“, or “Make it a bit smaller“. At the end, some commented like “it spoils my room“. About the icons, some PwDs mentioned that the help button and the find mobile button and the quarter-hour clock were not clear. In general, however, there were many positive comments about the overall design and only a few negative ones. The PwDs did not make any substantial suggestions to improve upon the design.

Mobile device

Eight PwDs answered the questions on the mobile device. The majority of the PwDs considered the overall size and the screen size of the mobile device appropriate, and showed no difficulty reading the text. At the end of the field test eight persons were observed reading the text on the mobile and only one showed some difficulty with it. Nearly all of the PwDs found the sensitivity of the touch screen appropriate, one considered it too sensitive (at the end of the test).

All PwDs thought the mobile was appropriate to carry around at the start of the test period, while two of the PwDs who used the mobile (29%) considered it too bulky and heavy at the end. Attaching the mobile to clothes or body was not problematic for the PwDs, only one said to have some difficulty at the beginning. Five PwDs thought they would not lose the mobile easily, while one other PwD did so. Four PwDs said at the end of the field test that they had not forgotten to take their mobile outdoors, the other one had forgotten it sometimes (one PwD did not know it). When questioned about when to charge the mobile, seven PwDs replied: for three this was clear, for two this was unclear and two did not know. At the end, this was clear for four PwDs, unclear for one and one did not know. Four out of eight PwDs had no difficulty with charging the mobile (at the end two out of eight). One PwD thought he had to charge the mobile too often and three thought it was acceptable (two did not know). Two-thirds of the PwDs thought the mobile device was not inconvenient or stressful, and two-thirds did not show signs of distress when using the mobile (both at the start and end of the field test).

The qualitative data showed that the PwDs reacted in general positively to the mobile device, although one mentioned that “My husband likes those things, but I don’t”. Another comment was that the PwD thought that the mobile was less clear than the stationary device and that the function of the little clock was not clear. The PwDs made no comments on the learnability of the mobile device. Although the PwDs were positive about the potential of the mobile and the design, the PwDs were negative mostly about its stability, because the mobile device was often not working, or was taken away by the researchers because of instability problems. As one PwD said: “I think it might work, but it has to be stable”.

5.1.2. The experiences of the carer

CDN

At the beginning of the test period, 82% of the carers totally agreed that they needed little support in using the device. At the end of the test period, half of the carers totally agreed with the statement that they themselves needed little support in using the device, 30% somewhat disagreed and 20% totally disagreed with this. At the start of the field test, 37% of the carers totally disagreed with the statement that *the PwDs* needed little support in using the device,

however, this percentage decreased to 22% at the end of the field test. At the first evaluation session, almost none of the carers considered the device as easy to use for their relative for the functions they needed and found the various functions easy to remember. At the end of the field test, opinions on these questions were somewhat less negative: 30% of the carers found it easy to use and 12% found it easy to remember for their relative.

From the qualitative data, one carer suggested, in order to make the device more easy to learn and use, "To make the device smaller and improve the mobile device; and that all warnings should be in spoken text in an asking way", the signal by itself he found annoying and the PwD did not know what to do: "the mobile charger should be a simple thing where you have to put it on, this is too abstract". Another suggestion to make the device more easy to learn and use was, that "it needed to function better; more consideration of the individual needs; the system could work well, but now it did not". It was mentioned by a number of carers that they would want to use the CDN if it was available today, but as they said: "If it was stable" or "With an improved version".

Stationary device

Approximately half of the carers considered the size of the stationary device appropriate (55% at the start of the field test, 50% at the end). Almost all carers thought that reading the text on the stationary device was easy for the PwD and considered the button size appropriate (at both evaluation sessions). During the first evaluation session carers noticed that choosing the right button caused some difficulty (44%) or a lot of difficulty (11%) for the PwDs; at the end this was 22% and 22%, respectively.

Most close persons considered the sensitivity of the touch screen appropriate at the start (73%) and at the end of the field test (90%). Three thought the touch screen was not sensitive enough at the start, and one found it too sensitive at the end of the field test. During the first evaluation session, about half of the carers (46%) did not find it inconvenient or stressful to have the stationary device in their home, while 36% found it a little bit inconvenient. At the end of the field test, they were somewhat less positive: though 30% still found it not inconvenient, 50% found it a little bit inconvenient. The majority was satisfied with the location of the stationary device in the home (82% at the start and 60% at the end). 60% of the carers said they turned off the stationary device at any time.

From the qualitative data it appears that, one carer suggested to have a speaker and a webcam to support the picture dialling. To improve the form of the stationary device, one carer suggested to being able to switch off the stationary device at midnight, as it was useless to leave it on all night, costing energy. Another one said: "when you push the picture, it goes away; it would be better if the picture was still visible"; and also "problems when calling wrongly, it takes time before the phone disconnect, this should be improved, also the sound in the phone". A number of other carers did not have any suggestions to improve the form of the stationary device. The quarter clock was considered difficult for the PwD by one carer. Another carer commented that he was negative about the stationary device because they could not work a lot with it during the field test due to technical problems with the device. More carers said to have had technical problems with the stationary device.

Mobile device

Eight carers answered the questions on the mobile device. At the start, the majority of them (75%) considered the overall size of the mobile device appropriate, half of them thought so at the end. Most carers thought that the screen size was appropriate and that reading the text

was easy. Only one of the carers found the touch screen too sensitive at the start, while two thought so at the end. At the start, one of the carers thought that the mobile was too bulky and heavy to carry around, but at the end 5 carers reported this. Most carers said at the start that it was not difficult for the PwDs to attach the mobile to their clothes or body; towards the end the attachment, however, had only been applicable for two PwDs and they had some difficulty. The majority of carers reported that the PwDs lost the mobile easily and, also, that they forgot the mobile easily when going outdoors. Half of the carers indicated that it was clear to the PwD when to charge the mobile. At the start of the field test, the carers thought the PwDs were not able (25%) or needed help (25%) with charging, but at the end of the field this increased to 57% and 43%, respectively. Approximately half of the carers thought the mobile device was not inconvenient or stressful.

From the qualitative data, the carers thought that the mobile device was easy to understand and interact with, but due to problems with the technical performance the carers had limited experience of the PwD interacting with the device. Perceived problems related to the device being too large and heavy to carry around and the touch screen too sensitive and easy to make mistakes with. A problem identified by the carers was the short duration of the charge in the battery. Carers commented that “the mobile was not useable, it was hooked up at the USB charger all the time”; and also “it would be good with longer time between charging the battery”. One carer suggested that it would be best to use with as fewer icons and as few functions as possible on the mobile.

5.1.3. The semi-structured observations by researchers

Stationary device

Observing the PwDs interactions with the stationary device in the first and second evaluation session revealed that most of them had a positive attitude towards interacting with the device and also easily could identify the different icons, though some PwDs were a bit hesitant when approaching the different functions or trying to execute them. The notion that the icons represent buttons that can be pressed to activate a function, seemed sometimes unclear. Distress was observed in situations when the device was not working properly. A number of comments from the observing researchers included several times the malfunctioning of the stationary device, e.g. the reminders did not come through regularly, there were no safety warnings, the sensors were out of range, and there was no activity assistance.

When asked to perform specific tasks, most of the participants could in most cases easily identify the different icons and could also execute the task by pressing the right icon on the screen. Easy recognisable icons were the ones for music and radio. Most observed problems were related to the help icon, the agenda, quarter-hour clock and the find mobile icon.

Mobile device

Observations both during the first and second evaluation session revealed that several of the participants showed a positive interest in interacting with the device during the evaluation sessions. At the same time many of them hesitated to use it on their own during the field test, when the researchers were not in the home. This seemed related both to a general hesitation of approaching a new device that they had little experience with and an insecurity created by the lack of stability of the technical performance.

While performing the different prescribed tasks related to the mobile device, most of the participants appeared to recognise the different icons and could perform the tasks. Text in general, time and date also seemed easy to read. Exceptions were the help button and the music icon. Several of the participants accidentally activated functions when picking up the

device or when carrying the device in their pocket. The accidental activations created some confusion since they had not noticed that they performed the action.

In the observation reports the researchers several times mentioned, that e.g. the mobile device was not working during the evaluation session or had never worked during the field test, that the mobile was not stable, that the mobile was not used because it started to ring people when people had it in a purse or somewhere else, and that the system was disabled one week earlier than planned. From the quantitative data it was already clear that only a few PwDs and carers could answer the questions regarding the mobile device.

Diary and in-between interviews

Besides comments that were functionality specific, people also had general spontaneous comments in the diaries. Some comments focused on the technical functionality of the CDN: "Problems with both devices", "Battery CCA Empty", "System stopped working", "PwD broke the electricity on CHH during the night". While other comments in the diaries covered how the PwD used the system: "No use of the CDN by herself", "He needs to be remembered to use the devices", "It works fine but my partner helps or does it for me", "The CDN is not disturbing, the fridge warning is helpful for me", "System is barely used", "(PwD) is able to use all functions with assistance when the system is working properly". In the weekly interviews carers also had some general comments: "Little used, but more relaxed now than last year. He is less nervous now, more used to the system", "System was too unstable to learn". Although one PwD said that he forgot about the system at the last bi-weekly home interview some other people commented that the system was working better now and that they were pleased with the new integrated stationary devices.

Because of instability of the functionalities and differences in people who used the functionalities at different times it was not possible to investigate if people could use the system more easily after a certain period of time. The data collected at the weekly interviews show however a tendency in some PwDs: after the first week there is a slight increase in the independent use of the system, more specifically in the use of the reminder functionality, the day and time indicator, the music player, the radio and the picture dialling function.

Suggested improvements

Stationary device

The PwDs had few suggestions on improvements of the stationary device. One suggestion was that the screen should be smaller in size and another one was to add a very simple and clear list what to do this week and which day it is today.

Suggested improvements by the carers were that it should be able to switch off the device at night; that the quality of the sound could be better; that it would be helpful to add a speaker and a webcam; and that more time between charging of the battery was preferred. The carers also suggested to not include the quarter-hour clock in the Agenda, they felt it was too abstract. More buttons were suggested to be included to represent various radio channels and also to have more variation in the music offered by the music player. Carers suggested having a multi-modal presentation: using pictures, texts and voice-messages. Finally, they suggested improving the stability of the stationary device, as there were many technical problems.

Mobile device

The PwDs had no new suggestions for improvement of the mobile device. The carers suggested making the mobile less heavy and thick, and more flat. They also suggested that the battery should have larger capacity for charging and usage duration; and also to improve the warning “charge mobile”. One carer suggested having a rubber casing around the mobile.

5.1.4. Integrated results on user-friendliness

The majority of the (in total) 12 participating PwDs considered the size of the stationary device appropriate, and also about half of the carers thought the size was appropriate. The PwDs and carers reported that they could easily read the text, and they valued the sensitivity of the touch screen positively. The general opinion on the design was positive. Some buttons on the stationary device were not clear: the help button, agenda, find mobile button, and quarter-hour clock. Approximately half of them did not find it inconvenient or stressful to have the stationary device in their homes. The majority of PwDs and carers were satisfied with the location of the stationary device in their home.

From both PwDs and carers observations and answers it can be concluded that PwDs were able to learn and understand the stationary device, though they nearly all needed some support. From the weekly interviews there was a slight increase shown in the independent use of the system when using the CDN. Suggestions to improve the stationary device were mostly to have a properly working and stable device.

The mobile device was tested with fewer PwDs (eight) because of technical problems with the device: several times it was mentioned by the researchers, that the mobile device was not working during the evaluation session or that the mobile was not stable. Most of the respondents liked the size and design of the mobile at the start of the test period. Only at the end of the test period, some PwDs and most of the carers thought the mobile was too large and heavy to carry around. The sensitivity of the device was mostly considered appropriate, but some indicated that the touch screen was too sensitive, sometimes creating mistakes. Some buttons on the mobile were not clear: the help button and the music button. The battery life of the mobile was perceived problematic and also knowing when and how to charge the mobile was problematic for several PwDs. The carers perceived that PwDs would be able to learn how to use the mobile.

5.2. Overall usefulness of the COGKNOW Day Navigator – v3

5.2.1. The experiences of the PwD

CDN

The quantitative analyses of the structured questions showed, at both evaluations, that the majority of the PwDs thought that the technical support they received for the CDN was sufficient: most were satisfied with the support in general (90%). Only one PwD was dissatisfied at the end of the field test (see Annex B 1). The qualitative data show that two PwDs remarked that they did not need the CDN. A number of PwDs could not indicate which part of the CDN they thought was helpful to them or not. One PwD reported that he thought the day and time indication was helpful and also said: “I liked it that beneath all the function buttons it was said what it was or could do. That was helpful”. Which part of the CDN the PwD liked most or the least, also depended on their personal preferences, as one person explained that the music function was the least helpful to him, because he was not musical:

"It does not do anything for me". Some preferred the mobile device above the stationary device.

Stationary device

With regard to the general satisfaction of the stationary device, the opinion of the PwDs remained more or less the same over time; 83% of the PwDs were (very) satisfied at the start, and 70% at the end of the field test. The qualitative data indicated that most of the participants liked the basic concept of the stationary device and they could anticipate that it may be useful for them in their daily life, providing the functions were stable. One participant expressed his positive perception: "I really like it, it is something good when it works". Another PwD reported: "It can be very good under certain circumstances". However, there were quite a number of participants who had difficulty in perceiving the usefulness of the device. They did not have an outspoken opinion on the usefulness of the stationary device; the PwDs reported that they did not know how useful the stationary device was in relation to their needs. A few participants negatively assessed the usefulness of the device, as one PwD said: "I couldn't wait to see it removed".

Mobile device

At the start of the field test, three (out of four) PwDs were (very) satisfied with the mobile and one was dissatisfied. At the end, five reported that they were (very) satisfied, and two were dissatisfied. From the qualitative data, one PwD reported that the mobile device was not useful to him, because he could still use his other phone. Another PwD thought that it was not useful for him for a different reason, as he said: "We have mobiles enough." A number of PwDs were positive and one also liked the clock on it; another said it was valuable to him as it was always available.

5.2.2. The experiences of the carer

CDN

The quantitative analyses showed that the majority of the carers thought that the technical support of the CDN was sufficient (67% at the start and 78% at the end of the field test). Although 90% of the carers were (very) satisfied with the CDN in general at the start of the field test, this had dropped to 33% at the end. Only one carer (10%) was dissatisfied at the start, but at the end of the test period the number of dissatisfied carers increased to six (67%). There was a large variation in carers in answering the question which part of the CDN they thought was most helpful for the PwD. This probably depended on the personal preferences, but was possibly due to instability of the system as well. The reminders were often mentioned as being most helpful and valuable. One carer commented, however, on the reminders: "But this disappeared quite some times". They also mentioned several times the helpfulness of the picture dialling function.

Some carers thought that none of the parts of the CDN were helpful for the PwD they cared for, as one said: "None, unfortunately". The radio and music function were considered the least helpful in daily life. The stationary device was considered more important than the mobile, as one carer stated: "For the stationary there are no alternatives, for the mobile there are (senior phones)".

Stationary device

Unlike the PwDs, who were mostly satisfied with the stationary device at both evaluations, the carers were in general satisfied at the start of the field test (82%), but less so at the end (50%). At the first evaluation, from the qualitative data, the usefulness of the picture dialling was mentioned several times. One carer reported that the stationary device was useful, because it structured the day. At the second evaluation at the end of the test period, few positive statements were made on the usefulness. Some comments were: “Too difficult to use it by himself, he does not look at it”, “She showed no interest in it”, and “Doesn’t need it yet, can be helpful if he learns how to use it”. A positive statement made by a carer was: “Useful, she is more confident in herself, she knows that she can fall back on something she knows and understands”.

Mobile device

All eight carers who participated in the test of the mobile device were (very) satisfied with the device at the start of the field test. However, at the end of the field test only one carer was satisfied with the mobile device, and six were dissatisfied (one never used it and therefore had no opinion). The qualitative data showed at the first evaluation that a number of carers were in doubt about the usefulness of the mobile for the PwD. One carer said: “The mobile device may be useful, but she’ll probably lose it”. At the second evaluation there were more negative comments than positive ones, for example: “Can be useful but needs improvement”, “Not useful, it doesn’t work properly”, and “She has to use it, but she has not been willing to test it”.

5.2.3. Integrated results on overall usefulness

Most PwDs and carers were satisfied with the overall CDN at the beginning of the test period. They liked the basic functions of the stationary device and thought it might be useful for them in daily life. At the end of the test period, however, while still only one of the PwDs was dissatisfied, most carers were now dissatisfied with the CDN, mainly because of the instability of the system. Among the carers there was a large variation on which part of the CDN they thought was most helpful for the PwD. The PwDs had difficulty indicating which part of the CDN they thought was helpful to them or not. The technical support of the CDN was considered sufficient by both PwDs and carers. The stationary device was considered more important than the mobile.

Opinions on the usefulness of the different functions on the stationary device were quite often related to personal preferences and needs of the PwDs, but it may also have depended on which part of the stationary device was unstable. Many PwDs could not perceive the usefulness of the stationary device; they did not know how useful the stationary device was in relation to their needs. The carers considered the time and day indication together with the reminders very useful for the PwD. Carers also considered the picture dialling function useful, but they differed in their opinions on the usefulness of the radio and music functions. Some PwDs mentioned that the radio and music function were least helpful in their daily life.

PwDs were in general satisfied with the mobile device. The carers were satisfied about the mobile device at the start of the test period, but not anymore at the end. Although at the first evaluation the carers were still in doubt about the usefulness of the mobile for the PwD, at the second evaluation, mainly due to technical instability of the mobile device, they predominantly gave negative comments about the usefulness.

5.3. Reminding functionality

5.3.1. User-friendliness of the reminding functionality

In the COGKNOW area of reminding and remembering, the following functions were aimed to be tested: pop-up reminders; date, day and time indication; the agenda with quarter-hour clock; and the find mobile/other items function.

The PwDs' experiences of design and interaction

The quantitative data showed that all PwDs (five receiving reminders) thought the reminders were easily heard when they were in the room, and when they were in another room reminders were still audible for 50% (at start of field test) and 67% (at the end of the field test). Three out of five PwDs thought that the frequency of repetition of a reminder was appropriate, two did not know. At the end, two thought the repetition was appropriate and three did not know. Most PwDs showed no emotional reaction to the repetition. Acknowledgement of the reminder was not difficult for two of the three PwDs at the start, and one out of two at the end. The other two had some or a lot difficulty with the acknowledgment of reminders. The question on timeliness of reminders was answered by two PwDs (at the start of the field test) and three PwDs at the end field test: All, but one at the end, agreed that the time of receiving the reminder was appropriate. None of the PwDs (five at the start and seven at the end of the field test) judged the reminder function as inconvenient or stressful.

Although the reminding functions were mostly considered recognisable and understandable by the PwDs, the qualitative evaluation showed, however, that the little clock on the mobile device for some PwDs was not clear or understandable. As one PwD said: "The function that when you push the little clock the bigger clock appears is a bit difficult". Other functions that some PwDs experienced as difficult to understand were the 'find mobile' icon and the help function. From the observations made by the research teams, it was also reported that the help button, the find mobile and the quarter-hour clock were difficult at times to understand for the PwD.

The PwDs' experiences of learnability

About one-third of the PwDs always understood the reminder at the start (2 out of six) and end of the field test (two out of five). The other four PwDs at the start sometimes did not understand the reminder, while at the end one sometimes did not understand and two never understood the reminder. The day and time indicator was quickly learned after the first demonstration by the majority of PwDs and most could recall how to use this function. It proved more difficult to learn how to use the quarter-hour clock. Almost none of them were able to use it in a correct way (100% were unable at the start of the field test and 75% at the end of it). None of them could recall this function. The qualitative data contained no further information.

The carers' experiences of design and interaction

The majority of the carers thought the reminders were easily heard when they were in the room. In another room reminders were still audible according to 100% of the carers at the start of field test, but this percentage decreased to 17% at the end of the field test. Most carers thought the frequency of repetition of reminders was appropriate. Though at the start all carers expected the acknowledgement of the reminders (by touching the screen in the center) to be easy manageable for the PwDs, only 40% of the carers still had this opinion at

the end of the field test (40%). At the start of the field test only three carers answered the question about the timeliness of reminders and all considered it appropriate. At the end of the field test three out of eight carers considered the timing of the reminders appropriate.

At the start of the test, most of the carers (83%) did not find the reminder function inconvenient or stressful, but at the end only 44% thought so. The majority (56%) then considered the reminders a little bit inconvenient or stressful for the PwD. In the qualitative data it was also suggested to make the reminding service more stable, as one carer added: "I set my own reminders but saw few on the screen". In general the carers thought that the reminders were easy to read and understand. One carer thought that the agenda function was not well visible. A suggestion by another carer was to make the reminders more context aware, for example "Work with GPS in the taxi that is ordered. You never know when they arrive, and [when the reminder is fixed and the taxi arrives late] the reminding message 'taxi is coming' will be offered too early".

The carers' experiences of learnability

At the start of the field test 33% of the carers thought the PwDs always understood the reminders, this decreased somewhat to 25% at the end of the field test. The majority of carers thought the day and time indicator was easy to learn and to recall for PwDs. One carer suggested enlarging the clock.

At the start of the field test, learning how to use the quarter-hour clock was considered difficult for PwDs by 20% of the carers (one out of five). At the end only three carers responded to this question, as it was not applicable (anymore) for the others; two thought it was difficult and one did not know. Carers thought the PwDs did not recall this function or recalled it with some problems. It was also mentioned by one of the carers, from the qualitative data, that the quarter-hour clock was difficult to understand.

Diary and in-between interviews

From the people who filled in the diary it appeared that people started to use the reminders on the stationary device from the second week on, after a non-usage period in the first week. However, at the end of the field test they stopped using the reminding function. At this time the reminders did not come in on the CHH and the CCA consistently. Sometimes they fired only during the morning, or they fired at the correct time but weren't shown on the screen. People were positive about the reminders, since they helped them remember to go to, e.g., the meeting centre. They commented that "it would have been nice to see what is coming tomorrow and what to bring to those appointments". Some carers also mentioned in the diary that they liked the breakfast reminder, since they were afraid that their spouse would not eat otherwise. From the bi-weekly home interviews it appeared that the PwD's liked the pictures that were shown in combination with the reminders. Although the idea of the reminders was rated positive, there were also some comments made in the diaries about how the reminder function worked. One carer wrote: "She (PwD) does not understand what to do when a reminder comes in, so it (the CDN) keeps beeping". Another carer wrote: "The stationary device agenda showed 'No appointments today' but we did have appointments, this is confusing". The importance of a properly working agenda was stressed by one carer: "He (PwD) does not look at the CDN for the date and time, he used to do so but since the reminders are gone he is not tempted to look at the CDN anymore". The PwD himself was also aware of this "You use the system, when it attracts your attention". The day and time indicator was mostly rated positive in the diaries. Due to problems with the CCA and with the Wifi-connection between the CCA and the CHH there were only a few comments about the

Find Mobile function in the diaries: Some carers found the function positive, some found it negative.

Data from the bi-weekly home interviews on the user friendliness of the reminders, show that during 4 *observation* moments with in total 11 observations with PwD's, there were 4 observations where PwDs were able to use the reminder functionality on the CHH without assistance and there were 7 observations where PwDs could not use this functionality without assistance. The experience of the PwD's whether they can use the reminder function with or without assistance, is the same as the observations of the researchers. For the reminders on the mobile device there is only data from one bi-weekly observation moment with 3 observations with PwDs. Here 1 PwD was able to use the reminder function without assistance, the two others PwDs were not able to use it and thought so as well, although one PwD declared he did not know whether he could or not. The carers were also *asked* about their beliefs whether a PwD could use a separate functionality without assistance. For the reminder function there were 5 different weekly question moments. In total there were 16 observations of carers. A small majority of the observations showed that carers felt that PwDs could not use the reminder function without assistance (9 from the 16). Seven observations showed carers who felt their spouse could use the function without assistance. One of the comments of the carers was for instance that the PwD did not always confirm the reminder when he performed the action. There were also 8 observations from carers on the reminders on the mobile device. Here as well the majority of the observations showed that carers felt that the PwDs could not use this function without assistance. There was only one observation from a carer who felt the PwD could use this function without assistance.

From the bi-weekly home interviews it appeared that the day and time indicator on the stationary device could be used by the PwD without assistance. 4 observation moments with 12 PwDs showed that all PwDs were able to use this function by themselves. The observations with the mobile were alike, 7 of the 7 observations with PwDs showed that the PwDs were able to use the day and time indicator without assistance. There was no difference between the experiences of the PwDs and the observations of the researchers. From 16 observations of carers that were collected during 5 weekly interviews, 10 show that carers feel that a PwD can use this function without assistance. Five observations showed that carers felt that the PwD could not use this function without assistance. In 3 cases it appeared that carers did not know whether a PwD could or couldn't use this functionality without assistance. One of the carers mentioned that the PwD "rather looks at the newspaper". There are also 12 observations from carers on the day and time functionality on the mobile. The majority of the observations (9) show that carers felt that the PwD can use this function without assistance. Three observations show carers who think the PwD does need assistance to use the day and time indicator on the mobile.

There are more problems reported with the Find Mobile function. During the bi-weekly interviews where 9 observations with PwDs were collected, 7 observations showed that PwDs were not able to use this function without assistance. Two observations showed PwDs able to use this function alone. There was no discrepancy in the way PwDs experienced their own abilities to use the Find Mobile function and the observations of the researchers. From 5 weekly interviews with in total 11 observations from carers, 6 show that carers felt that the Find Mobile function cannot be used without assistance by the PwD. Three observations show carers who do feel the PwD is able to use it on his own, and 2 show carers who did not know whether a PwD could or could not use it on its own.

Integrated results on user-friendliness

None of the PwDs found the reminding function inconvenient or stressful. Most of the carers thought the reminders were not inconvenient or stressful at the start of the test period, but at the end, the majority considered the reminders a little bit inconvenient or stressful. The

reminders were easily heard and the frequency of repetition was appropriate. Acknowledgement of reminders was not difficult for most PwDs, and carers also thought that this was easy for the PwDs, at least at the start of the field test. Towards the end of the field test, the carers considered this more difficult for the PwDs: The reminders were not always understood by the PwDs and the carers confirmed this. From the diary we see that at the end of the field test, the PwDs do not use the reminders anymore due to instability of the system and technical problems. The day and time indication was user-friendly for the majority of the PwDs. This was also confirmed by data from the bi-weekly interviews: the PwDs were able to use the day and time indicator without assistance. The quarter-hour clock was too difficult to learn and understand for most of the PwD. The PwDs could also not recall the quarter-hour clock. The help function and the find mobile function were sometimes difficult to understand for the PwDs. Problems related to these functions also came forward in the bi-weekly interviews.

5.3.2. Usefulness of the reminding functionality

The experiences of the PwD

Because not all PwDs had configured all the reminders and because in some of the homes the reminders could not be tested, the questions on usefulness of specific reminders could only be answered by some of the PwDs. Five PwDs answered the question on supportiveness of a reminder to eat: Three of them considered this very supportive, while two PwDs found it sometimes supportive. At the end of the test, however, no PwDs (four) reported that the reminder to eat was supportive anymore. Two (out of two) PwDs thought that the reminder for phone calls was very supportive, but again at the end, the one PwD who answered this question considered the phone reminder not supportive at all. New reminders (adjusted to the wishes of PwDs, such as appointments with the doctor and the meeting center), were considered sometimes or very supportive by four PwDs, and not supportive at all by one PwD. Three PwDs were (very) satisfied with the reminder function, one was dissatisfied, and one did not know. At the end of the test period, half of the reminders were considered supportive, the other half not supportive; six out of seven PwDs were (very) satisfied with the reminder function and only one was dissatisfied. The majority of PwDs considered the reminders useful to support their memory at both evaluations sessions. From the qualitative data it appeared that one PwD said that the reminders helped him most in daily life. Another comment from a PwD was that the CDN was considered most valuable for the reminders, which were useful.

All PwDs thought that the day and time indicator was (very) useful to support their orientation. Again by one PwD it was mentioned (in the qualitative data) that the CDN was considered most valuable for the day and time indicator and that this part was most helpful in his daily life.

The experiences of the carer

The reminders to eat were considered supportive by three (75%) carers at the start of the field test, and by two (50%) at the end, the other carers considered it not supportive. The reminder for phone calls was considered supportive by three carers (100%) at the start of the field test. At the end none of the carers answered this question, as it was not applicable due to problems with this functionality. Questions on the other reminders (for daily activities, to charge the battery of the mobile, and new reminders) were answered by a few carers and they considered them most of the time supportive (67%) at the start, but not supportive at the end (100%). At both evaluations, the reminder function was appreciated by six out of ten carers, whilst four were dissatisfied with this functionality. All carers thought that the day and

time indicator was (very) useful to support the time orientation of the PwD; 75% thought so at the end. Several carers also mentioned (in the qualitative data) that the reminders were considered most valuable for the PwDs. One of the carers suggested removing the alert sounds from the reminding service, while another commented to include a voice that tells/asks you what to do. Another suggested: "It would be nice if other people could enter the CDN to make appointments with me". One carer thought the reminders were most valuable, but added "When they worked".

Integrated results on usefulness

The majority of PwDs was satisfied with the reminder functionality. Because not all PwDs had reminders configured and sometimes these could not be tested, the questions on usefulness were only answered by a few PwDs. The majority of PwDs considered the reminders useful to support their memory. Most carers, however, were not satisfied with the reminding functions, mostly due to stability problems with this functionality. All PwDs and most carers thought that the day and time indicator was useful to support the time orientation of the PwD.

5.4. Social contact functionality

In the COGKNOW area of social contact support, the basic audio call and picture dialling function were tested and evaluated.

5.4.1. User-friendliness of the social contact functionality

The PwDs' experiences of design and interaction

The basic audio function of the picture dialling function was considered appropriate or very good by 57% (4/7) of the PwDs at the start; at the end 83% (5/6) considered it appropriate or very good. At the start of the field test, however, 71% had a lot or some difficulty hearing his interlocutor, only 29% had no difficulty with this. At the end of the field test 83% had a lot or some difficulty hearing his interlocutor, and 17% had no difficulty with it. All PwDs could easily recognise the pictures of the persons in the address book on the stationary device as well as on the mobile device. They almost all thought that the icon for picture dialling was easy or good to use. Approximately half of the PwDs (5 out of 9 at the start; 4 out of 8 at the end) found the picture dialling function not at all inconvenient or stressful. Two persons at the start of the field test found it a lot more inconvenient or stressful than regular phone calling. The other PwDs thought it was a little bit more inconvenient. The qualitative data revealed no further information.

The PwDs' experiences of learnability

At the start of the field test period, nearly all PwDs (9 out of 10) thought that the picture address book on the stationary device was easy to use, one PwD considered this not easy but appropriate. On the mobile device, half of the PwD (3 out of 6) were always able to handle the address book, while the other half sometimes succeeded and sometimes not. At the end of the test period, still half of the PwDs thought that the picture address book on the stationary device was easy to use and 38% considered this appropriate. Only one PwD (12%) said that it was difficult for him to use the picture address book on the stationary device. On the mobile device at the end of the test period, 2 out of 5 PwDs were always able to find

the contact to dial and 3 out of 5 PwDs sometimes succeeded and sometimes not. In general, the ease of use on both devices facilitated the learning process.

All of the PwDs could also use the dialling function of the helpbutton adequately after the first (30%) or after repeated explanation (70%). The open questions posed to the PwDs added no new information.

The carers' experiences of design and interaction

The basic audio function was considered appropriate or very good by most of the carers. The audibility of the call was considered too soft by 14% at the start of the field test and 60% at the end. The other carers considered it appropriate. Most of the carers thought there were no difficulties in recognising pictures of the persons in the address book on the stationary device or on the mobile device. Only one carer at the start thought that the picture size on the mobile was too small. The majority also thought the picture address book was easy to use. At the start one carer (14%) thought that the picture address book on the mobile was difficult to use; and at the end two carers (28%) reported that the picture address book on the stationary device was difficult to use for the PwD. All carers found the picture dialling not at all, or only a little bit, inconvenient or stressful at the start. At the end, two carers (25%) reported that the picture dialling was a lot more inconvenient or stressful than normal phone calling.

From the qualitative data, it was suggested that "The quality of the sound could be better, to leave the picture visible if you call someone (on the mobile device), incoming calls are not obvious and it would be nice if you could see a picture from the person who is calling you (If this person is programmed in the address book)". Further suggestion to improve the picture dialling function was to keep it as practical and simple as possible. Some comments were related to the instability of the system (the phone kept on ringing sometimes and saying 'pick up the phone').

The carers' experiences of learnability

In general the carers found the picture directory easy to understand and to use for the PwDs and that ease of use facilitated the learning process.

Diary and in-between interviews

Picture dialling was rated positive in the diaries by several carers. However there were some negative comments on how the function worked: "The CDN keeps ringing too long after an incoming call", "The quality of the sound is not that good", "Not possible to stop a call", "The called one heard a fax noise". Two carers noticed that when the PwD wanted to make a phonecall and per accident pushed the telephone icon too long, the system immediately called the person on the photo that appeared when the phone icon vanished. They therefore suggested leaving the space free in the address book, where the phone icon is situated. They also wrote that the picture dialling worked well if you picked up the phone directly instead of pushing the icon, and that the phrase "pick up the phone" was very helpful. Carers stressed the importance of training how to use the picture dialling function in the diaries: "Practiced today but it goes difficult", "(...) (PwD) needed help working with picture dialling". Yet there were also several quotes on the positive effect after using the picture dialling, like: "She called our son today and she liked it a lot". During the bi-weekly interviews there were some carers and PwDs who said that the PwDs did not use the picture dialling much since they were a bit afraid of it.

The picture dialling on the CCA was also commented on in the diaries. Several people found the mobile too sensitive and explained the need for a key lock on the mobile. Some said the picture dialling function was difficult for the PwD's to use by themselves. At the bi-weekly home interviews several carers complained about the battery lifetime. The PwD's could not take the mobiles along when they were going outside, since the CCA stopped working after 2 or 3 hours. Especially the functionality to call outside was thought of as helpful, but then it should work.

At 4 different bi-weekly observation moments there were 9 observations with PwDs in total about the user friendliness of the picture dialling. It appeared from 7 observations that this function on the CHH could be used without assistance by PwDs. There were also 2 observations where PwDs could not use this functionality without assistance. The experiences of the PwDs were all in accordance with the observations from the researchers. The picture dialling on the mobile was also observed twice with 5 observations of PwDs in total. Three observations showed that PwDs could use this function without assistance. Two observations showed that PwDs were not able to use this function without assistance. There was no discrepancy between the observations of the researchers and the opinions of the PwDs. At 5 different weekly interviews 16 carer opinions were collected. Eight observations showed carers who thought that the PwD could use the picture dialling function without assistance, 7 with assistance and 1 observation showed a carer who did not know it. One of the carers mentioned during the weekly interviews that there was no initiative from the PwD, and that the PwD needed to be stimulated to use the picture dialling. There were also 12 carer observations collected on their opinions about user-friendliness of the picture dialling function on the mobile device. The majority of the observations (8) show that carers felt that PwDs need help to use this function, three observations showed carers who said that the PwD did need assistance, and one observation showed a carer who did not know if the PwD needed assistance to use the picture dialling on the mobile.

Integrated results on user-friendliness

Most of the respondents considered the picture phone easy to use, the pictures were recognised without difficulties. From the bi-weekly observations, however, it was shown that the PwDs needed help to use this function. Hearing the interlocutor was (somewhat) difficult because the sound in the hand set had low quality and/or because of having a hearing aid. Half of the PwDs and most of the carers did not consider the picture dialling function inconvenient or stressful. It was suggested to leave the picture visible on the mobile if someone was called. Although the picture dialling was rated positive, negative comments were made as well, but they were mostly related to the instability of this function and technical problems. This was confirmed in the diaries: picture dialling was rated positive by several carers, but there were also negative comments on how the function worked: "CDN keeps ringing too long after an incoming call" and "The quality of the sound is not that good". There were some problems for the PwD to act adequately in response to the help button and to recall the help button function.

5.4.2. Usefulness of the social contact functionality

The experiences of the PwD

All PwDs found the picture dialling function very helpful or appropriate at the start. 75% still thought so at the end, but two PwDs (25%) reported that the picture dialling function was not very helpful. 70% of the PwDs thought the picture dialling function facilitated social contact, 30% thought it was not useful. At the end of the field test, the opinions were similar: 56% thought that the picture dialling function facilitated social contact, 44% thought it was not

useful to keep in touch with family and friends. The majority of the PwDs was satisfied with the picture dialling function, 22% were dissatisfied with it at the start of the field test and 38% at the end. From the qualitative data there were some positive statements about the usefulness of the picture dialling, e.g. “Yes, because you can call people very quickly, and then someone can send my husband back home to help me”. One PwD mentioned that the picture dialling helped him most in daily life. The negative statements included, e.g. “Yes, it could be helpful, but it calls automatically”; and “I don’t need it. I don’t get any better by using it”.

The experiences of the carer

The carers thought that the incoming call indication was sometimes helpful for the PwD. At the start of the field test, all carers thought that the picture dialling function was useful for the PwD to keep in touch with family and friends via telephone. At the end of the field test 65% had this opinion, 35% thought it was not useful. All carers were (very) satisfied with the picture dialling function at the start of the field test. At the end of the field test, 38% were dissatisfied with it. In the qualitative data, several carers mentioned the usefulness of the picture dialling and two carers thought that the phone was most helpful for the PwDs in daily life. Suggestions to improve upon the picture dialling included: “It would have been nice to be able to answer incoming calls as well.”; and also “To have this function with you outdoors on the mobile.” (Though in principal the mobile already has this functionality, not all PwDs could use it because of technical problems.) Some carers did think that the communication function could facilitate social contacts for the PwD.

Integrated results on usefulness

At the start of the test period, most PwDs and carers considered the picture dialling function helpful and they thought it facilitated social contact. Also, most carers were satisfied with this functionality. At the end of the field test, the opinions on usefulness were a little bit more negative, though the majority of carers still appreciated the picture dialling function as helpful. The increased dissatisfaction seemed mostly related to the technical problems with this functionality. Despite these technical problems, several carers mentioned the usefulness of the picture dialling for the PwD and two carers thought that the phone was most helpful for the PwDs daily life.

5.5. Activity functionality

In the COGKNOW area of support with daily activities, the following functions were aimed to be tested: radio function, music player, motivate to eat by accompanying music and activity assistance. The ‘motivate to eat with music’ function was not used in all three sites. The activity assistance was only tested in one home in Amsterdam.

5.5.1. User-friendliness of the activity functionality

The PwDs’ experiences of design and interaction

The majority of the PwDs thought the music function was (very) enjoyable. 18% at the start and 50% at the end of the field test considered the music function boring. The majority considered the music player not at all, or a little bit more, inconvenient or stressful than a regular music player at both evaluation sessions. The remainder (17% at the start; 33% at

the end) thought it was a lot more inconvenient or stressful. The majority of the PwDs thought the radio function was (very) enjoyable. However, 38% at the start and 17% at the end considered the radio function boring. None of the PwDs thought that the radio function was inconvenient or stressful at both evaluation sessions. The comments and reactions about the user-friendliness of the music and radio function, as reported in the qualitative data, were mostly positive, as one PwD said: "It is easy, and it is nice to put some music on, and the music is very nice!".

The PwDs' experiences of learnability

Except for one PwD at the start, who could not use the music player correctly, all the other PwDs were able to learn and understand the music player immediately or after repeated demonstration. Only one PwD could not recall how to use the music player at the start. About 40% had some problems recalling how to use the music player at both evaluation sessions. All the PwDs were able to use the radio function immediately or after repeated demonstration at both evaluation sessions. For the radio function, one PwD had some problems recalling at the start and the end. Regarding the activity assistance (tested with one PwD), the PwD could follow the instructions and could remember these. He was able to use this function without the help of another person. The qualitative data contained no further information on the PwDs' experiences of learnability.

The carers' experiences of design and interaction

All carers thought that the radio function was enjoyable for the PwD at the start of the field test, while 60% thought so at the end of the field test (the remaining 40% of carers considered this boring). For the music player, 30% thought it was boring for the PwD at the start and this increased to 78% towards the end. Most carers thought the radio and music function were not at all inconvenient or stressful at the start; this remained so for the radio function at the end, but the music player was considered a little bit, or a lot more, stressful than the normal music player by half of the carers at the end. Although the carers were mostly positive about the user-friendliness of the music player (qualitative data), they had some suggestions for improvement. This concerned mostly to avoid too much repetition of the repertoire in the music player, which probably caused the boredom towards the end of the test period. These included, e.g. "(a possibility) to put some music on yourself", "Include a possibility to choose songs", and "More choices and longer". For the improvement of the radio service carers suggested: "It should be made possible to easily choose from different channels" and "To include more choices, sound could be better and the sound volume better". There were no further comments about the activity assistance.

The carers' experiences of learnability

The majority of carers thought it was easy for the PwD to learn to use the radio and music function. At the start, recalling the radio or music function went well according to 86% and 50% of the carers, respectively. At the end of the field test, 83% of the carers thought PwDs knew how to use the radio function and 67% thought PwDs knew how to use the music function. No information is available from the carer how easy or difficult it was for the PwD to learn and use the activity assistance function. The carer of the only PwD that used the activity support reported that it was easy for the PwD to recall how to use this. The qualitative data contained no further information on the carers' experiences of learnability.

Diary and in-between interviews

The opinions in the diary on the music player and the radio are varied. Some people mention that it is a “very positive function” while others thought the function was not helpful at all (“He does not use the music player at all”). A comment that was given during a bi-weekly interview with a PwD was: “I’ve used it a couple of times and I liked it”. Some participants did not choose for the radio but instead had a button to switch on a lamp or the electric fire. There were no comments on these functions or on the Activity Assistance in the diaries. During the bi-weekly interviews it appeared that the Activity Assistance responded too slowly, but that the PwD did enjoy seeing pictures of himself executing the different steps of the activity.

The music functionality was evaluated during 4 bi-weekly observation moments with 11 observations of PwDs in total. The researchers and the PwDs both felt that it was possible during almost all observations to use this functionality on the CHH without assistance. There was only one observation where a PwD could not use the music function without assistance. There were no discrepancies between the PwDs’ experiences and the researchers’ observations. The use of the music function on the mobile was observed with 6 PwDs, where 4 observations showed PwDs who could use it without assistance and 2 observations showed PwDs who were not able to use it without assistance. This was in accordance with the opinions of the PwDs themselves. From 5 weekly interviews 17 observations from carers were collected on the music functionality. From these, 12 reports tell that carers think the PwD does not need any assistance to use this functionality, 4 reports show carers who think the PwD does need assistance and one shows a carer who does not know if the PwD needs assistance. A comment in the weekly interviews with the carers was that the PwD almost never used the music function without encourage, but when they were stimulated they could use it without assistance. Another 12 observations were collected on the user-friendliness of the music functionality on the mobile from 5 weekly interviews with carers. Eight observations show that carers felt that the PwD could use this functionality without assistance. Three observations show carers who think the PwD needs assistance, and there is one observation of a carer who does not know if the PwD needs assistance or not.

During 3 bi-weekly observations where 9 PwDs in total were observed, all observations showed that PwDs thought they could use the radio without assistance and the researchers agreed with them. There were also 17 observations from carers that were collected from 5 weekly interviews. Like the music function the radio function was believed to be manageable without assistance in 12 of these observations. In four observations carers reported that the PwD did need assistance and one showed a carer who did not know whether the PwD needed help or not. Again some carers commented that the radio function was not used by the PwD if they weren’t stimulated. However, when they were encouraged PwDs could use it without assistance.

The activity assistance was only once observed with one PwD during the bi-weekly home interviews. In this particular case the PwD felt, unlike the researcher, that he could use the function without assistance. However, this PwD had problems with practical handling (apraxia) which is also visible on his MMSE score. It could be that he was not aware of these problems. Although this is just one observation, it is possible that, while people are still well able to answer other questions that require self-reflection, PwDs with apraxia have difficulty answering questions about this area. The carer was asked twice (at beginning and end of the field test) about the need for assistance for the PwD to work with this functionality. The first time the carer answered he did not know whether there was a need for assistance or not, the second time the carer said that the PwD did not need activity assistance.

Integrated results on user-friendliness

Most of the PwDs appreciated the music function, but at the end half of the PwDs thought that this function was boring. The majority of the PwDs did not think the music player was inconvenient or stressful. The carer's experience regarding the music function was similar. The PwDs were able to learn and understand this function, although almost half of the PwD's had some problems recalling the music function. The majority of carers thought that the PwDs knew how to use the music function. The radio function was considered enjoyable by the majority of the PwDs and the carers; this function was not perceived as inconvenient or stressful. It was easy for the PwDs to learn how to use the radio function; the carers' also thought that this was easy for the PwDs. The PwDs and the carers were mostly positive about the radio and music function. The researchers also observed during the bi-weekly home interviews, that the PwDs could use the music and radio functionality without assistance. The carers made some suggestions to improve upon these functions, e.g. to offer a larger variety of music and adding radio channels. The sound and volume could also be improved according to the carers.

The activity assistance function was only observed with one PwD during the bi-weekly home interviews. Although the PwD felt that he could do this activity (making coffee) without assistance, this did not correspond with the observations of the researchers. The PwD could follow the instructions and remember these.

5.5.2. Usefulness of the activity functionality

The experiences of the PwD

The majority of PwDs thought the radio and music function was very easy to use, except at the end, when the PwDs had sometimes difficulties to use the radio (33%) and some could not use it well (17%). At the start only 14% to 18% of the PwDs were dissatisfied with the radio and music function; this increased towards the end only for the music player, to about 40% of the PwDs who were dissatisfied with it. Half of the PwDs considered the music player (very) useful for enjoying music; the other half did not think this was useful. At the end, 70% of the PwDs did not think that the music player was useful for enjoying listening to music. For enjoying music on the radio, 63% of the PwDs thought that this was useful at the start, and 71% at the end. The usefulness of the radio and/or music function depended also on the personal preferences of the PwD, as some did or did not like the radio and/or music function (qualitative data). Those PwDs who liked music, were also positive and enthusiastic about the function. Others never used the radio and/or music function. The only PwD who tested the activity assistance was dissatisfied with it at the beginning, but was satisfied at the end. The PwD said that the activity assistance was not useful to him to support his daily activities.

The experiences of the carer

The radio and music function was (very) useful according to most of the carers at the start. Few carers thought that these functions were useful towards the end (33%). Most were (very) satisfied with the radio and music function at the first evaluation session. Later on, one carer was dissatisfied with the radio (20%) and four were dissatisfied with the music player (50%). The majority of carers (73%) thought that the music player was useful for the PwD to enjoy listening to the music; at the end, only 33% thought that this was useful. From the qualitative data, several carers reported that the radio and music function was the least helpful for the daily life of the PwD. As was already mentioned above, the carers had some suggestions to improve upon the radio and music function, mostly to offer more variety in the selection of music and/or radio channels. For the activity assistance, only quantitative data

were available, indicating that the carer of the PwD who tested the activity assistance was not satisfied with this function. She commented: "It does not work". The carer did not think that the activity assistance was useful to support the daily activities of the PwD.

Integrated results on usefulness

At the start, half of the PwDs considered the music player (very) useful for enjoying music; towards the end, about one-third of the PwDs thought that this was useful for them. The majority of PwDs said that the radio was useful for them to enjoy music. The usefulness mostly depended on the personal preferences of the PwD. Most carers considered the radio and music function useful at the start, but only one-third thought so towards the end. At the start the PwDs and the carers were mostly satisfied with these functions, but at the end only half of them were still satisfied. The PwD who tested the activity assistance was satisfied with this function at the end of the test, but the carer was not. The PwD and the carer thought that the activity assistance was not useful to support the daily activities of the PwD.

5.6. Safety functionality

In the COGKNOW area of enhancing feelings of safety, the aim was to test the following functions: pop-up safety warnings (open front door, open fridge door), help function, and navigation outside the home (Take-me-home). The Take-me-home function was tested with two PwDs. At one site a sensor-triggered lamp and an electric fire were used (on/off switch).

5.6.1. User-friendliness of the safety functionality

The PwDs' experiences of design and interaction

Two PwDs, who answered the question on hearing the safety warning (open front door or fridge), said that they had no difficulty hearing them; they always reacted to the warning. The visibility of the safety warning was also very good or appropriate according to the PwDs at both evaluation sessions. At the start, the two PwDs experienced the safety warnings as a little bit more inconvenient or stressful; at the end, the one PwD who answered this question, did not think the safety alarms were inconvenient or stressful. The used lamp and electric fire (on/off switch) were not perceived as inconvenient or stressful at the beginning, but a little bit more inconvenient or stressful at the end. In the qualitative data there were some comments by the PwD on the help function. The icon was not always clear and understandable; this was also observed by the researchers. The qualitative data on the Take-me-home function showed that, after some initial technical problems, the PwD was excited about this function. She liked the arrows on the mobile and the voice telling her where to 'go to'. The mobile was hanging around her neck. The only problem which arose was when she accidentally pushed the screen and a choice had to be made between the Take-me-home or the Go-back-to-home screen. This was confusing to her. PwDs should be made aware of this change in screen, possibly by means of an error sound.

The PwDs experiences of learnability

Both PwDs were able to learn and understand the safety warning; at the start they acted adequately after the first explanation and at the end, one PwD still acted adequately after the first explanation and the other after repeated explanation. The lamp/electric fire was correctly

used after the first demonstration; only one PwD could not recall this function at the start. All ten PwDs were able to learn and understand the help button, because they acted adequately after repeated explanation (70%) or immediately after the first explanation (30%) at both evaluation sessions. However, 50% had some problems recalling this function at the start of the field test and 86% at the end. Only one PwD, at the end of the field test, did not know how to use this function. One PwD who was involved in the Take-me-home function had no difficulty to learn and understand this function; she also did not have problems recalling. She thought it was easy to start this function. The researchers also observed that she could easily learn this function. There were no risky behaviours observed by the researchers. The qualitative data contained no extra information on learnability.

The carers' experiences of design and interaction

All (four) carers thought the safety warnings were well audible and also the visibility of the warnings was considered very good or appropriate. The safety warnings worked well at the start of the field test. At the end of the field test, one carer reported that the alarms were working correctly and the other reported they sometimes worked correctly. At the start, one carer thought the safety warnings were not at all inconvenient or stressful, the other carer reported that they were a little bit more inconvenient or stressful; at the end of the field test, both carers reported that receiving warnings was a little bit more inconvenient or stressful than the normal situation without warnings. In the qualitative data, carers mentioned several times that there were technical problems with the safety warnings and that this was stressful. One carer said: "The fridge was dismantled, it was very stressful, it started to beep randomly, since the sensor is influenced by the metal from the fridge". Several carers considered the helpbutton confusing (life buoy) or thought it was not clear for the PwD. One carer said about the help button: "Dramatic, not good if you have kids in the house, they will like to touch it".

The carers' experiences of learnability

Two of the carers at the start thought it was somewhat difficult to learn to understand the safety warning function; one carer thought it was easy. Later on, two carers reported it was difficult and one reported it was easy. Recalling this function was mostly possible after some explanation was given. One carer (50%) at the end of the field test thought the PwD could recall this function without explanation. Two of the carers thought it was (somewhat) difficult to learn how to switch on/off the lamp or electric fire, the other two thought it was easy for the PwD. At the end, three carers thought this was somewhat difficult. One carer (1/4) reported that the PwD could not recall how to use the lamp/electric fire function at the start; at the end all three could not recall this function. 44% of the carers thought the PwDs could easily find and understand the help button, and the other 56% thought the PwDs would have some difficulty with this function. At the end of the field test, a large majority of carers (67%) thought that the PwDs could easily, or only with some difficulty, find and understand the help button, while 33% of the carers (2/6) reported that the PwDs had difficulty with this.

44% of the carers thought the PwDs could easily find and understand the help button, and the other 56% thought the PwDs would have some difficulty. At the end of the field test, 67% thought the PwDs could easily, or with some difficulty, find and understand the help button, while 33% of the carers (2/6) reported that the PwDs had difficulty with this. At the start the carers reported that the PwDs could recall the help function without (56%) or with some problems (44%). At the end of the field test, 67% could recall this, while 33% could not recall the help function. There was no extra information from the qualitative data on learnability.

Diary and in-between interviews

No comments were made in the diary about the help button. During the bi-weekly interviews one of the PwDs said that he did not need to use the help button yet, but that he knew how to use it when necessary. Another PwD did not understand the function and asked if the button was to go to the sea.

At 4 bi-weekly observation moments the user friendliness of the help button was evaluated. From the 10 observations with PwDs, 6 showed the PwD able to use this button on the CHH without assistance. Four observations show PwDs who need assistance to use this function. On the CCA the user-friendliness of the help button was observed twice and had 5 observations with PwDs in total. Four observations showed that PwDs were not able to use this function without any help, one observation showed that a PwD could use the help button on the mobile without assistance. The researchers' observations were alike the opinions from the PwDs. From 5 weekly interviews with carers 15 observations in total were collected. There were 7 observations that showed that carers thought the PwD was in need of assistance to use the help button. From 6 observations it appeared that the carers thought the PwD could use the help button without assistance. Four observations showed carers did not know if the PwD needed assistance for the help button. One carer, however, commented in the weekly interviews that he was "(...) not sure if the intention of the help button was clear to her (PwD)". There were also 12 observations collected during the weekly interviews on the opinion of the carer on the help button on the mobile. The majority (8) of the observations showed that carers thought that the PwD could not use this function without assistance. Three observations show carers who thought the PwD could use it alone, and one observation showed a carer who did not know if the PwD needs assistance with using the help button on the mobile.

The safety warnings were rated positive as well as negative in the diaries. Some of the comments were on the disfunctioning of the warning: "Door warning went off when door was open, but did not stop after closing door", "Sensor removed because it beeped randomly". Others were about how the PwD reacted on the warnings: "Warning signal confuses her", "A voice would be better instead of the beeping, since the beeping annoys her". At 2 bi-weekly home interviews where 3 PwDs in total were observed, all observations show PwDs who could use the safety warning functionality without assistance. From three weekly interviews 6 observations from carers were collected. Four observations show carers who think the PwD did not need assistance to use this function on the CHH. One carer observation showed the PwD did need help, and one observation showed that a carer did not know if the PwD needed help. In the weekly interviews one carer for instance said: "He (PwD) needs explanation when he hears the beeping". There was no difference between the experiences of the PwDs and the observations of the researchers.

Integrated results on user-friendliness

The safety warnings were easy to hear and see according to most PwD's and carers. The safety warnings were sometimes working well and at other times not. The PwDs and carers found the safety warnings a little bit inconvenient or stressful. The technical problems with the safety warnings made it stressful to both the PwDs and the carers. In the diaries, the safety warnings were rated positive as well as negative by the carers.

The majority of the carers thought it was somewhat difficult for the PwDs to learn and understand the help button. At the end of the field test most of the PwDs had problems recalling this function. The majority of the observations during the bi-weekly interviews also showed that the carers thought the PwD could not use the help function without assistance.

The results of the Take-me-home function was judged from the perspective that it was only tested with one PwD and the function had some technical problems. The PwD had no difficulty to learn and understand the function. The use of voice indication of directions, together with displaying simple arrows on the mobile screen was well received by the PwD. The carers thought the lamp/electric fire (on/off switch, tested with three PwDs) was somewhat difficult to learn for the PwDs: the PwDs could not recall the function at the end of the test period.

5.6.2. Usefulness of the safety functionality

The experiences of the PwD

All PwDs were satisfied with the safety warnings at both evaluation sessions. Most PwDs found the help button (very) useful (at both sessions). 10% of the PwDs at the start of the field test and 25% at the end found the help button not useful. For the lamp/electric fire, all three PwDs were satisfied with this function at the beginning, but not at the end of the test period. One PwD who used the Take-me-home function was pleased to be able to use this service (qualitative data).

The experiences of the carer

All carers (three at the start and two at the end) were (very) satisfied with the safety warnings. All carers (9) considered the help button (very) useful at the start of the field test. At the end of the field test only two carers (33%) considered it (very) useful; the other four carers (56%) thought the help button was not useful. Two-thirds of the carers thought that the warning alarms were useful to give the PwD a feeling of safety; at the end half of them thought so. The carers were satisfied with the lamp/electric fire for the PwD at the start; no data was available on this from the end of the field test. From the qualitative data it appeared that carers found the safety warnings useful, but they commented on the instability of the warnings: "Useful, if it works".

Integrated results on usefulness

Most PwDs were satisfied with the safety warnings and considered the help button useful. Also the carers considered the help button useful at the start, but not so much at the end, when more than half of the carers thought that the help button was not useful. The carers were satisfied with the safety warnings. The evaluation of usefulness was hampered by the technical problems with sensors and warning function. The PwDs were satisfied with the lamp/electric fire at the start, but not at the end of the test period.

5.7. Differences and similarities between test-sites

For some of the main questions on user-friendliness, satisfaction and usability of the functions of the CDN we found some differences between the test-sites. In the analyses, only data were used from the interviews and observations at the start of the field test. The reason for this was that we wanted to exclude differences caused by the impact of site differences in technical performance of the device during the period of the field test. For the PwDs we found differences between the sites with regard to learning and understanding the day and time indicator ($\chi^2= 97,02$, $df=2$, $p=0,0103$). PwDs from Luleå and Belfast seemed to understand this function more often immediately after the first demonstration as compared to PwDs from Amsterdam. Another difference was found for the perceived helpfulness of the

picture dialling function ($X^2=6,35,93$, $df=2$, $p=0,045$): PwDs from Luleå and Belfast considered the picture dialling function more often very helpful, as compared to PwDs in Amsterdam, where the respondents considered this function 'appropriate'. PwDs from Amsterdam and Luleå were more often satisfied with the picture dialling function as compared to PwDs from Belfast ($X^2= 8,0$, $df=2$, $p=0,02$). With respect to the device control (radio, lamp, electric fire), PwDs from Luleå and Belfast seemed to understand this function more often immediately after the first demonstration as compared to PwDs from Amsterdam ($X^2= 6,6$, $df=2$, $p=0,04$). Furthermore, PwD from Luleå and Belfast were more satisfied with this function as compared to PwDs from Amsterdam ($X^2= 6,3$, $df=2$, $p=0,04$).

Based on carer reports we found four differences between the sites: As compared to carers in Amsterdam and Belfast, carers in Luleå reported that PwDs were less quickly able to learn how to use the CDN ($X^2= 6,3$, $df=2$, $p=0,04$). Carers from Belfast thought more often that the PwDs could easily choose the right button than carers from Amsterdam and Luleå ($X^2= 7,3$, $df=2$, $p=0,03$). Carers from Belfast were less satisfied with the reminder function as compared to the other sites ($X^2= 9,0$, $df=2$, $p=0,01$), but they were more satisfied with the music player function as compared to Amsterdam and Luleå ($X^2= 9,0$, $df=2$, $p=0,01$).

5.8. Differences between the pretest and posttest

Differences between opinions of respondents at the start of the field test and at the end of the test period were analysed for some of the functionalities of the CDN. It was decided to only do this analysis for those functionalities that worked well for more than four weeks for at least four respondents during the test period. Since there were a lot of problems with stability and functionalities in field test #3 (see D4.5.1), only data on the music function, the device control (radio, lamp, electric fire) and the help function were analysed. For these three functions no statistical significant differences were found in user-friendliness, satisfaction or usability between the pretest and posttest evaluation sessions.

5.9. Conclusions on user-friendliness and usefulness of the CDN in field test #3

Integrated results on user-friendliness

The general opinion of the PwDs and carers on the design of the stationary device was positive: the size of the device and the sensitivity of the touch screen were appropriate and the text could easily be read. Some buttons were not clear: the help button, agenda, find mobile and the quarter-hour clock. The PwDs were able to learn and understand the stationary device with some additional support. The main problem during the field test period was the instability of the system. Most PwDs and carers also liked the design of the mobile device, but the mobile was found too large and heavy to carry around. The touch screen was sometimes considered too sensitive. The help button and the music button were not clear. The battery life of the mobile was perceived as problematic. Because of technical problems with the mobile, the device was tested by fewer PwDs than the stationary device.

From the reminding functionalities, the day and time indicator was considered user-friendly by the majority of PwDs and they could use the indicator without assistance. The quarter-hour clock was difficult to learn and understand. The reminders were used in the first field test period, but were not used anymore towards the end of the test period due to instability and technical problems.

Regarding social contact support: The PwDs thought that the picture dialling phone was easy to use, although from observations it appeared that they needed help with this function. The pictures were recognised without difficulties. Hearing the interlocutor was difficult because the sound in the hand set had low quality. People preferred the pictures to remain visible when someone was called on the mobile. The picture dialling was rated positively, negative comments were only related to the instability of this function.

With respect to the activity functionalities, the PwDs and carers were positive about the radio and music function. The PwDs could use these functions without assistance. The appreciation depended on the personal preferences of the PwD. The main suggestion to improve the radio and music functions was to offer a larger variety of music and adding radio channels. The activity assistance proved easy to learn to use for the only PwD that tested it.

From the safety functionalities, the safety warnings were easy to hear and see, but they were not always working properly, and the PwDs and carers (therefore) thought the warnings were a bit stressful. The help button was difficult to learn and understand for the PwD: the PwDs needed assistance. The Take-me-home function had technical problems, but the PwD could learn and understand this function.

Integrated results on usefulness

The PwDs could not indicate which part of the system they thought was most helpful to them. The usefulness of the different functions was related to the personal preferences and needs of the PwDs. The carers considered the time and day indication, the reminders and the picture dialling function most useful for the PwDs. At the end of the test period, the carers were dissatisfied with the overall system, the stationary device as well as the mobile device, mainly because of the instability of the system and the technical problems. The support from the technical helpdesk was considered sufficient and adequate.

6. Preliminary results in field test #3 on the impact of the CDN in daily life

In field test #3 a first explorative investigation of the impact of the CDN on the experienced autonomy and quality of life of people with dementia and their carers was conducted. For this purpose, some questions were posed in the semi-structured interviews with the PwD and their carers and a number of standard questionnaires were administered, such as: the Experienced Autonomy Questionnaire, the Quality of Life in Alzheimers Disease scale (QoL-AD), the Camberwell Assessment of Needs for the Elderly (CANE) on (unmet) needs regarding daily activities, memory, safety and company, and the Dementia Coping Questionnaire (for more details see 3.2.3). For the carer we used the following questionnaires: the Short sense of Competence Scale (SSCQ), the CANE on psychological distress of the carer himself, the QoL-AD (family version), and an overall judgement on quality of life of the carer (see 3.2.3). The semi-structured observations and interviews were carried out twice during the field test, at the start and at the end of the test period. Information on the use of services was also collected at pretest and posttest to check for changes in service use during the test period that may have influenced the autonomy and quality of life of the users as well. For this reason, also at post-test, the MMSE was administered again.

6.1. Overall impact of the CDN in daily life

6.1.1. The experiences of the PwD

In the semi-structured interview at the end of the field test, the PwDs were asked a number of questions to gain insight into possible changes in their lives over the course of the test period caused by the use of the CDN. The questions were as follows: “Since you have the CDN, do you think that you function in a different way?” and “Do you think your life has changed since you have the CDN?”. If the PwD responded positively they were asked to give some examples. Most of the PwDs answered these questions with no, they did not think that they functioned in a different way or no, their life had not changed since the beginning of the test period. There was one positive remark: “I think so, I am a bit more aware of things. I like the help button.” and there was one negative remark: “I have been very stressed”. The results from the qualitative data of the semi-structured interviews were confirmed by the results from the standard questionnaires. In these results, the quality of life measured with the QoL-AD and the experienced autonomy hardly changed during the test period. From the results of the coping questionnaire, it was shown that there was a slightly more favorable score at the end of the test period. However, none of the results showed any statistical significant differences between the pretest and posttest data. The MMSE scores were also available from pretest and posttest; again there were hardly any differences between the two evaluations. At the end of the test period, the number of used services, e.g. General Practitioner, memory clinic, and meeting centre, also were similar as compared to the beginning. More detailed information of the pretest and posttest results are listed below.

- For the QoL-AD (score range 13-42; higher score is more favourable), measuring several aspects of quality of life of persons with dementia, the mean score at pretest was 38.5 ± 3.67 (n=11, range 32-45) and at posttest 37.7 ± 4.78 (n=11, range 31-48).

- For the Experienced autonomy scale (score range 12-60; lower score more favorable), the mean score at pretest was 46.9 ± 5.49 (n=11, range 41-56) and at posttest 46.3 ± 7.53 (n=11, range 34-58).
- For the Dementia Coping Questionnaire (score range 24-96; lower score more favorable), the mean score at pretest was 49.2 ± 5.49 (n=10, range 42-59) and at posttest 46.3 ± 4.38 (n=11, range 40-53).
- For the MMSE (score range 0-30; higher score more favorable), the mean score at pretest was 21.7 ± 1.83 (n=12, range 19-25) and at posttest 20.7 ± 3.26 (n=11, range 14-27).
- From the used list of services, the mean number of services used was 2.8 ± 1.47 (n=12) at the beginning of the field test and 3.0 ± 1.61 (n=11) at the end.

6.1.2. The experiences of the carer

In the semi-structured interview at the end of the field test, the carers were also asked a number of questions to gain insight into possible changes in the life of the PwD over the course of the test period. The questions were as follows: "Since you have the CDN, do you think that the PwD functions in a different way?" and "Do you think that the PwDs life has changed since you have the CDN?" If the carer responded positively they were asked to give some examples. Most of the carers answered these questions with "No, they did not think that the PwD functioned in a different way" or "No, the PwDs life had not changed since the beginning of the test period". There was one positive answer: "The music made her happy." and there were two negative answers: "It was traumatic for my wife" and "Yes, it has made my wife very unhappy". The results from the qualitative data of the semi-structured interviews were confirmed by the results from the standard questionnaires. In these results, the quality of life of the PwD as judged by the carer measured with the QoL-AD (family version), the SSCQ on carers sense of competence, and the CQoL-AD, the quality of life of the carer, showed hardly any changes at the end of the test period compared to the beginning. The way the carers judged the quality of life of the PwDs, with the QoL-AD, was slightly less favorable than the quality of life as perceived by the PwDs themselves (score 34 versus score 38, respectively). None of the results showed any statistical significant differences between the pretest and posttest data. More detailed information of the pretest and posttest results are listed below.

- For the QoL-AD (family version)(score range 13-42; higher score is more favorable), measuring several aspects of the PwDs quality of life, the mean score at pretest was 34.4 ± 3.32 (n=12, range 26-39) and at posttest 33.3 ± 5.92 (n=11, range 24-41).
- For the SSCQ, measuring sense of competence of the carer (score range 7-35; higher score more favorable), the mean score at pretest was 25.6 ± 5.21 (n=12, range 17-35) and at posttest 25.7 ± 3.82 (n=11, range 23-33).
- For the CQoL-AD, the overall grade of the quality of life of the carer (score range 1-4; higher score more favorable), the mean score at pretest was 2.8 ± 0.87 (n=12, range 1-4), and at posttest 2.7 ± 0.65 (n=11, range 2-3).
- On the CANE, regarding psychological distress, two out of 11 carers showed a change in their need for mental health care at the end of the test period. One carer expressed his need for mental health care at the start of the test period and apparently this was taken care of during the test period (at the end of the field test he reported to receive mental health care, visited a carer discussion group at a meeting centre, and visited a psychologist). The other carer indicated to have a need of mental health care at the end of the test period, while he had no needs in this area at the beginning of the field test, but no further details are available.

6.1.3. The experiences of the researcher

The testing period of this third field test was at all three sites much shorter than planned in the original project proposal and in the final time plan of field test #3, because of delay in the technical development, delay in equipment delivery, technical problems with the CDN and instability of the system for several functionalities. Under different circumstances with more favorable conditions, including a stable system, a positive impact of the CDN on the autonomy and the quality of life of the PwD would be expected by the researchers.

6.2. Impact on reminding

6.2.1. The experiences of the PwD

One question in the QoL-AD on memory revealed only a minor less favorable (non-significant) change at the end of the test period compared to the beginning (pretest score 1.9 ± 0.54 ; posttest score 1.8 ± 0.41 (range 1-4, higher score more favorable)). No further data are available on the impact of the CDN on reminding from the semi-structured interviews.

From the CANE, the section on memory, three out of 11 PwDs reported a change in their need of care regarding their memory problems (one PwD dropped out; no second measurement available). All three PwDs reported to receive sufficient care for their memory problems at the beginning of the test period, while at the end they felt they needed more support for their memory problems. It is difficult to say if using the CDN made them more aware of their memory problems, or that their memory problems increased because of progression of the disease. For the other PwDs, no change occurred during the test period in this area. Most PwDs experienced sufficient care and support for their memory problems.

6.2.2. The experiences of the carer

In the semi-structured interview at the end of the field test, the carers were asked a number of questions about the impact of the reminding functionalities on the PwD's functioning during the test period. Most of the carers thought that the memory and reminding support did not have an effect on the quality of life of the PwDs, nor did it have an effect on the way of functioning of the PwD. There were two additional negative comments on the effect on the PwD's (and carer's) quality of life: "Yes, it nearly drove us mad" and "Yes, it annoyed my wife". The results from the qualitative data of the semi-structured interviews were confirmed by the results from the standard questionnaires (see below).

- One question in the QoL-AD (family version) on the memory of the PwD revealed only a minor favorable (non-significant) change at the end of the test period compared to the beginning (pretest score 1.4 ± 0.52 ; post test score 1.5 ± 0.52 (range 1-4, higher score more favorable)). The memory of the PwD was perceived as slightly less well by the carer compared to the perception of the PwD (see 6.2.1). No further data are available on the impact of the CDN on reminding as judged by the carers.

- On the CANE, the section on memory, none of the carers reported a change in the need of care regarding memory problems of the PwDs. The care needs for memory problems as experienced by the PwDs in 6.2.1 were not reported by their carers. Most carers reported that the needs with respect to the memory problems of the PwD were sufficiently taken care of.

6.2.3. The experiences of the researcher

No data are available on the experiences of the researchers regarding the impact of the CDN on reminding of the PwD (see also 6.1.3.).

6.3. Impact on social contact

6.3.1. The experiences of the PwD

In the semi-structured interview at the end of the field test, the PwDs were asked a number of questions about the possible impact of the picture dialling on the PwD's functioning during the test period. Most of the PwDs thought that the picture dialling function did not have an effect on their quality of life, nor did it have an effect on their way of functioning. There was one positive comment on the effect on the PwD's way of functioning: "The fact that it is just ON the device already gives me a good feeling". The results from the qualitative data of the semi-structured interviews were confirmed by the results from the standard questionnaires (see below).

- Two questions in the QoL-AD on family and friends revealed only minor more favorable (statistically non-significant) changes at the end of the test period compared to the beginning (family question: Pretest score 3.2 ± 0.60 and posttest score 3.3 ± 0.65 ; and friends question: Pretest score 2.9 ± 0.54 and posttest score 3.1 ± 0.54 (range 1-4, higher score more favorable)). No further data are available on the impact of the CDN on social contacts.

- The data collected with the CANE, the section on company, showed that none of the 11 PwDs experienced a change during the test period in their needs regarding social contacts. Most PwDs were already satisfied with their social contacts at the start and remained satisfied at the end of the test period.

6.3.2. The experiences of the carer

The semi-structured interviews did not reveal any impact of the picture dialling function on the quality of life of the PwD, nor on their way of functioning, as judged by the carers. One carer mentioned that the field test period was too short to show any effect of the devices on the quality of life of the PwD. Again, the standard questionnaires also did not show any impact on the PwD's functioning (see below).

- Two questions in the QoL-AD on family and friends, as judged by the carers, revealed no less favorable, or only minor less favorable, (non-significant) changes at the end of the test period compared to the beginning (family question: pretest score 3.5 ± 0.52 and posttest score 3.3 ± 0.79 ; and friends question: pretest score 3.0 ± 0.43 and posttest score 2.9 ± 0.54 (range 1-4, higher score more favorable)). No further data are available on the impact of the CDN on social contacts.

- The data collected with the CANE, the section on company, showed that only one out of 11 carers experienced a change during the test period in the needs of the PwD regarding social contacts (this was not experienced by the PwD himself, see 6.3.1). The carer thought that the PwD's social contacts possibly could be improved. All other carers thought that the PwDs were satisfied with their social contacts at the start and at the end of the test period, or at least they revealed no further needs in this domain.

6.3.3. The experiences of the researcher

No data are available of the experiences of the researchers regarding the impact of the CDN on social contacts of the PwD (see also 6.1.3.).

6.4. Impact on daily activity

6.4.1. The experiences of the PwD

The semi-structured interviews did not reveal any impact of the different kinds of support in daily activities offered by the CDN on the quality of life of the PwD, nor on their way of functioning. One observation made by the researcher showed that the PwD was bothered by the radio and/or music player services. The standard questionnaires also did not show any impact on the PwD's functioning (see below).

- Two questions in the QoL-AD on 'doing chores' and 'doing things for fun' revealed only minor (non-significant) changes at the end of the test period compared to the beginning (chores question: pretest score 2.5 ± 1.21 and posttest score 2.3 ± 1.01 ; and fun question: pretest score 3.0 ± 0.63 and posttest score 2.7 ± 0.47 (range 1-4, higher score more favorable)). No further data are available on the impact of the CDN on daily activities.

- Data collected with the CANE, the section on daily activities, showed that three out of 11 PwDs changed in their needs regarding daily activities during the test period. Two of them wanted more activities in their daily life at the beginning of the test period, and these needs were met during this period: one PwD started having a dog, another PwD went to a meeting centre for people with dementia and their carers. Most PwDs were satisfied with their daily activities at the start and at the end of the test period and experienced no further needs.

6.4.2. The experiences of the carer

The semi-structured interviews did not reveal any impact of the different kinds of support in daily activities offered by the CDN on the quality of life of the PwD, nor on their way of functioning, as judged by the carers. One of the carers did mention that the life of his wife had changed since they had the CDN, he said: "The music makes her happy". The standard questionnaires did not show any impact either on the PwD's functioning (see below).

- Two questions in the QoL-AD on 'doing chores' and 'doing things for fun', rated by the carer, revealed only minor (non-significant) changes at the end of the test period compared to the beginning (chores question: pretest score 1.9 ± 1.00 and posttest score 1.8 ± 0.98 ; and fun question: pretest score 2.6 ± 0.67 and posttest score 2.3 ± 0.79 (range 1-4, higher score more favorable)). No further data are available on the impact of the CDN on daily activities.

- Data collected with the CANE, the section on daily activities, showed that only one out of 11 carers thought that the PwD was in need of more daily activities at the end of the test period compared to the beginning (this was not experienced by the PwD himself, see 6.4.1). Two more carers thought that the PwDs needed to extend or change their daily activities (again this was not experienced by the PwDs themselves), but they reported this at the start as well as at the end of the test period. The other carers were satisfied with the daily activities of the PwD at the start and at the end of the test period and no further needs were experienced in this area by the carers.

6.4.3. The experiences of the researcher

No data are available of the experiences of the researchers regarding the impact of the CDN on the daily activities of the PwD.

6.5. Impact on safety

6.5.1. The experiences of the PwD

The semi-structured interviews did not reveal any impact of the support for safety offered by the CDN on the quality of life of the PwD, nor on their way of functioning. Only two PwDs said that they thought it had an effect on their way of functioning, one was positive and said: "Yes, safer", while the other said: "It depressed me". From the CANE, the section on 'causing unintended danger to oneself': two out of 11 PwDs at the start of the test period reported that they had a 'met' need concerning 'getting lost' and 'not paying attention', while no needs were experienced anymore at the end of the test period. All other PwDs experienced no needs in this domain, neither at the beginning nor at the end of the field test. No more data are available on the impact of the CDN on safety of the PwD.

6.5.2. The experiences of the carer

None of the 11 carers reported that the PwD had needs regarding the CANE section 'unintended danger to oneself'. No further data are available on the impact of the CDN on safety of the PwD as judged by the carer.

6.5.3. The experiences of the researcher

No data are available of the experiences of the researchers regarding the impact of the CDN on safety of the PwD (see also 6.1.3.).

6.6. Preliminary conclusions on impact (field test #3)

Based on the results from the qualitative data of the semi-structured questionnaires and the results from the standard questionnaires conducted in this third field test, we must conclude that the CDN-v3 had no impact on the autonomy and quality of life of the PwDs as experienced by the PwDs and as judged by the carers. It is clear from the comments made by PwDs, carers and researchers that the instability and technical problems with the system first need to be resolved before any impact of the system may be observed on the quality of the PwD's and carer's life. Future research, preferably a randomised controlled trial, in which a stable system is offered to PwDs for a longer period of time, needs to give a decisive answer on this.

7. Final Human factors impact analyses based on the three field tests: Conclusions and discussion

In this chapter we will draw conclusions based on the three field tests performed during the COGKNOW project (September 2006 - August 2009) and will discuss the results in relation to existing knowledge and the limitations of the study. We will also go into the scientific relevance of the study results and the relevance for psychogeriatric care.

7.1. Conclusions

The main research focus was on user-friendliness and usefulness of the COGKNOW Day Navigator. In the third field test, we also aimed to exploratively investigate in a small (one group) pilot study the impact of the developed system on actual and perceived autonomy and quality of life in the selected domains of daily life of the PwD. However, due to problems with stability of the system during the field test period, we could only evaluate the impact on daily life in a limited manner.

Conclusions on reminding functionality

The reminding function was overall judged positively during the three field tests. The day and time indication was improved after comments received during the first field test (an analogue clock was added and the picture indicating the period of the day was removed), and PwDs and carers considered this function useful. The reminder function for activities and events were considered user-friendly and useful. Comments during the first field test concerned the wish for more personalisation and configuration of reminders and the way of attracting attention to the reminders on the screen. During the last field test carers who had some computer skills were able to set reminders themselves. Also more configuration regarding the content and presentation of reminders was possible: people could choose the pictures that accompanied the text reminders. Because of memory problems/limitations of the system, an extensive multimodal presentation of reminders (text, picture and voice) was not possible. The quarter-hour clock was considered too difficult to understand. Perhaps if the lay-out of this option could better be personalised, it would be more easy to understand and to use by PwDs (small-scale tests at the three sites indeed indicated this). However, the limited development time did not allow for attunement of the quarter-hour clock to personal preferences during the third field test.

In general the Find Mobile function was considered useful. However, PwDs and carers thought the icon was difficult to understand, and PwDs could often not use the function on their own. The function was not used much because the mobile phone itself was hardly used.

Whether the device actually supported the memory problems of the PwD in their daily lives is difficult to judge. The carers considered the reminder function helpful in reminding them to remind the PwDs. The reminder function for the PwDs themselves was less useful because they still needed some assistance. There was no impact found of the reminding functionality on the autonomy or quality of life of the PwDs.

Conclusions on social contact

The picture dialling function to support PwDs in maintaining their social contacts was evaluated positively in the three field tests, the majority considered it useful for keeping in contact with family and friends. After comments in the first field test, the icon for making a telephone call was removed from the screen so that the number of steps needed for performing a phone call was reduced. However, in the second field test this made the function less easy to understand and use. So in the third field test, the icon was replaced on the main screen again and this was considered supportive. However, some problems with the picture-phone function remained, such as: hearing problems related to the quality of the sound of the hand set and delay of the hang up function. The elaboration of the contact address book was evaluated positively and the function was considered easy to use. There was no impact found of the picture dialling functionality on the autonomy or quality of life of the PwDs.

Conclusions on daily activities

The radio function and music playback function were evaluated positively during the three field tests. The PwDs and carers considered it easy to use and user-friendly. After the comments in the first field test, people could add more preferred pieces of music in the device in the next field tests, which was appreciated. However, there were some comments regarding the quality of the sound and people wanted to be able to select more than one channel on the radio. Sometimes people indicated that they could still use their own radio or music player and did not need the COGKNOW device for this.

The activity support function was tested with a limited number of persons in the second and third field test. The PwDs were able to perform an activity with the activity support function, but further research is needed on how activities can be divided best into steps in order to be supportive. Further research is also needed regarding the preferred person showing the sequential steps in a video or photo (should this be PwD himself, a relative or an outsider?) or how to personalise the number of steps needed to support the individual PwD. There was no impact found of the different types of support in daily activities on the quality of life of the PwDs, nor on their way of functioning.

Conclusions on safety

All three field tests showed that the help function was difficult to understand. The (different) icons that were used for this function were not very helpful. Despite this, most PwDs and carers considered the help function useful. Only at the end of the third field test, the majority of the carers considered the help function not useful. The safety warnings were easy to use and understand during the three field tests. In general PwDs and carers considered this function useful.

The navigation support function that helps people find their way back to their house was tested only limitedly. This function seems useful for PwD and carers in increasing feelings of safety, but more research on this is needed.

There was no impact found of the safety functionality on the autonomy or quality of life (e.g. mood, self-esteem, feelings of isolation) of the PwDs.

Conclusions on impact on autonomy, quality of life and burden

The impact of using the COGKNOW Day Navigator on daily life of PwDs and carers was only studied in field test #3. Due to problems with stability of the system, the field test period was shortened and during the tests new problems occurred. These factors influenced the

evaluation of the COGKNOW Day Navigator and a thorough impact analysis was therefore not possible. As a consequence, it was not surprising that we hardly found any differences in quality of life, actual and perceived autonomy of the PwDs, when comparing the situation at baseline (before introducing the CDN) and at posttest (after using the CDN for several weeks until two months). We also did not find an impact of using the CDN on the burden/sense of competence of the carer. However, people did mention several functionalities of the COGKNOW Day Navigator as most helpful in their lives. For PwDs it were the functions: day and time indication, the picture dialling function, the radio control, and the mobile phone. Carers indicated the following parts and functions as most helpful in their daily life: the reminders, radio control and music playback on the stationary device.

7.2. Discussion

In the COGKNOW project we employed a user-driven design method to develop and evaluate an ICT device to support PwDs in their daily life. The PwDs and carers in our project were willing to participate in this research and they provided us with lots of comments regarding their experiences and with advices for improvement of the device. For future research the PwDs should be guarded against being burdened too much when testing a device by reaching adequate stability performance during lab tests prior to field tests at the persons' homes.

Findings of the COGKNOW project in relation to existing knowledge

Our experiences in this study were that PwDs and carers were able and willing to actively participate in a research project on development and evaluation of ICT services. The user-driven or user-participatory design method is advocated to enhance the chances of developing an ICT device that is user-friendly and useful for the target group and will be accepted by users (Sixsmith et al., 2007; Nugent, 2007). From a recent literature review we know that in the last decade many ICT solutions aimed to support elderly persons were developed (Lauriks et al., 2007), but only in some studies the ICT solutions were tested with PwDs and in real life situations (Woolham, 2005; Gilliard & Hagen, 2004; Ager et al., 2001; Wilson et al., 2001). The majority of studies, however, did not test the developed applications in the target group. In a recent review of Nijhof et al. (2009) the first results of ICT solutions for PwDs are promising. For instance the fall incidences of PwD decreased and their quality of life improved (see also Lauriks et al., 2008). However, Nijhof concludes that the actual effects of ICT solutions for the care of PwDs (and informal and professional carers) are not well known. It is therefore important that more studies such as the COGKNOW project are undertaken to evaluate the user-friendliness, usefulness and effects of ICT solutions in the target group.

The preferred ICT solutions that PwDs and carers brought forward during workshop interviews in our study correspond partly with other studies among persons with dementia (Lauriks et al., 2007), e.g. aids for reminding appointments of activities like NeuroPage (Hersh et al., 1994), Electronic Memory Aids (EMA) (Inglis et al., 2003; Wilson et al., 2001), an Electronic agenda (Zanetti et al., 2000) or calendar (Holthe et al., 1998), and aids to find items (Gilliard et al., 2004). To enhance communication, simple photo phones (Sixsmith et al., 2007), videophones (Sävenstedt et al., 2003) or mobile phones were proposed and tested (Gilliard & Hagen., 2004; Ager et al., 2001). Technological support for leisure activities was recommended by Sixsmith (et al., 2007) and Wherton (et al. 2008), and amongst other things an activity guidance system with music and sung messages (Yasuda et al., 2006) and a picture gramophone were tested (Gilliard et al., 2004). To enhance feelings of safety, several Global Positioning Systems to locate elderly persons with cognitive impairments

were developed, such as GPS Columba and Keruve. Also, monitoring systems inside and outside the house were tested in which alarm messages are forwarded in case of potentially dangerous behaviour of the person with dementia (Masuda et al., 2002; Lin et al., 2006).

A surplus value of the COGKNOW Day Navigator is that it integrates several functionalities that can support people with dementia on a variety of need areas, i.e. memory, social contact, daily activities and feelings of safety. This is the first system that does so.

When persons with dementia accept such technological solutions, these may enhance their experienced autonomy, help them to keep in contact with family and friends, help them in engaging in useful activities and enhance their feelings of safety. All these domains are considered important determinants of quality of life by people with dementia (Dröes et al., 2006). Our impression based on this study is that PwDs and carers are willing to accept assistive technology, provided that they can trust the technological performance (stability) of the support system. The usability of reminders for persons with dementia is well documented in previous studies (Baruch et al., 2004; Gilliard & Hagen, 2004; Lauriks et al., 2007) and the COGKNOW field tests confirmed that people with mild dementia find this function useful and easy to use. The time and day indication of the CDN was well understood and positively evaluated by the people with dementia and is therefore expected to support the orientation in time that is a commonly faced problem in people with dementia (Nygård & Starkhammer, 2007). Also other functions, such as the picture dialling function, the music and radio function, the activity support function and the safety warnings in general were well understood after one training session and easily used afterwards, partly guided by the carers. This confirms the results from previous research that PwDs can still learn how to use prosthetic aids in combination with training schemes managed by carers (Bourgeois, 1990; Hanley & Lusty, 1984; Clare et al., 2000).

Study limitations

The results of our study must be interpreted in the context of some limitations as a consequence of the user-driven design method. First of all, the evaluation of the devices was conducted during the process of (iterative) development of the devices. This resulted in (partially) unstable systems that were tested in the PwDs homes. These instability problems will have influenced the results on user-friendliness and usefulness and limited the possibility of performing a full human factors impact analyses. Second, the reliability of the answers of PwDs could be questioned sometimes, especially when PwDs were asked to give an opinion regarding experiences over a longer period of time. When opinions of PwDs and carers were different, we do not always know whether this is caused by cognitive problems of the PwDs or by real differences in opinions. Also, it might be possible that some PwDs were inclined to provide socially desirable answers. However, this problem that occurs more often in social research is – to our knowledge – not specific for this target group. Unfortunately, the technical instability of the system in field test #2 and #3 made it impossible to reliably check answers by means of analysis of the logged data collected by SeniorXensor. Third, the expectations of the users regarding the device they wanted to be developed could not always be met. Reasons for this were the restricted development time and technical feasibility of developing new functionalities within the research project. Since new users were included in each new iteration phase, part of their wishes could not be fulfilled, because it was not possible to develop complex new functionalities after the first iteration. They could help however to fine tune the developed services by expressing their wishes and comments on these. Because different prototypes were tested in the field tests with different users, the progress or improvement of the developed devices was hard to assess, because new users could have new needs or other preferences. On the other hand, this design with new users in each cycle was especially chosen to allow for inclusion of a larger variation in the user group

and therewith a better representation of the target group of people with mild dementia and carers. This was also the reason for testing the device in three different countries in Europe.

The mentioned limitations make it difficult to generalise the results to the opinions of PwDs in the general population. In a project with more development time and different PwDs, other functionalities might have been given priority. On the other hand, the support areas were selected on the basis of study results in a larger sample and our findings regarding user-friendliness and usefulness of the developed functionalities may also be relevant for other functionalities, such as the use of concrete non abstract icons, the use of multimodal messages and the need for personalisation of functionalities.

Scientific relevance

In the COGKNOW project, the PwDs and carers were involved in the development and evaluation of a new cognitive prosthetic device right from the start of the study. It is rather new to involve the potential end-users in this way (Lauriks et al., 2007). We based our research on a large survey into care needs of PwD conducted by one of the consortium partners (Van der Roest et al., in press). In this survey a large group of PwD and carers were interviewed on the (unmet) needs of the PwD. Based on the results of this study, the COGKNOW project focused on four need areas in which most frequently unmet needs are experienced in the target group. Smaller samples of PwDs and carers were included in three iteration phases to allow in depth assessment of the way ICT support could fulfill the needs and wishes of the PwDs. The study design also allowed us to optimize the user-friendliness and usefulness of the developed services and to evaluate this in a detailed manner.

Besides the needs and wishes of the PwDs and carers, the development of the COGKNOW Day Navigator was based on the state of the art of ICT solutions for elderly persons and PwDs (Dröes et al., 2005; Lauriks et al., 2007). The innovation aim in the project was not to develop totally new functionalities, but to integrate existing systems into one remotely configurable integrated system.

We used a multi-method approach to gain a more accurate insight in the user-friendliness and usefulness of the CDN (see also Maxwell, 1996; Patton, 2002). During the evaluation sessions, PwDs performed prescribed tasks that were observed by the researchers and PwDs and carers were also interviewed. During the field test period PwDs and carers kept diaries, and the actual use of the system was checked by a logging method (at least in field test #2). This multi-method approach helped us to better understand the different views on user-friendliness and usefulness.

The evaluation of the impact of using the device on the daily lives of PwDs and carers was limited in this project because of problems with the stability of the system. It is recommended to perform an impact study within the target group only when the system is considered stable and to make use of a randomised controlled design in a larger study population.

Relevance for psychogeriatric practice

In our opinion the COGKNOW Day Navigator can support the PwD to become more autonomous in terms of memory, maintaining social contact and daily activities. Especially the reminder function (day and time indication and the reminders) seems to help PwDs to actually use the CDN. For the domain of safety we feel that more research is needed. Perhaps the functionality should be more broadened, for instance it was a wish of many PwDs and carers to have an opportunity to control the gas. Also the Take-me-home function needs to be evaluated more thoroughly. In the CDN, the help function was restricted to help by the main informal carer. Possibilities to get help when the carer is not available should be

investigated further. Also professional care organisations could be included in the help function of the CDN.

The fact that PwDs might be less dependent on others because they are reminded about appointments and are able to engage in social contacts and activities more easily, might enhance their feelings of self-esteem and thus their feelings of quality of life.

The advantage of the CDN is that it is not only a care service (helping people with cognitive impairments), but also a welfare or well-being service, aiming to support people in performing enjoyable activities. This service function could even be more elaborated, for instance by adding a functionality to play games (chess, cards games). When extending the functionalities in the CDN, it might be possible to make use of the CDN from early stages of dementia to more severe stages of dementia. PwDs and carers should be able to select those functionalities that could help them with their unmet needs, and to de-select or deactivate functionalities that have become useless for them.

For the carers the CDN is also considered potentially supportive. It might diminish the burden of carers because PwDs are reminded by the system to undertake activities, such as having lunch. Even though carers may have to motivate the PwDs sometimes, for instance to make a phone call, the PwDs are able to perform the phone call themselves with the aid of the CDN. The carers may also feel more at ease knowing that the PwD takes the mobile along when leaving the home and is supported by the CDN to find the way back home when lost or to make a phone call in case of trouble.

To conclude, the user-driven design method with a multi-method approach could be applied successfully in this study. The target group participated actively and helped us to develop and evaluate an assistive device for persons with dementia and their carers. By using this method we think it will be easier to gain acceptance by the target group. The target group was receptive to assistive technology, which is an important precondition for effectively implementing technological applications as an additional means of supporting people with dementia at home in the coming decades.

8. Recommendations

Based on the conclusions of the final Human Factors Impact Analysis the following recommendations are made:

Recommendations for future development of the COGKNOW Day Navigator

- The technical problems must be resolved of the COGKNOW device to attain a technical stable performance of the CDN.
- The charging problems of the mobile device must be resolved and charging must last for at least 24 hours of normal use. The mobile device should be lighter and the touch screen less sensitive. When the picture phone is in use, the pictures should stay visible on the mobile.
- The multi-modal interaction of the different functions of the device must be further developed, including verbal prompts in combination with pictures and text.
- Regarding the support for reminding: the quarter-hour clock should be further developed, made more user-friendly and more personalised to a persons' preference. The reminders should be further personalised and be remotely configurable by the carers. The reminder configuration interface needs simplification for elderly. The reminders should be put forward more multimodal, for instance also with a voice message that is given by a "character" instead of a familiar person in order to avoid confusion. This voice message probably improves attracting the attention of the PwD. Furthermore, when a reminder is acknowledged it should be possible to still be able to view this reminder (in the current version, the reminder disappears from the screen and agenda). A calendar function with an overview of activities for the coming days was suggested. The user-friendliness of the find mobile button should be improved
- For the support in social contacts: It is recommended to improve the quality of the sound of the phone handset.
- Regarding the support in daily activities: For the Activity assistance function it is advised to make this function together with the PwDs, so to make this function attuned to a person's needs. Activity support should be tested for a variety of activities. The consultation of an occupational therapist is advised. The quality of the sound of the music player and radio should be improved. Also more variety of preferred music and the possibility of choosing a specific piece of music (instead of randomly selected) or a specific radio channel, should be offered.
- Regarding the support for safety: the icon "help function" can be improved by removing the text help (the text 'help' is confusing because the whole system is intended to help people with dementia and it is therefore difficult to make a distinction between different types of help). A picture of the main carer as a shortcut to make an easy telephone call might be more clear than the current life-buoy (It is recommended to also have a picture of the carer in the picture dialling address book). In case of a short cut to the main carer, precautions should be taken to prevent too frequent calling to (and overburdening of) the carer. The Take-me-home function should be further developed.

- In general it is advisable to use the COGKNOW Day Navigator as a family device, which will help to make it less stigmatising to use the device for PwDs and will improve learning how to use the device, because PwDs have a role model of whom they can copy the behaviour. A simple teaching intervention or manual for the PwD and carer to learn how to use the devices on their own, needs to be further developed and tested.

Recommendations for future research

- It is recommended to develop a device together with PwDs and carers in a multidisciplinary team consisting of experts in the field of dementia care and technological system developers. PwDs and carers should be informed about the possibilities within a research project and about limitations regarding time, finances and technical feasibilities to avoid too high expectations.
- The inclusion of more, or more elaborate, functionalities could be further investigated, for instance to add a professional support to the help function.
- The assessment of impact of using the CDN, and assistive technology in general, on daily life should be done with a service that is stable during the test period and can be tested for a longer period of time.
- A randomised controlled trial design in a large sample is the preferred research design. The device should be tested in a varied study sample to gain knowledge about the impact of using an assistive device in different (stages of) diseases, and in people with different background characteristics, such as living alone or together.

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Annex A. Research questions of field test #3

Human Factors: research questions and methods Field Test 3 (v0.8)

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The structure of the Human Factors RQs:

0 General questions

I Remembering and Reminding functionality

- A. Evaluate user friendliness of COGKNOW DayNavigator prototype for Remembering & Reminding functionality
- B. Evaluate usefulness of COGKNOW DayNavigator prototype for Remembering & Reminding functionality
- C. Evaluate efficacy of COGKNOW DayNavigator prototype for Remembering & Reminding functionality

II Social contact functionality

- A. Evaluate user friendliness of COGKNOW DayNavigator prototype for Communicating functionality
- B. Evaluate usefulness of COGKNOW DayNavigator prototype for Communicating functionality
- C. Evaluate efficacy of COGKNOW DayNavigator prototype for Communicating functionality

III Daytime activities functionality

- A. Evaluate user friendliness of COGKNOW DayNavigator prototype for Daytime activities functionality
- B. Evaluate usefulness of COGKNOW DayNavigator prototype for Daytime activities functionality
- C. Evaluate efficacy COGKNOW DayNavigator prototype for Daytime activities functionality

IV Safety functionality

- A. Evaluate user friendliness of COGKNOW DayNavigator prototype for Safety functionality
- B. Evaluate usefulness of COGKNOW DayNavigator prototype for Safety functionality
- C. Evaluate efficacy of COGKNOW DayNavigator prototype for Safety functionality

V Business research questions

NB. Each research question concerns both the stationary and the mobile device, unless it is stated explicitly that it focusses on either the stationary or the mobile device.

0 General questions

Questions	Methods	WP/Who	Answered in FT#3
<p>1. How user-friendly was the carer interface for the carer?</p> <ul style="list-style-type: none"> a. adding reminders b. personalisation 	Semi-structured interviews with carer	Wp1: VUMC & BCH & CDH	<p>No specific carer interface</p> <p>Only two experienced users used the present configuration interface</p>
<p>2. How user-friendly do PwD find the devices concerning factors such as:</p> <ul style="list-style-type: none"> a. form factors b. basic interactions, c. easy to learn d. wearability 	observation and semi-structured interviews with PwD	Wp1: VUMC & BCH & CDH	Yes
<p>3. How user-friendly do carers find the devices concerning factors such as:</p> <ul style="list-style-type: none"> a. form factors b. basic interactions, c. easy to learn d. wearability 	Semi-structured interviews with carer	Wp1: VUMC & BCH & CDH	Yes
<p>4. Do PwD take along the mobile device ?</p> <ul style="list-style-type: none"> a. where? (inside and outside the house) b. how often? c. how often is it forgotten? d. Why or why not? 	<p>Outdoors: logging & in situ measurement (we log the location of the mobile device every 5 minutes via GPS; when indoors GPS we can typically determine where based on log history) 4c cannot be logged</p> <p>semi-structured interviews and diaries</p>	Wp2&3? (otherwise WP1)	Yes

<p>5. What is the battery life of the device in practice?</p> <ul style="list-style-type: none"> a. How often was the mobile device without battery power? b. How often was it charged and when (time, battery level, battery warning)? c. How often did PwD forget to recharge? d. How easy did PwD find charging the device? e. How can we help the PwD not to forget recharging the device? 	<p>Logging & in situ measurement</p> <p>Log battery status every 5 minutes: percentage of battery power left and directly/indirectly: charging/not charging and battery charging reminders.</p> <p>Observation or semi-structured interview</p> <p>include in pre-scribed tasks (possibly test 2 charging solutions: new cradle, a cable)</p>	<p>WP2&3: TI, UU, Mobi</p> <p>WP1</p>	<p>Yes</p>
<p>6. How do people prefer to carry the mobile device:</p> <ul style="list-style-type: none"> a. neck strap (= lanyard, keychain) b. belt pouch (= leather case on belt) c. trouser pocket d. jacket pocket e. handbag/purse f. other? 	<p>Offer the different solutions during the introduction and let them choose</p> <p>Semi-structured interviews (post: which method was used most and why)</p>	<p>Wp1: VUMC & BCH & CDH</p>	<p>Yes</p>
<p>7. How do PwD like the system in their house?</p> <ul style="list-style-type: none"> a. What is the best location? b. Is the design and size acceptable for their home environment? 	<p>Semi-structured interview</p> <p>combined with a map or pictures</p>	<p>Wp1: VUMC & BCH & CDH</p>	<p>Yes</p>

<p>8. How frequent was the system used?</p> <p>a. If not used, how come (why) ? Did people turn the system off, why?</p>	<p>Logging & in situ measurement (we can detect when the Stationary Device was not working; this may be PwD or other person turning it off, power failure or a crash. We cannot distinguish between these in logs)</p> <p>Diaries</p> <p>Semi-structured interview (post) : use results of logging data 2 wks after installation & 2 wks before last interview</p>	<p>WP2&3: TI, UU, Mobi</p> <p>Wp1: VUMC & BCH & CDH</p>	<p>Yes</p>
<p>9. To what extent do carers and PwD think the COGKNOW Day Navigator is useful for the PwD?</p>	<p>Semi-structured interview</p>	<p>Wp1: VUMC & BCH & CDH</p>	<p>Yes</p>
<p>10. Do PwD and carers have suggestions to improve the user friendliness and usefulness of the interface and devices</p>	<p>Semi-structured interviews</p>	<p>Wp1: VUMC & BCH & CDH</p>	<p>Yes</p>
<p>11. Does overall use of the CDN have an impact on PwD 's</p> <p>a. Quality of Life?</p> <p>b. Experienced and actual Autonomy?</p>	<p>Semi-structured interviews and questionnaires</p> <p>Observations</p>	<p>WP1: VUMC & BCH & CDH</p>	<p>Yes</p> <p>Only first explorative investigation</p>
<p>14. Does overall use of the CDN have an impact on carer' s</p> <p>a. Burden</p> <p>b. Overall Quality of life</p>	<p>Semi-structured interviews and questionnaires</p>	<p>WP1: VUMC & BCH & CDH</p>	<p>Yes</p> <p>Only first explorative investigation</p>
<p>Metaquestions</p>			
<p>15. Reflecting on research methods:</p> <p>a. How useful was the combination of the used methods (workshops, semi-structured interviews, observation, logging & in situ measurement, bottle-neck list) for answering our research questions?</p>			<p>Yes</p>

<p>16. To what extent has the user feedback from FT1 and FT2 been met?</p> <p>a. To what extent is the user feedback reflected in the FRs for FT3?</p> <p>b. To what extent is the user feedback implemented in Version 3 of the Cogknow DayNavigator?</p> <p>c. To what extent did the revisions based on user feedback lead to improved user results?</p>	<p>a & b is reflected upon in D1.4.3</p> <p>c: compare full results of FT1 and FT2 with full results of FT3</p>	<p>WP5</p>	<p>Only Partly</p> <p>Not well possible because different users in the three field tests</p>
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I Remembering and Reminding functionality

Aim A: Evaluate user friendliness of COGKNOW DayNavigator prototype for Remembering & Reminding functionality

Questions	Methods	WP/Who	Answered in FT#3
<p>1 How easy was it to learn, understand and remember the reminding functionality?</p>	<p>Observation or semi-structured interview (asking PwD as well as carers)</p>	<p>Wp1: VUMC & BCH & CDH</p>	<p>Yes</p>
<p>2 How well were reminders on the stationary device heard (in different rooms)?</p>	<p>Include in pre-scribed tasks: vary in locations observation or semi-structured interview</p>	<p>Wp1: VUMC & BCH & CDH</p>	<p>Yes</p>
<p>3 How often were reminders acknowledged (button pressed)?</p> <p>a On the stationary device?</p> <p>b On the mobile device?</p>	<p>logging & in situ measurement (only stationary reminders; cannot confirm working of logs of mobile reminders yet)</p>	<p>WP2&3: TI, UU, Mobi</p>	<p>No</p>
<p>4 How often does it happen that the PwD is reminded <i>incorrectly</i> not to forget the mobile device?</p>	<p>Semi-structured interview and diaries</p>	<p>Wp1: VUMC & BCH & CDH</p>	<p>Yes</p>
<p>5 How often were carers notified (SMS) regarding negative acknowledgement of reminders?</p>	<p>Logging & in situ measurement</p>	<p>WP2&3: TI, UU, Mobi</p>	<p>No</p>

Questions	Methods	WP/Who	Answered in FT#3
6 How easy was it to learn, understand and remember the Time and Day Indicator?	Observation or semi-structured interview	Wp1: VUMC & BCH & CDH	Yes
7 How easy was it to learn, understand and remember the Quarter hour clock?	Observation or semi-structured interview	Wp1: VUMC & BCH & CDH	Yes
8 How easy was it to learn, understand and remember the 'find mobile' function? a. how often was this function used during the field test and what pattern was there in the frequency of use of this function?	Observation or semi-structured interview logging & in situ measurement	Wp1: VUMC & BCH & CDH WP2&3: TI, UU, Mobi	Yes
9 Do PwD and carers have suggestions to improve the user friendliness of remembering and reminding functionality?	Semi-structured interviews	Wp1: VUMC & BCH & CDH	Yes
10 How user-friendly do PwD find the reminding functionality concerning factors such as: a form factors b interactions	observation and semi-structured interviews with PwD	Wp1: VUMC & BCH & CDH	Yes
11 How user friendly do carers find the reminding functionality (and the notification regarding negative acknowledgement for carers) concerning factors such as: a form factors b interactions	Semi-structured interviews with carer	Wp1: VUMC & BCH & CDH	Yes

Aim B. Evaluate usefulness of first full COGKNOW DayNavigator prototype for Remembering & Reminding functionality

Questions	Methods	WP/Who	Answered in FT#3
1 How adequate do PwD react upon reminders (on stationary and mobile)? a if not: why not	observation or semi-structured interview, diaries logging for reminders to make a phone call	Wp1: VUMC & BCH & CDH WP2&3: TI, UU, Mobi	Yes No (logging)

2	How useful did PwD and Carers feel the reminders were? a Why? b In which situations (e.g. on mobile or stationary) were reminders useful or not useful?	Observation and semi-structured interviews: pre, post and during	Wp1: VUMC & BCH & CDH	Yes
3	How useful was the Day & time indicator?	Observation or semi-structured interview	Wp1: VUMC & BCH & CDH	Yes
4	How useful was the Quarter hour clock?	Observation or semi-structured interview	Wp1: VUMC & BCH & CDH	Yes
5	How useful was the 'find mobile' function?	observation or semi-structured interview	Wp1: VUMC & BCH & CDH WP2&3: TI, UU, Mobi	Yes
6	How useful do carers find the notification in case of negative acknowledgement of reminders?	Semi-structured interviews	Wp1: VUMC & BCH & CDH	No
7	Do PwD and carers have suggestions to improve the usefulness of remembering and reminding functionality?	Semi-structured interviews	Wp1: VUMC & BCH & CDH	Yes

Aim C. Evaluate the efficacy of COGKNOW DayNavigator prototype for Remembering & Reminding functionality

Questions	Methods	WP/Who	Answered in FT#3
1 Does the CDN help the PwD with remembering and reminding?	Semi-structured interviews Observations In-situ measurements	Wp1: VUMC & BCH & CDH WP2&3: TI, UU, Mobi	Yes
2 Do carers think use of the CDN helps the PwD with remembering and reminding?	Semi-structured interviews	Wp1: VUMC & BCH & CDH	Yes
3 Does the remembering and reminding functionality contribute to the PwD's Quality of Life?	Semi-structured interviews and questionnaires	Wp1: VUMC & BCH & CDH	No Only first explorative investigation

II Social contact functionality

Aim A. Evaluate user friendliness of COGKNOW DayNavigator prototype for Communicating functionality

Questions	Methods	WP/Who	Answered in FT#3
<p>1 How easy was it to learn and understand the picture dialing functionality? Both for stationary and mobile device</p> <p>a Were the steps to dial intuitive/natural? (without hesitation)</p> <p>b Compared to traditional behavior? Do PwD also use their own phone (traditional, gsm)?</p>	<p>Semi-structured interview and observation</p> <p>logging & in situ measurement (speed between steps . Henri checks if possible)</p>	<p>Wp1: VUMC & BCH & CDH</p> <p>WP2&3: TI, UU, Mobi</p>	Yes
<p>2 How well do PwD remember how to use picture dialing?</p> <p>a How fast do they execute the steps?</p> <p>b Can they perform the whole dialing process?</p>	<p>Observation or semi-structured interview</p> <p>logging & in situ measurement (most steps, except select party to dial step)</p>	<p>Wp1: VUMC & BCH & CDH</p> <p>WP2&3: TI, UU, Mobi</p>	Yes
<p>3 How often did PwD use the phone (stationary/mobile/traditional phone)?</p> <p>a with whom (primary carer or other people from the contact list)</p> <p>b where? (indoor/outdoor)</p> <p>c Which device did they choose to use and why?</p> <p>d Did PwD reach the person they intended to call? (background info: picture dialing leads to less errors)</p>	<p>logging & in situ measurement: how often, length of call, which device (we can log calls made from the mobile device, incoming and outgoing calls on the stationary device, but we don't know the phone number of the other party for stationary calls, but not on other phones in the house of the PwD)</p> <p>Semi-structured interviews</p>	<p>WP2&3: TI, UU, Mobi</p> <p>Wp1: VUMC & BCH & CDH</p>	Yes
<p>4 How easy was it to learn, understand and remember the incoming call indication?</p>	<p>Observation or semi-structured interview</p>	<p>Wp1: VUMC & BCH & CDH</p>	Yes
<p>5 Do PwD and carers have suggestions to improve the user friendliness of the communication functionality?</p>	<p>Semi-structured interviews</p>	<p>Wp1: VUMC & BCH & CDH</p>	Yes

Questions	Methods	WP/Who	Answered in FT#3
6 How user-friendly do PwD find the communicating functionality concerning factors such as: a form factors b interactions	Observation and semi-structured interviews with PwD	Wp1: VUMC & BCH & CDH	Yes
7 How user-friendly do carers find the communicating functionality concerning factors such as: a form factors b interactions	Semi-structured interviews with carer	Wp1: VUMC & BCH & CDH	Yes

Aim B. Evaluate usefulness of first full COGKNOW DayNavigator prototype for Social contact functionality

Questions	Methods	WP/Who	Answered in FT#3
1 How useful do PwD and Carers find using the picture dialling function? a Compared to traditional method of calling?	Observation or semi-structured interview	Wp1: VUMC & BCH & CDH	Yes
2 How effective do PwD and Carers feel using the picture dialling was in maintaining their social network?	Observation or semi-structured interview	Wp1: VUMC & BCH & CDH	Yes partly
3 What did users think about usefulness of incoming call indication?	observation or semi-structured interview	Wp1: VUMC & BCH & CDH	Yes
4 Do PwD and carers have suggestions to improve the usefulness of the social contact functionality?	Semi-structured interviews	Wp1: VUMC & BCH & CDH	Yes

Aim C. Evaluate the efficacy of COGKNOW DayNavigator prototype for Social contact functionality

Questions	Methods	WP/Who	Answered in FT#3
1 Does the CDN help the PwD to stay in contact with family or friends? a Did picture dialling contribute to an increase in calls by PwD (social contact)	Semi-structured interviews In-situ measurements	WP1: Vumc & BCH & CDH WP2&3: TI, UU, Mobi	Yes, partly Only first explorative investigation (no logging)

2	Do carers think the use of the CDN helps PwD to stay in contact with family or friends?	Semi-structured interviews	WP1: Vumc & BCH & CDH	Yes Only first explorative investigation
3	Does the picture dialing functionality contribute to the PwD's Quality of Life?	Semi-structured interviews and questionnaires	WP1: Vumc & BCH & CDH	No Only first explorative investigation

III Daytime activities functionality

Aim A. Evaluate user friendliness of first full COGKNOW DayNavigator prototype for Daytime activities functionality

Questions	Methods	WP/Who	Answered in FT#3
1 How easy was it to learn, understand and remember how to use the radio feature?	Observation or semi-structured interview logging & in situ measurement	Wp1: VUMC & BCH & CDH WP2&3: TI, UU, Mobi	Yes
2 How easy was it to learn, understand and remember how to use the music player?	Observation or semi-structured interview logging & in situ measurement	Wp1: VUMC & BCH & CDH WP2&3: TI, UU, Mobi	Yes
3 How easy was it to learn, understand and remember how to use the activity assistance? [one person per site]	observation or semi-structured interview logging & in situ measurement videotaping [permitted for one day]	Wp1: VUMC & BCH & CDH WP2&3: TI, UU, Mobi	Yes
4 How user-friendly are the instructional videos on the stationary device? [Think of: visibility, location, etc.]	observation or semi-structured interview videotaping [permitted for one day]	Wp1: VUMC & BCH & CDH WP2&3: TI, UU, Mobi	No, for videos Yes, for Instructional still pictures
5 Do PwD and carers have suggestions to improve the user friendliness of the daytime activities functionality?	Semi-structured interviews	Wp1: VUMC & BCH & CDH	Yes

Questions	Methods	WP/Who	Answered in FT#3
6 How user-friendly do PwD find the day time activities functionality concerning factors such as: a form factors b interactions	observation and semi-structured interviews with PwD	Wp1: VUMC & BCH & CDH	Yes
7 How user-friendly do carers find the day time activities functionality concerning factors such as: a form factors b interactions	Semi-structured interviews with carer (tbd)	Wp1: VUMC & BCH & CDH	Yes

Aim B. Evaluate usefulness of first full COGKNOW DayNavigator prototype for Daytime activities functionality

Questions	Methods	WP/Who	Answered in FT#3
1 How useful do PwD and Carers find using the radio feature? a Compared to a traditional radio?	Observation or semi-structured interview	Wp1: VUMC & BCH & CDH	Yes
2 How useful do PwD and Carers find using the music player? a Compared to a traditional music player?	Observation or semi-structured interview	Wp1: VUMC & BCH & CDH	Yes
3 How useful are video fragments in supporting PwD to carry out a task and why? a would still pictures be sufficient (instead of videos)? b to what extent do video fragments need to be personalized? i) do they need to be made at the home of the PwD: their own kettle, washingmachine, etc., ii) should it be the carer in the videos	observation or semi-structured interview logging & in situ measurement videotaping [permitted for one day]	Wp1: VUMC & BCH & CDH WP2&3: TI, UU, Mobi	Yes (no logging or videotaping)
4 Do PwD and carers have suggestions to improve the usefulness of the daytime activities functionality?	Semi-structured interviews	Wp1: VUMC & BCH & CDH	Yes

Aim C. Evaluate the efficacy of COGKNOW DayNavigator prototype for Daytime activity functionality

Questions	Methods	WP/Who	Answered in FT#3
<p>1 Does the CDN help the PwD to execute or participate in daily activities they enjoy?</p> <p>a Do they enjoy listening to music and radio? How is this compared to situation before use of the CDN?</p> <p>b Does the acitivity assistance support them in daily life?</p>	<p>Semi-structured interviews</p> <p>Observations</p> <p>In-situ measurements</p>	<p>Wp1: VUMC & BCH & CDH</p> <p>WP2&3: TI, UU, Mobi</p>	<p>Yes, partly</p> <p>Only first explorative investigation (no logging)</p>
<p>2 Do carers think the use of the CDN helps PwD to execute or participate in daily activities they enjoy?</p> <p>a Do they think PwD enjoy listening to music and radio? How is this compared to situation before use of the CDN?</p> <p>b Do they think the acitivity assistance supports PwD in daily life?</p>	<p>Semi-structured interviews</p>	<p>Wp1: VUMC & BCH & CDH</p>	<p>Yes</p>
<p>3 Does the daytime activity functionality contribute to the PwD's Quality of Life?</p>	<p>Semi-structured interviews and questionnaires</p>	<p>Wp1: VUMC & BCH & CDH</p>	<p>No</p> <p>Only first explorative investigation</p>

IV Safety functionality

Aim A. Evaluate user friendliness of COGKNOW DayNavigator prototype for safety functionality

Questions	Methods	WP/Who	Answered in FT#3
<p>1 Was the route navigation functionality used by PwD on their own?</p>	<p>Observation or semi-structured interview</p> <p>Logging & in situ measurement</p>	<p>Wp1: VUMC & BCH & CDH</p> <p>WP2&3: TI, UU, Mobi</p>	<p>Yes</p>

Questions	Methods	WP/Who	Answered in FT#3
<p>2 How easy was it to learn, understand and remember the route navigation functionality?</p>	<p>Observation or semi-structured interview</p> <p>Logging & in situ measurement (although we cannot detect how often the PwD by accident touched the screen and used the menu)</p>	<p>Wp1: VUMC & BCH & CDH</p> <p>WP2&3: TI, UU, Mobi</p>	<p>Yes</p>
<p>3 How user-friendly was the navigation support functionality:</p> <p>a How easy was it to start navigating: find the initial right direction? (potential problems: gps-fix takes long, initial orientation)</p> <p>b How often did people deviate (intentionally or by accident) from planned track? (potential problems: take wrong turn, etc.)</p> <p>c To what extent do PwD exhibit risky traffic behavior when walking with the navigation support functionality?</p> <p>d How easy was it to find the last 100 metres to their homes? (potential problems: navigation stops too early or too late)</p>	<p>Observation during prescribed tasks</p> <p>Logging & in situ measurement during remainder of 3 weeks</p>	<p>Wp1: VUMC & BCH & CDH</p> <p>WP2&3: TI, UU, Mobi</p>	<p>Yes, partly (no logging)</p>
<p>4 How easy was it to learn, understand and remember how to act on the different safety warnings?</p>	<p>Observation or semi-structured interview</p> <p>logging & in situ measurement</p>	<p>Wp1: VUMC & BCH & CDH</p> <p>WP2&3: TI, UU, Mobi</p>	<p>Yes, partly (no logging)</p>
<p>5 How easy was it to learn, understand and remember how to use the help button?</p>	<p>Observation or semi-structured interview</p>	<p>Wp1: VUMC & BCH & CDH</p> <p>WP2&3: TI, UU, Mobi</p>	<p>Yes</p>
<p>6 How easy was it to learn, understand and remember how to react on the warnings? Do we do this (Chris will check this)?:</p> <p>a take your mobile device when leaving the house</p> <p>b take your keys when leaving the house</p>	<p>Observation or semi-structured interview</p> <p>Logging & in situ measurement</p>	<p>Wp1: VUMC & BCH & CDH</p> <p>WP2&3: TI, UU, Mobi</p>	<p>Yes, partly (no logging)</p>

Questions	Methods	WP/Who	Answered in FT#3
7 Do PwD and carers have suggestions to improve the user friendliness of safety functionality?	Semi-structured interviews	Wp1: VUMC & BCH & CDH	Yes
8 How user-friendly do PwD find the safety functionality concerning factors such as: a form factors b interactions	Observation and semi-structured interviews with PwD	Wp1: VUMC & BCH & CDH	Yes
9 How user-friendly do carers find the safety functionality concerning factors such as: a form factors b interactions	Semi-structured interviews with carer	Wp1: VUMC & BCH & CDH	Yes

Aim B. Evaluate usefulness of first full COGKNOW DayNavigator prototype for Safety functionality

Questions	Methods	WP/Who	Answered in FT#3
1 How useful do PwD and carers find the route navigation functionality?	Semi-structured interviews	Wp1: VUMC & BCH & CDH	Yes
2 How often did the PwD find the way back to their home on their own using the route navigation functionality?	Logging & in situ measurement semi-structured interview: were they on their own?	WP2&3: TI, UU, Mobi Wp1: VUMC & BCH & CDH	Yes, partly (no logging)
3 How confident does the PwD feel outside on their own with the route navigation functionality?	Semi-structured interviews	Wp1: VUMC & BCH & CDH	Yes
4 Did PwD call the carer when outdoors? a Why?	Logging & in situ measurement (only when using the Cogknow Mobile Device to make the call) Semi-structured interview (with carer)	WP2&3: TI, UU, Mobi Wp1: VUMC & BCH & CDH	Yes, partly (no logging)
5 How useful were the different safety warnings?	Semi-structured interviews	Wp1: VUMC & BCH & CDH	Yes

Questions	Methods	WP/Who	Answered in FT#3
6 How useful was the help button?	Semi-structured interviews	Wp1: VUMC & BCH & CDH	Yes
7 How useful were the warnings?: a Take your mobile device when leaving the house i) Compare usefulness of warning with a more traditional way: a picture of the mobile device glued on the door b Take your keys when leaving the house	Semi-structured interview & observation	WP2&3: TI, UU, Mobi Wp1: VUMC & BCH & CDH	No
8 Do PwD and carers have suggestions to improve the usefulness of the safety functionality?	Semi-structured interviews	Wp1: VUMC & BCH & CDH	Yes

Aim C. Evaluate the efficacy of COGKNOW DayNavigator prototype for Safety functionality

Questions	Methods	WP/Who	Answered in FT#3
1 Does the CDN increase the PwD's feelings of safety? a Do PwD experience less anxiety compared to before using the CDN? b Do PwD feel more safe outside when using the route navigation?	Semi-structured interviews Observations	Wp1: VUMC & BCH & CDH	Yes Only first explorative investigation
2 Do carers think the use of the CDN increases the feelings of safety of PwD and themselves?	Semi-structured interviews	Wp1: VUMC & BCH & CDH	Yes
3 Does the safety functionality contribute to the PwD's Quality of Life?	Semi-structured interviews and questionnaires	Wp1: VUMC & BCH & CDH	No Only first explorative investigation

V Business Research Questions

Questions	Methods	WP/Who	Answered in FT#3
<p>1 COGKNOW and (user) benefits:</p> <ul style="list-style-type: none"> a What are in your opinion the benefits of the COGKNOW system? for the PwD, informal carer, relatives? b What do you consider the most valuable features / services of COGKNOW? for the PwD, informal carer, relatives? c In what context do you consider COGKNOW features the most valuable? d What kind of people would in your opinion benefit the most from a COGKNOW system? e What features / services are missing in your opinion? f If COGKNOW were available today, would you want to use it? [if yes, why], [if no, why not] 	Semi-structured interviews	Wp1: VUMC & BCH & CDH	Yes (see 5.6.1.)
<p>2 COGKNOW and provisioning:</p> <ul style="list-style-type: none"> a Who would you expect to offer a system like COGKNOW? E.g. a care provider, municipality, consumer electronics shop, ...? b Would you consider this a care service or rather a comfort service? c Would you (PwD, informal carer, family member) be willing to pay for the system, or pay a monthly amount for these services? d Who would you expect to pay for a COGKNOW kind of system? e How can potential users be made aware that these kind of systems exist? f How can (potential) users become acquainted with such systems and /or best trained in how to use them? g What would be a good moment to start with this kind of services? 	Semi-structured interviews	Wp1: VUMC & BCH & CDH	Yes (see 5.6.1.)

Annex B. Results of field test #3

B.1. Quantitative results on main questions for all test sites

Question	PwD m1 N (%)	PwD m2 N (%)	Carer m1 N (%)	Carer m2 N (%)
General opinion on CDN				
<i>Pwd shows/is able to learn to use device: (OL2 / L4)</i>				
Not able to use device	1 (8)	1 (11)	1 (9) difficult to use	2 (20)
Adequate use after repeated demonstration	7 (58)	3 (33)	8 (73) somewhat easy	5 (50)
Adequate use after first demonstration	4 (34)	5 (56)	2 (18) easy to use	3 (30)
<i>Satisfied with device in general (L9)</i>				
Very satisfied	1 (8)	-	3 (30)	-
Satisfied	11 (92)	9 (90)	6 (60)	3 (33)
Dissatisfied	-	1 (10)	1 (10)	6 (67)
Stationary device				
<i>Shows/has problems finding right button (OS5/ S5)</i>				
A lot of difficulty	1 (8)	-	1 (11)	2 (22)
Some difficulty	5 (42)	5 (56)	4 (44)	2 (22)
No difficulty	6 (50)	4 (44)	4 (44)	5 (56)
<i>Satisfied with stationary device (S10)</i>				
Very satisfied	2 (17)	2 (20)	-	1 (10)
Satisfied	8 (67)	5 (50)	9 (82)	4 (40)
Dissatisfied	2 (17)	3 (30)	2 (18)	5 (50)
Mobile device				
<i>Satisfied with mobile (M15)</i>				
Very satisfied	1 (25)	2 (29)	1 (13)	-
Satisfied	2 (50)	3 (43)	7 (88)	1 (14)
Dissatisfied	1 (25)	2 (29)	-	6 (86)
Remembering				
<i>Shows/is understanding (of) reminder function (OR2 / R2)</i>				
Never understands	-	2 (40)	-	3 (38)
Sometimes (not) understands,	4 (67)	1 (20)	4 (67)	3 (38)
Always understands	2 (33)	2 (40)	2 (33)	2 (25)
<i>How supportive is new reminder 1 (R12c)</i>				
Not supportive at all	1 (25)	2 (50)	2 (67)	2 (100)
Sometimes (not) supportive,	1 (25)	-	-	-
Very supportive	2 (50)	2 (50)	1 (33)	-
<i>Satisfied with reminders (R16 / R17)</i>				
Very satisfied	1 (25)	1 (14)	-	1 (10)
Satisfied	2 (50)	5 (71)	6 (60)	5 (50)
Dissatisfied	1 (25)	1 (14)	4 (40)	4 (40)
<i>Usefulness reminder to support memory (RIII-5 / R15)</i>				
Very useful	1 (13)	-	2 (29)	2 (20)
Useful	5 (63)	5 (71)	3 (43)	4 (40)
Not useful	2 (25)	2 (29)	2 (29)	4 (40)
<i>How easy to learn the day and time indication (ORII-1a / RII-1a)</i>				
Does not use it in a correct way	2 (17)	-	1 (9) difficult to use	-
Correct use after repeated demonstration	1 (8)	2 (25)	2 (18) somewhat easy	2 (22)
Correct use immediately after first	9 (75)	6 (75)	8 (73) easy to use	7 (78)

Question	PwD m1 N (%)	PwD m2 N (%)	Carer m1 N (%)	Carer m2 N (%)
demonstration				
<i>Usefulness day and time indication to support time orientation (RIII-1)</i>				
Very useful	4 (36)	5 (50)	2 (18)	1 (12)
Useful	7 (64)	5 (50)	9 (82)	6 (75)
Not useful	-	-	-	1 (12)
<i>How easy to learn the quarter-hour clock (ORII-2a / RII-2a)</i>				
Does not use it in a correct way	1 (100)	3 (75)	1 (20) difficult to use	2 (100)
Correct use after repeated demonstration	-	1 (25)	4 (80) somewhat easy	-
Correct use immediately after first demonstration	-	-	- easy to use	-
<i>Usefulness quarter-hour clock to support time orientation (RIII-2)</i>				
Very useful	-	-	-	-
Useful	2 (67)	-	2 (67)	-
Not useful	1 (33)	5 (100)	1 (33)	3 (100)
Communicating				
<i>How easy to use photo address book (P7)</i>				
Difficult to use	-	1 (12)	-	2 (29)
Appropriate	1 (10)	3 (38)	4 (44)	2 (29)
Easy to use	9 (90)	4 (50)	5 (56)	3 (43)
<i>How helpful is picture dialling function (P4)</i>				
Very helpful	5 (50)	2 (25)	5 (56)	3 (43)
Appropriate	5 (50)	4 (50)	4 (44)	2 (29)
Not very helpful	-	2 (25)	-	2 (29)
<i>How satisfied with telephone function (P13)</i>				
Very satisfied	-	2 (25)	4 (50)	2 (25)
Satisfied	7 (78)	3 (38)	4 (50)	3 (38)
Dissatisfied	2 (22)	3 (38)	-	3 (38)
Media playback				
<i>How easy to understand radio function (OTII-1 / TII-1)</i>				
Does not use the radio correctly	-	-	1 (9) difficult to use	1 (10)
Correct use after repeated demonstration	3 (27)	-	1 (9) somewhat easy	3 (30)
Correct use immediately after first demonstration	8 (73)	9 (100)	9 (82) easy to use	6 (60)
<i>How satisfied with radio function? (TIII-7)</i>				
Very satisfied	4 (40)	1 (10)	1 (9)	2 (40)
Satisfied	5 (50)	5 (50)	10 (91)	2 (40)
Dissatisfied	1 (10)	4 (40)	-	1 (20)
<i>Usefulness radio to support enjoying radio (TIII-4a)</i>				
Very useful	2 (25)	-	1 (14)	1 (17)
Useful	3 (38)	5 (71)	6 (86)	1 (17)
Not useful	3 (38)	2 (29)	-	4 (67)
<i>How easy to understand music player (OTII-3 / TII-3)</i>				
Does not use the music player correctly	1 (8)	-	- difficult to use	4 (40)
Correct use after repeated demonstration	2 (17)	3 (33)	4 (36) somewhat easy	-
Correct use after first demonstration	9 (75)	6 (67)	7 (64) easy to use	6 (60)
<i>How satisfied with music function? (T9)</i>				
Very satisfied	3 (27)	1 (11)	4 (36)	2 (25)
Satisfied	6 (55)	4 (44)	6 (55)	2 (25)
Dissatisfied	2 (18)	4 (44)	1 (9)	4 (50)
Safety warning				
<i>How easy to understand safety warning?</i>				

Question	PwD m1 N (%)	PwD m2 N (%)	Carer m1 N (%)	Carer m2 N (%)
<i>(OWII-12 a1 / WII-12 a1)</i>				
Does not understand or learn	-	-	- difficult to use	1 (50)
Acts adequately after repeated explanation	-	1 (50)	2 (67) somewhat easy	-
Acts adequately after first explanation	2 (100)	1 (50)	1 (33) easy to use	1 (50)
<i>How useful is the safety warning function of open door? (W3)</i>				
Very useful	1 (33)	-	1 (50)	-
Useful	2 (67)	1 (100)	1 (50)	1 (100)
Not useful	-	-	-	-
<i>How satisfied with warning alarm? (W12))</i>				
Very satisfied	-	-	1 (33)	-
Satisfied	2 (100)	1 (100)	2 (67)	2 (100)
Dissatisfied	-	-	-	-
<i>Learns and understand help button (OWII14 / WII 14)</i>				
Doesn't understand or learn	-	-	- difficult to use	2 (33)
Acts adequately after repeated demo	7 (70)	5 (71)	5 (56) somewhat easy	3 (50)
Acts adequately after first demonstration	3 (30)	2 (29)	4 (44) easy to use	1 (17)
<i>Usefulness of helpbutton to increase feeling of safety (WII-16)</i>				
Very useful	4 (40)	2 (25)	3 (33)	1 (17)
Useful	5 (50)	4 (50)	6 (67)	1 (17)
Not useful	1 (10)	2 (25)	-	4 (67)

B.2. Results on experts opinions regarding CDN –v3

Usability Test 1 in Amsterdam

TI/VUMC 6 March 2009	Expert opinion CDN version 3.x (CHH v3.6) Amsterdam
Test site	Dementia expert: Professor in Geriatric Psychiatry (specialised in dementia). Site researchers: Rose-Marie Dröes / Sanne Bentvelzen (VUMC) Site technician: Johannes de Boer (TI)
Remembering	
-1002 Reminder - Text - Image - Audio	The reminders could not be shown, but are explained. -- The expert liked the idea that carers can choose to get a text message for indicated reminders when a PwD did not respond to the reminder.
-1005 Visual signal of reminder	Expert: The PwD might not be able to interpret the clock correctly. When the reminder comes with an audible and visible signal their attention is attracted towards the system. The importance of visual and audible signals is stressed.
-1015 Day/Time Indication	The expert is not sure if the clock is still understandable for the PwD. But he thinks the quarter-hour clock is a good visual supplement.
Communicating	
-2000 Picture Dialling	The expert thinks the picture dialling is a good way to communicate. Picture dialling is useable by the PwD, since facial recognition is mostly still intact. (unlike normal dialling) It is good that picture dialling has few interaction steps.
1-5 Stationary	(there are no batteries in the phone at this moment, so when touching the picture to dial, it would constantly tell us to 'pick up the phone"...)
1-5 mobile	Does not work at this moment
-2003 Audio Call	Not available
-2004 Video Call	not available
Activities	
-3015 Activity Assistance	Does not work correctly on the CDN in Amsterdam, but the method is explained/demonstrated by means of the YouTube video. The expert thinks the AA can be helpful, especially when it is cut into understandable steps. Some steps could be too complicated when there is planning and organising involved (searching for things in the closet). His advice is to prepare all materials for the activity so that people do not have to search for it.
-3023 Motivate to eat with music playing, sensor based	not available
-3006 Media Playback with music files	The expert likes that the button is enlarged and colored when touched.
3001 Device control (e.g. Radio on/off or	Did not work (problems with sensor), but explained. Comment expert: It's OK.

lamp on/of)	
Safety	
-4003 Household appliances warning: fridge warning	Did not work in Amsterdam, Explained. Is rated helpful by the expert.
-4024 Navigation Support outside of house	Expert would like to see the ADDRESS of the PwD at the top of the screen immediately after touching the 'Take-me-home' button. In this way people see their address and can also ask bystanders to help them (point the way) home. This would increase their feeling of safety.
-4015 Switch off household appliances	Not available. Expert suggested turning the cooker off.
General	
-2017 Personalisation	Expert is pleased to hear that functions can be added or removed according to peoples wishes.
-2018 Ease of interaction	The expert hopes that the explanation/training of the system is clear enough for PwD and (in)formal carers.
-2019 Language (native)	Not answered
Other	
-4016 Safety Warning (fire/gas)	Not available
-1003 Extended repetition of reminder	The expert liked the idea that carers can choose to get a text message for indicated reminders when a PwD did not respond to the reminder.
-1012 Finding item using RFID tag	Did not work in Amsterdam
Find mobile	Did not work in Amsterdam
-4013 Emergency contact	The expert thinks that the availability of the HELP button enhances the feeling of safety. But the icon used on the stationary is not very clear. He preferred the icon for HELP on the mobile.
-1022 Audible signal in multiple rooms	Not available
-1009 Remotely setting reminders - simple using wizard - event description and priority - text - image/video - audio - recurring schedule - context conditions - output devices	Not available, but explained. The expert points out that we should be aware that configuration of reminders etc needs to be manageable by (in)formal carers.
-4000 Mobile device warning with RFID tag	Not available
-4001 Keys warning with RFID tag	Not available
Sensorised Light at night	Not answered

Usability Test 2 in Amsterdam

VU 1 July 2009	Expert opinion CDN version 3.x (CHH v3.x) Amsterdam
Test site	Dementia expert: Social Geriatrician Site researcher: Sanne Bentvelzen (VUmc) Site technician : Johannes de Boer (Novay)
Remembering	
-1002 Reminder - Text - Image - Audio	The Reminder function is very convenient. It is good that there is a possibility to add sound or even a voice. The quarter-hour clock will probably not work, people with AD can not learn new things that good. They also have problems with abstraction of matters and this will be too abstract for them. Since they do need help with their orientation in time it might be good (for some of them) to have a count down with numbers instead. You should not put more than 2 or 3 reminders a day in it, otherwise it would be too much. The reminders can help them to orientate in the day.
-1005 Visual signal of reminder	Good, especially the combination of a visual and a sound stimuli.
-1015 Day/Time Indication	It is very helpful to have a day and time indication, although the clock could be more clearer. The needles should differ more in size and perhaps also in colour. It is good that it is an analogue one and not a digital one, since PwDs cannot understand them that well. The digital clock on the mobile device is not understandable for PwDs. The step to touch the little one (which is probably also not well understood) to enlarge the clock is also too difficult.
Communicating	
-2000 Picture Dialling	Good function. Maybe you can expand it with a webcam so they can see the person they are talking with. But be aware of the fact that when the disease progresses, a PwD will have a problem to distinct what is real and what is not. They might think that things can come through the screen (water/fire/persons). But the webcam function could be removed and switched back to the audio one (like now) when people deteriorate. It might be a wise idea to leave the help button always available, but program the CDN in such a way that the Picture Dialling will not be visible during night time. Perhaps it is also smart if the system makes sure that it is not possible to call the same person more than 6 times in a row.
1-5 Stationary	It is very understandable, but the pictures should be bigger (the version shown has 8 pictures). Maybe 8 persons on the screen is already too much. PwDs have problems recognising faces, so the pictures should be very well visible. The name and picture combination is therefore good. It could be more understandable if you would use a traditional phone instead of this one. Since this one could easily be put down the wrong way (upside down). (Especially for people with Apraxia)
1-5 mobile	Mobile devices are already difficult to use by elderly people with cognitive intact capacities, for PwDs this could be too difficult to use. There is also no name and picture combination, and the pictures are very small.
-2003 Audio Call	Not available
-2004 Video Call	Not available

Activities	
–3015 Activity Assistance	(not active on CDN but explained). If you want to do this, you should work closely together with an occupational therapist. But I am not sure if this could work, it is a lot of information they will still need to understand. You should use a voice to tell them what to do and take a lot of time for every step.
–3023 Motivate to eat with music playing, sensor based	Not available
–3006 Media Playback with music files	Very nice and helpful. It would be nice to adjust the volume, but then you have the risk of another button that needs to be added. So perhaps it is better to tune it once (at installation) and that it can not be altered by the PwD. Otherwise the neighbours will have to pay the consequences.
3001 Device control (e.g. Radio on off or lamp on of)	Nice. The possibility to use this function for a TV is also a good idea. But then you have to figure something out for switching between channels.
Safety	
–4003 Household appliances warning: fridge warning (field test #2)	(CDN stopped working during explanation (laptop overheated) but the function is explained) This is a good function, especially for the front door. It would be nice that if it is still left open after several warnings, there will be a message to a carer.
–4024 Navigation Support outside of house	(Explained, not possible to show on mobile). Since it is very difficult for elder people to use a mobile, I think that to make use of some kind of TomTom is too difficult for PwDs. But it might help for people with very mild dementia which have had a good education, but probably only for them. PwDs are already in their own home disoriented. Let alone when they are outside and have to remember to use the button and understand all the hints from the Take-me-home.
–4015 Switch off household appliances	Not available
General	
–2017 Personalisation	Very good that people can make the device their own. But you should make sure that all the possibilities you will offer them meet some basic terms. It might be wise to come into contact with the foundation “Visio” since they know what the basic terms should be (f.i. colour contrast / size icons/ colour dept) And keep into mind that the stationary device and the mobile device should be designed in the same way (same colour, same icons).
–2018 Ease of interaction	The CDN is not only helpful for PwDs, but possibly also for people with CVA or Vasculair dementia. The size of the icons and the text could be bigger. The way it is now might not be that well visible for people of age.
–2019 Language (native)	ok
Other	
–4016 Safety Warning (fire/gas)	There is really a need for something that can switch off the gas, or puts out a signal when it is forgotten. This and the ‘Open Door’ are the two main problems you should be focusing on. It would be very helpful if a system like this can support that. Maybe the fire alarm can be inserted as well. But, again, do not put too many safety warnings on it, because it would be difficult to understand them all.

-1003 Extended repetition of reminder	Good. Maybe you can say that it will fire 5 times, and after that it fires again after one hour.
-1012 Finding item using RFID tag	Keys and wallet could be good
Find mobile	Probably not understandable for people with dementia. And since the mobile is also hard to use in my opinion, you should replace this function for helping them finding their wallet or keys.
-4013 Emergency contact	It is a very helpful function. You should leave it out of the centre, like it is now. Otherwise they will always see this button first. My advice to make it better is to give the background of the button another colour, like red. And you can keep the icon, although the symbolics of icons wont be very well understood by people with AD, it could be helpful. Keep the 'Help' written beneath it. If you use a picture there will be a lot of extra burden on the carer or nurse, since they will call regularly.
-1022 Audible signal in multiple rooms	Not available
-1009 Remotely setting reminders <ul style="list-style-type: none"> - simple using wizard - event description and priority - text - image/video - audio - recurring schedule - context conditions - output devices 	(Explained. The CDN in Amsterdam has no Internet connexion so it is not possible to show it) It is very nice that you can personalise the reminder by f.i. adding pictures of the person who's birthday it is. Or pictures of breakfast. Good that the carer can do it themselves.
-4000 Mobile device warning with RFID tag	Not available
-4001 Keys warning with RFID tag	Not available
Sensorised Light at night	Not available

Usability Test in Luleå

NLL/CDH 17 march 2009	Expert opinion CDN version 3.x (CHH v3.x) Luleå
Test site	Dementia experts: Kjell Fahlander. Psychologist, Dagny Wikström, occupational therapist, expert on dementia care Site researcher: Eva Karlsson (CDH) Site technician: Stefan Kullberg (NLL)
Remembering	
-1002 Reminder - Text - Image - Audio	A combination with picture, voice and text is good. Preferably a voice that is familiar to the PwD, or at least a very friendly voice, since PwD's are very sensitive to voices. <i>It would be good if there was some way to check that the PwD really respond to the reminder</i> , and if not the reminder could be repeated.
-1005 Visual signal of reminder	
-1015 Day/Time Indication	Good with an analogue clock, much better than a digital. If possible <i>it would be good to show if it is day or night inside the clock</i> . Maybe by making the inside white during the day and black during the night, or use symbols e.g. a sun and a moon. <i>The quarter-hour clock indication should not change colour from green to red</i> , since the abstract notion of colour indicating urgency is mostly not recognised by PwD. The suggestion is to always use a red colour for this indication, since for PwD any high-priority event within the next hour creates a big concern to be ready for it.
Communicating	
-2000 Picture Dialling	Picture dialling is good, since PwD's most often remember faces but not names. Therefore it is positive that the names are written under the picture. It is important that there are few steps to make a phone call. Some PwD do not know if it is day or night, and making it easier to call will induce more needless calls, also during night. Therefore <i>there is a need to redirect</i> with great care and with respect for the dignity of the PwD – <i>if the PwD attempts to make a call during the night</i> , If the context-rule is triggered, then an Action (like for reminders) should be rendered. E.g. a voice could say "Now it is night time, you will be connected to the service center", and another contact is then called. This will support a) smart redirecting to a service center during the night, b) disabling the ability to call a contact during certain times or other specific contexts (but giving a text/image/voice message). The carer would configure these contextual redirects at the CS, in a similar way as Context Conditions are configured.
1-5 Stationary device	
1-5 Mobile device	Good with the same system (with pictures) on both the stationary device and the mobile.
-2003 Audio Call	
-2004 Video Call	
Activities	

-3015 Activity Assistance	Too abstract to understand for people with dementia, since there are too many steps.
-3023 Motivate to eat with music playing, sensor based	
-3006 Media Playback with music files	Can be appreciated by those who like music. Good with the possibility to chose favourite music.
3001 Device control (e.g. Radio on off or lamp on of)	Easy to push the buttons
Safety	
-4003 Household appliances warning: fridge warning	Could be of use.
-4024 Navigation Support outside of house	Not available.
-4015 Switch off household appliances	Not available.
General	
-2017 Personalisation	It is good with the possibility to choose buttons and functions.
-2018 Ease of interaction	Very clear screen and readably text. The icons are clear, apart from the emergency contact, see comment below. It is very important to write the text on the buttons with starting upper-case letterl and then lower-case letters , e g Radio . There could be a screen saver during night , and a detector which will start the screen if the PwD goes up.
-2019 Language (native)	
Other	
-4016 Safety Warning (fire/gas)	Not available.
-1003 Extended repetition of reminder	Not available.
-1012 Finding item using RFID tag	Good function. And if the PwD can't use it, the carer can use it to search for things that the PwD has lost.
Find mobile	Very loud signal, which is good.
-4013 Emergency contact	The best combination is a picture of the carer and a text which says Help
-1022 Audible signal in multiple rooms	Not demonstrated
-1009 Remotely setting reminders <ul style="list-style-type: none"> - simple using wizard - event description and priority - text - image/video - audio - recurring schedule 	Not demonstrated

- context conditions - output devices	
-4000 Mobile device warning with RFID tag	Not available.
-4001 Keys warning with RFID tag	Not available.
Sensorised Light at night	Could be useful to those that get up during the night.

Report on Workshop with professionals in Belfast (BCH/UU) Y3

30Jan 2009

Researchers: Eilish Armstrong/Hazel Johnston (BCH)

Install equipment, technical support: Ricky Davies (UU)

Participants in workshops with professionals:

1. Specialist Alzheimer's Nurse for the Belfast City Hospital Trust
2. Ophthalmic Surgeon researching possible link between Macular Degeneration and Alzheimer's Disease
3. Consultant Physician researching Platelet Beta Secretase Activity in Alzheimer's Disease
4. Registrar researching Dementia in Stroke Patients
5. Consultant physician researching Mild Cognitive Impairment and conversion to Dementia
6. Research Nurse in Alzheimers Disease
7. Pharmacist in Dementia Services Unit

Equipments:

The COGKNOW Day Navigator (version of 8 January 2009)

Procedure:

- *Short introduction to the COGKNOW project*
- *Introductions participants*
- *Presentation of COGKNOW Day Navigator version 3*

The Cogknow Device was presented and the project explained.

Results of workshop with professionals:

The workshop with professionals lasted about one hour. Some thought that COGKNOW might be of assistance to PWDs with very mild dementia but simplicity would be vital. One person was impressed by the picture dialling which generated some discussion, as others thought that the traditional method of making calls is usually more familiar for PWDs. One person expressed concern that the presence of a COGKNOW device in the home might only cause added anxiety. Three people felt that the radio and media player would not enhance activities of daily living as PWDs are familiar with their own systems and extra buttons would only add to their confusion. Everyone agreed that the door sensors would create a feeling of safety. However, it was suggested that a text message transmitted to the carers mobile phone might be valuable.

**Annex C. Information booklet for field test #3
and consent form**

Procedure and confidentiality

You as a participant in this project are very important to us and you can be reassured that we will do our very best to take into account your wishes, so that the project is as smooth and as enjoyable as possible. Your participation is totally voluntary and you are free to withdraw from the project at any time.

All personal data that are collected during this project will be handled confidentially and destroyed at the project's termination. Participants have the right to inspection. All personal data will be security encoded preventing access by third parties. Experienced doctors and researchers will manage all confidential data. The results of the evaluation will be documented in scientific papers and reports

If you have any questions regarding your participation in the test, or the function of the devices, please contact:

Franka Meiland VUmc
Sanne Bentvelzen VUmc
Researchers
Phone 020-7885623/665

Johannes de Boer
Technical support
Novay
053-4850356

An independent expert informant (Dr.) will be available during business hours at tel nr or email:

COGKNOW
*Helping people with mild dementia
navigate their day*



***A study into the use of
electronic supportive instruments***

Information for participants



Explanation of the purpose of the project

Dementia frequently occurs in elderly people. Most people prefer to stay in their own home as long as possible. Often they need help to do so.

The European COGKNOW project aims to develop technological solutions to help people with mild dementia experience greater autonomy and feelings of empowerment and enjoy an enhanced quality of life.

COGKNOW focuses on electronic means of support that will help people remember, maintain contact with family and friends, perform daily activities and enhance feelings of safety.

Up to now little research has been done into technical solutions specifically from the point of view of people with dementia themselves. For instance, little is known about the person's individual needs and wishes. We feel it is very important that technical means of support are developed alongside the sufferer so that solutions actually fit their needs.

We are seeking participants to collaborate in this project to develop adequate support solutions that are user-friendly, useful and effective. The results of the project could help many people with dementia live at home in a safer and more enjoyable way and for a longer period of time.

Participation in field test 3

Three phases of assessing needs are now completed and we are asking you to participate in the test of the third version of the assistive electronic device. The test will be held in March/May, 2009 and is aimed at testing the user-friendliness and usefulness of the device as well as the impact in daily life. Based on information from this third test, a final report will be made with recommendations for further development. In total, two preliminary tests and one final test is conducted during the time period of September 2006 until August 2009. Participants can join one or more test phases if they want.

We are asking you and your next of kin/primary informal caregiver for explicit consent to participate in the project. Participation includes an initial home visit to discuss your present situation and to check information that is needed by the technical staff in order to install the device. Some weeks later the device will be installed in your home and you and your next of kin will be trained in how to use it. The testing of the device in field test #3 will take place during two months. Both during the test and after two researchers will ask you and your next of kin many questions related to the use of the devices.

The technical devices will be installed in your home only during the test period. During this time you have access to a helpdesk that can answer all questions on the device and assist you (See phone numbers at the back of this brochure).

Helping people with mild dementia navigate their day



CONSENT FORM

I hereby declare I have been informed, orally and in writing, and I understand the nature, method and goal of the study. My questions have been answered to my satisfaction. I have received the written information booklet which accompanies this consent form. I give my permission to obtain, if necessary, information from other caregivers. I voluntarily consent to participate in this study. I reserve the right to withdraw my consent at any time and I am not obliged to give a reason.

signature participant:

.....

signature legal representative /informal carer:

.....

name participant:

.....

name legal representative /informal carer:

.....

date:

date:

Being the *informal carer* of (name) I consent to participate in the abovementioned study. I hereby declare I have been informed, orally and in writing, and I understand the nature, method and goal of the study. My questions have been answered to my satisfaction. I have received the written information which accompanies this consent form. I give my permission to obtain, if necessary, information from other caregivers. I voluntarily consent to participate in this study. I reserve the right to withdraw my consent at any time and I am not obliged to give a reason.

signature:

name:

date:

You have received oral and written information on the study. I will answer any additional questions you may have about the study to the best of my ability.

researcher:

place of test site:

telephone number:

date:

