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DELIVERABLE DESCRIPTION	This deliverable describes the three evaluation phases that aim at enabling an iterative optimization and encompasses a lab study with a low-fidelity prototype and a lab study with a high-fidelity prototype. End users from Austria and Romania will be involved.
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ABBREVIATIONS

ABBREVIATIONS	DESCRIPTION
AAL	Active and Assisted Living
AAL CMU	AAL Central Management Unit
PwD	Participants with dementia

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EXECUTIVE SUMMARY

This intermediate version of D2.3 Low and High Fidelity Prototype Report describes the first step within the iterative evaluation process, i.e., study setup, methodology, and results of the 1st user study in the laboratory that has been carried out in Austria with a total of 12 potential end users (including formal as well as informal care givers).

1 ABOUT THIS DOCUMENT

1.1 ROLE OF THE DELIVERABLE

This deliverable (intermediate version) describes the methodological approach and results of the first low fidelity prototype evaluation (user study in the laboratory) that aimed at validating the service and interaction design concept as well as the use cases.

1.2 RELATIONSHIP TO OTHER SUCCESS DELIVERABLES

The deliverable is related to the following SUCCESS deliverables:

DELIVERABLE	RELATION
D2.2	Deliverable 2.2 presents the uses cases, scenarios, and services as well as the interaction design concept. D2.3 describes the methodological approach and results of the iterative evaluation of the low and high-fidelity prototypes, which are developed based on the developed use cases and scenarios.

2 FIRST USER STUDIES IN THE LABORATORY

In order to evaluate the first prototypes that have been developed based on scenarios and use cases, a user study in the laboratory is carried out, including overall 12 potential end users (formal as well as informal care givers).

2.1 GOAL AND RESERACH QUESTION

The overall goal of the user studies in the laboratory is to evaluate the first mock-ups that have been developed based on the scenarios and use cases (see also D2.2). We aim at identifying usability, user acceptance as well as accessibility problems while potential end users carry out some predefined tasks. Moreover, we aim at investigating to what extent users are motivated by the gamification elements the app provides. Based on this, suggestions for improvements are elaborated and communicated to the technical partners in the project.

2.2 METHODOLOGICAL APPROACH

There are a variety of inspection methods available that allow to evaluate the usability of first prototypes, e.g., heuristic evaluations, cognitive walkthroughs, or formal usability inspections (Nielsen 1994, Holzinger 2005). A study in the laboratory is a valuable approach to perform usability testing, with mobile applications (Zhang, Adipat 2009), which pose a variety of challenges, e.g., the mobile context, connectivity, or the small screen size. We will apply think aloud (see for example Holzinger 2005) to gather information about participants' intentions/thoughts while performing a certain task. Moreover, the following user experience and user acceptance factors will be considered during the evaluation:

- **Effectiveness**¹ (How accurate and complete can users perform a certain task? – task completion – successful/not successful/with help)
- **Efficiency**² (task completion time, learning time)
- **Subjective Satisfaction**³ (How pleasant do users experience the usage of the system? What are likes/dislikes?)
- **Ease of use**⁴ (How easily could users carry out/complete a certain task? – subjective experiences)
- **Perceived Usefulness**⁵ (To what extent do users believe that the application would enhance their performance)
- **Accessibility** (Does the target group identify any accessibility problems? E.g., Do they experience any difficulties with regard to font size)

¹ Effectiveness is the “accuracy and completeness with which users achieve specified goals“. ISO 9241-11 (1998)

² Efficiency is the relation between the accuracy and completeness with which users achieve certain goals and the resources expended in achieving them. Indicators include task completion time and learning time ISO 9241-11 (1998)

³ The three basic components of satisfaction are expectations, desires and perceived performance (Lowry et al. 2006)

⁴ Ease of use describes the degree to which an individual believes that using a system would be free of physical and mental effort (Chuttur 2009) – for the operationalization see also Davis 1998

⁵ Perceived usefulness is the degree to which an individual believes that using a system would enhance his/her job performance (Chuttur 2009)

2.3 STUDY SETUP

In order to answer our central research questions, we chose to apply an experimental design that allows us to explore users' behavior in a controlled environment. Users will carry out five predefined tasks. In the following paragraph, the overall procedure is briefly described.

In the run-up phase to the study, participants will receive information about the overall project idea and the procedure of the study (place, duration, etc.). An information sheet will be handed out in advance by EURAG, who takes care of the recruitment of formal as well as informal care givers (e.g., family members). Six formal and six informal care givers will be recruited. The following selection criteria are considered: participants do have approx. one year of experience in caring for people with dementia, participants are smart phone users (preferable Android). In order to allow a participatory design process, participants in Austria will be asked if they are willing to take part in a second evaluation with the iterated prototype.

2.3.1 INTRODUCTION TO THE STUDY

When participants arrive, they will be briefly introduced to the study (overall information, procedure and methodology (think aloud). Open questions (if there are any) are clarified. Moreover, participants are asked to fill out a brief questionnaire, assessing basic demographic data (age, gender, highest education, ...) and mobile phone usage (android, iOS).

2.3.2 PRE-INTERVIEW

Before starting with the task, the test leader will gather information about participants' experiences with people with dementia (guideline-based interview). The following information will be assessed:

- **Experience in the field of dementia care:** E.g., How long have participants been working in the field of dementia care/taking care of a family member?
- **Experiences when caring for people with dementia (positive and negative):** What are highlights or lowlights when caring for people with dementia (personal experiences)?
- **Support:** Do participants obtain support (practical, emotional, ...)?
- **Expectations.** Do they have any expectations towards the app in terms of functionalities; if yes, what are their expectations?

2.3.3 TASKS

After the pre-interview, the test leader will hand out the smart phone and will introduce the participant to the tasks (task by task). The participant will be reminded to talk about his/her thoughts while carrying out the task. Participants will receive task cards which include all relevant information to carry out the task. During the tasks, the test leader will take notes; after each task the participants will be asked to answer a few questions (e.g., how easy s/he could carry out the tasks, if problems occurred and why, if they have any suggestions for improvement). Each task is based on a small scenario to support the participants imagining a certain situation. Thereby we consider both target groups (formal and informal care givers). In the following, the tasks are briefly described.

Task 1: Get guidance for a specific situation – training for a specific situation (based on use case 3)

Scenario (formal care giver): The last few months you have been taking care of an older lady with dementia. Although you have knowledge and experience with dementia you sometimes feel over challenged, because the lady often over-reacts to minor things and starts hitting and cursing. Moreover, you are often not sure how you should behave in terms of memory loss. The app provides guidance how you can deal with such situations.

Scenario (informal care giver): A few months ago, your mother was diagnosed with dementia. Although you have knowledge and experience with dementia you sometimes feel overcharged, because she often over-reacts on minor things and starts hitting and cursing. Moreover, you are often not sure how you should behave in terms of memory loss. The app provides guidance how you can deal with such situations.

Task:

- ➔ Please search for **respectively two suggestions** on how you could cope with somebody, who starts **hitting** and **cursing** and find tips in terms of **memory loss**.
- ➔ Afterwards, return to the home screen

Questions:

- ➔ How easily could you find the required information? / Did you miss information? (*explicitly ask participants how they experienced the navigation structure*)
- ➔ To what extent is the information useful for you? (*ask why / why not*)
- ➔ Do you have any suggestions for improvement?

Task 2: Guidance for specific situation – in situ guidance (based on use case 2)

Scenario 2a (formal care giver): You just arrived at your client's home. The lady is upset and insists to go shopping. You do not have that much time this day. You start explaining that this won't be possible this day and while you are talking the lady becomes starts cursing and hitting at you. You feel slightly overstrained in this situation and decide to search for a quick advice via the app.

Scenario 2a (informal care giver): You just arrived at your mother's home. She is upset and insists to go shopping. You do not have that much time this day. You start explaining that this won't be possible this day and while you are talking, your mother starts cursing and hitting at you. You feel slightly overstrained in this situation and decide to search for a quick advice via the app.

Task 2a:

- ➔ Look up some **quick advice for cursing and hitting** (the first advice that is provided is not useful for you, but can make use of the second quick advice).
- ➔ Afterwards you will be automatically redirected to the home screen

Scenario 2b (formal and informal care giver): After you are at home again you open your app. You receive some follow-up information regarding the in-situ advice you received that day.

Task 2b:

- ➔ Please **rate the usefulness of the advice** (very useful) and find out how many experience points you earned this day.
- ➔ Afterwards return to the home screen

Questions:

- ➔ How easily could you find the required situation?
- ➔ Could you find out how many experience points you received?
- ➔ What are your thoughts towards the visualization of the quick info – was it useful? (if yes/no why was it useful/not useful?)
- ➔ Can you imagine using this functionality in a case where you would need quick advice?
- ➔ Do you have any suggestion for improvement?

Task 3: Train your communication strategies (based on use case 4):

Scenario (formal and informal care giver): The app does not only provide information about possible behavior in specific situations, but allows you to train and expand your skills. You have already read some useful information about cursing and hitting, so the app unlocks a training challenge for you. You are curious and since you would like to strengthen your knowledge, you decide to accept the challenge.

Task:

- ➔ Please strengthen your communication skills.
- ➔ Afterwards return to the home screen

Questions:

- ➔ How easily could you find the required information?
- ➔ How useful did you experience the “dialogue” with the avatar?
- ➔ Can you imagine training you skills in a virtual dialogue with an avatar?
- ➔ Do you have any suggestions for improvement?

Task 4: Tips for meaningful activities / gamification (based on use case 5)

Scenario (formal and informal care giver): Offering activities to people with dementia can help to create meaning in their lives. Imagine that you want to provide such activities to the person you are caring for.

Task:

- ➔ ***Explore the app*** for suitable suggestions for reminders of the past
- ➔ ***Read more about one concrete activity*** you could carry out (reminders of the past)

Questions:

- ➔ How easily could you find the required information?
- ➔ How helpful / useful were the suggestions?

- ➔ Would you use such a function in your day-to-day care routine?
- ➔ What do you think about the reward provided by the app? (Do you consider the reward to be motivating?)
- ➔ Do you have any suggestion for improvement?

Task 5 Emotional Support / Gamification (based on use case 7)

Scenario (formal and informal care giver): Imagine you've had a hard day. During care, you faced some incriminating situations. You wish for a possibility to reflect upon your feelings to take care of yourself.

Task:

- ➔ Explore, in what way the app provides support for reflection (*after the user has found the area for self-reflection indicate that s/he should find out more about “rejuvenation”*)
- ➔ Return to the home screen

Questions:

- ➔ Was the information easy to find?
- ➔ Do you think a self-assessment (or similar wording) like in the app can support you in a comparable, real situation?
- ➔ Would you do something different? If so, what would you change?

2.3.4 POST INTERVIEW/DEBRIEFING

After the participants have completed the tasks a brief guided interview takes place. The test leader will clarify open issues and will ask the participants to indicate their overall satisfaction (e.g., likes, dislikes) towards the system. Suggestion for improvement are further elaborated.

2.4 ORGANIZATION

2.4.1 RECRUITING PROFILE

Overall six formal and six informal care givers are recruited. The following selection criteria are considered:

- At least one year of experience in caring for people with dementia
- Smart phone usage (preferred android users)

2.4.2 TIMELINE AND RESPONSIBILITIES

Calendar week	Activity	Responsibility
KW45 (6.11-10.11)	Concept development, definition of tasks	AIT, TE
KW46 (13.11-17.11)	Implementation, modification of mock-ups – Translation	AIT, Center for Health and Biore-sources
	Start recruitment of participants	EURAG
KW47 (20.11-24.11)	Prepare materials, pretest	AIT, TE
KW48 (27.11-01.12)	Prepare materials, pretest	AIT, TE
KW49 (04.12-7.12)	Implementation lab studies	AIT, TE
KW50 (11.12-15.12)	Implementation (back up), analysis and report	AIT, TE
KW51 (18.12-22.12)	Analysis and report	AIT, TE

2.5 RESULTS

In the following the main results as well as suggestions for improvement are provided. Thereby, we will answer the main research questions, i.e., 1) How accurate, complete and efficient could users perform a certain task? 2) How pleasant do users experience the usage of the system (likes, dislikes)? 3) How easily could users carry out and complete a certain task? 4) To what extent do users believe that the application would enhance their performance (usefulness)? and 5) Does the target group identify any accessibility problems?

2.5.1 PARTICIPANTS

Overall 14 participants took part in the evaluation, 7 formal care givers and 7 informal care givers. The evaluation took part in nine sessions, four sessions were carried out with one participant and five sessions with two participants at once. Almost half of them were male ($n=6$) and more than half were female ($n=8$). Participants were between 23 and 71 years old ($M=53,4$, $SD=13,2$). On average, they had 9,9 years of experience in caring for persons with dementia, whereby there were differences between formal and informal care givers. The formal care givers had between one and 28 years of experience ($M=13,4$, $SD=9,9$) and the informal care givers had between one and 15 years of experience ($M=6,4$, $SD=4,0$).

All of the participants had a smart phone and the majority of them (11) indicated that they had good or very good smart phone skills; only two participants indicated that they had bad skills and one participants did not specify any information. Six participants said that they were using their smart phone more than three hours a day, six participants between one and two hours and only two participants indicated that they were using their smart phone less than one hour a day.

2.5.2 EFFECTIVENESS AND EFFICIENCY

Task 1: Get guidance for specific situation

In terms of task 1 most of the participant had difficulties to accomplish the task accurately and efficiently. In four of nine sessions participants explicitly needed help from the test leader to solve the task. The main problems that were identified refer to **information architecture (navigation)**. Thereby the following issues were identified:

- **Find the appropriate “main category” on the home screen.** Within two sessions, participants were not aware that they could search for advice in “get guidance for specific situations”. Alternative categories that were selected were “learn communication strategies” or “emotional support”. This indicates that the main categories need to be more meaningful to support users to find guidance for specific situations.
- **Find the appropriate “sub-categories”.** Participants were asked to find guidance in terms of hitting, cursing and memory loss. The study shows that in six out of nine sessions, participants could hardly find advice in terms of “memory loss”. Here the main problem was that participant did not comprehend that memory loss could be a sub-category of physical aggressive/non-aggressive, verbal aggressive/non-aggressive. For example, one participant pointed out: *“This is neither verbal aggressive/non aggressive nor physical aggressive/non aggressive.”* (Session 9). Moreover, physical sexual advances were not considered as sub-category of “physical aggressive”. Particularly, the professional carers pointed out that it might be difficult for informal carers (laymen), who do not have any knowledge about different forms of behaviour, to find the right sub-categories.
- **Too much navigation levels.** Almost all participants indicated that the navigation structure was too complicated (too much levels), which is illustrated in the following statements: *“It’s tedious! This is too much mental effort!”* (Session 1) *“This is not logical. I could only guess where to find the solution.”* (Session 3) *“It’s not comprehensible. I would first need some time to play around with the system to know how it works”* (Session 4) *“This is too much. [referring to the buttons] It is irritating that I need to push that much buttons.”* (Session 7).
- **Difficulties to recognize the globes as buttons.** Finally, participants had difficulties to recognize that they could push the globes to retrieve results, i.e., the forms were not recognized as buttons.

Suggestions for improvement. In order to simplify the navigation participants suggested to reduce the navigation levels (e.g., remove the first and second level) and only provide the information on a “behavioral level” (e.g., directly search for information about hitting, cursing, memory loss). Moreover, they suggested to allow multiple choice, to easily retrieve results, e.g., if a person is hitting and cursing at somebody. Furthermore, the study revealed a variety of suggestions to improve the visual design. Participants recommended to reduce the size of the pictures in favor of huge text and clear labelling (in German not in English). In this context, all participants pointed out that the font size needs to be increased. Moreover, clear back buttons (participants had difficulties to recognize the white arrow as back button) should be implemented to allow an easy navigation back and forth.

Task 2: Quick help

Similar as in task 1, most of the participant had difficulties to accomplish the task accurately and efficiently. Again, the most issues that were identified concern the **overall information architecture** and the **visual design**. It was not comprehensible for participants to retrieve quick help via the search field, i.e., the virtual object of the text field did not fit users' mental model to quickly receive help. Moreover, the visual design (light grey font) made it hard for participants to find the function. Within six sessions, participants needed support from the test leader to find the required functionality. Within three sessions participants were searching for quick help via "training communication strategies".

Suggestions for improvement. It was suggested to design a kind of quick help button that is more prominent (e.g., red button) and to automatically suggest categories or terms that could be selected. Particularly in a situation where a user is stressed (e.g., because the patient is hitting or cursing) some participants had concerns that they would be able to quickly find good suggestions via the search field. One participant suggested that it would be good if the system could automatically recognize certain behavior. Based on this appropriate suggestions could be provided.

Task 4: Meaningful activities

Most of the participants could easily and quickly complete the task, however some of them pointed out that the structure was ambiguous and not logical, which is illustrated in the following statements: *"Memories of the past could also be something related to the work of a person with dementia. In this case I would search for the information in the category work"*. (Session 3). *"The categorization of suggestions for activities is not clear."* (Session 1) In this context, music was considered very important and it was pointed out that it could be applied in all kinds of different areas (leisure, work, etc.). Hence, the main categories seem to be obsolete.

Suggestions for improvement. In order to simplify the navigation, it was suggested to remove the main categories and to provide a possibility to search for activities based on the health status of the person with dementia or his/her biography, i.e., to allow for personalized information retrieval.

In terms of **task 3 (train communication strategies)** and **task 5 (emotional support)** the basic functionality was demonstrated to participants and since hardly any active interaction was possible (e.g., responses were already pre-selected or participants had to simply click through the questions and only the correct answers could be selected), it was rather easy for participants to accomplish the respective tasks. Hence, it is hardly possible to provide information to what extent the participants could accurately and effectively complete the tasks.

2.5.3 SUBJECTIVE SATISFACTION

With regard to subjective satisfaction, participants could indicate their overall satisfaction on a scale from 1 to 5 (1 = very satisfied, 5= very dissatisfied). Moreover, they could indicate what they liked or disliked when using the different functionalities. Scores were only indicated for task 1,2 and 4

(see also the comment above). Suggestions for improvement in this context refer to likes and dislikes we could identify during the evaluation.

Task 1: Get guidance for specific situation

Participants' average satisfaction when interacting with the system to retrieve guidance for specific situation was 2,9, which indicates that they were averagely satisfied when using the system during task 1. It was rather difficult for most of the participants to find information about hitting, cursing, and memory loss. Other issues that were identified concern the information content and the lack of tips. Most of our participants were not satisfied with the content that is currently provided and pointed out that it is only **useful as "first information"** but not for somebody, who has already some years of experience in caring for a person with dementia. In almost half of the sessions (4), participants indicated that they **missed concrete tips** how they could behave in certain situations.

Suggestions for improvement. Considering, that most of the participants in our study had already a couple of years of experience in caring for a person with dementia, most of them said that more profound information should be provided and that they would appreciate direct links to valuable literature. Furthermore, links to organizations or persons, who could help were considered important. Moreover, it was suggested to provide medical information. Since people with dementia often face physical problems that go along with the disease, e.g., due to physical inactivity, some participants pointed out that it would be good to provide medical information, e.g., about bedsores, constipation or issues related to fluid intake, in order to avoid hospital stays. Also, medical documentation (e.g., blood pressure or medical intake) was considered useful. Finally, participants would wish for concrete tips how users could behave in such situations, i.e., not only background information, why participants show a certain kind of behavior, but tips to receive guidance for specific situations.

Task 2: Quick help

Participants were also averagely satisfied when using the system to retrieve quick help (average rating 3,1), because the service was difficult to find, which is illustrated in the following statements *"It would be good to have a red button, this looks rather like a search field"* (Session5) *"This needs to be more eye-catching."* (Session 9). Moreover, it was not clear why they should rate the tips they received at the end of the day. Some participants were questioning if other users could see their ratings.

Suggestions for improvement. Besides the suggestion to provide a more prominent button to retrieve quick help, it was suggested to include a possibility to directly contact a person, who could help in a situation where the user is overstrained. Moreover, users would like to have emergency numbers or information about organizations in the near vicinity they could contact in case of an emergency.

Task 3: Train communication strategies

There were a few issues we could identify in terms of users' satisfaction about the training with an avatar, which mainly concern the gamification element. The meaning of the stars was not clear (*"Why did I get stars?"* Session 2) and some participants were doubting that the stars are motivating

to further learn or train communication strategies (*"The stars do no harm, but I think I would be only motivated if the training would work."* (Session 3). Moreover, a few participants said that they do not feel taken seriously and the stars do not fit in such a serious context (*"I feel childish"* Session 4, *"I do not feel taken seriously."* Session 3). One pair even laughed when they saw the stars and were wondering what would happen if they didn't answer all questions correctly. It also needs to be considered that not all participants could imagine training their communication strategies with a kind of avatar.

As a suggestion for improvement, it was recommended to make use of color psychology instead of the stars. Moreover, regular updates regarding the content would be required, also links to newspaper articles, books, literature or even events, which are considered important to learn and train communication strategies.

Task 4: Meaningful activities

Participants average satisfaction when searching for meaningful activities was 1,7, hence most of them were rather satisfied. However, they were not satisfied with the examples that are currently provided (too simple). Moreover, the gamification element was not clear for some of the participants. *"What is happening when I have earned some stars? This seems to be more a dalliance"* (Session 5)

Suggestions for improvement. In order to improve the system, participants suggested to provide a bigger range of activities, one could choose from and meaningful descriptions (see also perceived usefulness). Furthermore, more concrete material, e.g., handicraft instructions were suggested.

Task 5: Emotional Support

In terms of emotional support, participants were rather satisfied with the content provided, however they did not like negative formulations. One participant did not like that the system asked questions s/he needed to answer: *"This is again some work to do and I need to contemplate. I would rather prefer something that gingers me up. I could imagine that an avatar talks to me, saying: Well done today!"* (Session 3).

Suggestions for improvement: Personalization was considered as an important element to increase users' satisfaction which is illustrated in the following quote: *"Would be good to have the possibility to indicate activities, e.g., to take a bath to relax depending also on the condition on a particular day."* (Session 8) As further suggestion for improvement, users asked for direct links to organizations or persons, where they could receive emotional support. Moreover, it was pointed out that it is important to make users aware that the burden (in terms of care) somebody is able to carry varies from person to person. One person suggested to implement an avatar, who could remind users of the app to take care of themselves.

2.5.4 EASE OF USE

Overall, the results from our evaluation indicate that there is still potential to simplify the navigation and make the system easier to use. Particularly, get guidance and quick help were considered very difficult to use. For “get guidance” the main issue was the navigation, which was considered too complicated and too difficult to quickly retrieve information and for the quick information it was the visual design (a more prominent button would be required) and the navigation (*“This is difficult, because I need to type in text”* Session 1). Moreover, some participants had doubts, that they were able to search for appropriate terms in a stressful situation.

2.5.5 PERCEIVED USEFULNESS

Besides usability issues, users’ satisfaction and likes and dislikes when interacting with the system, we discussed with our participants to what extent the provided services were considered useful, considering their personal circumstance. The evaluation shows, that the content that is provided need to be adapted to the users’ as well as participants’ (PwD) needs. The main results with regard to the different tasks are described in the following paragraphs.

Task 1: Get guidance for specific situation

Overall, all participants considered the function “get guidance” useful, however indicated suggestions for improvement to further increase the perceived usefulness.

Suggestions for improvement. First, the information that is provided **needs to be adapted to users’ knowledge** about dementia, which is particularly important for professional care givers, how could only make use of “get guidance” if **more deeper insights** would be provided. Otherwise it might be only useful to recall knowledge about the disease. Second, participants lack **concrete tips**, indicating that not only information about the disease and its effects should be provided but that they would like to receive advice how they could behave in certain situations.

Task 2: Quick help

In principle, participants considered the idea of the quick help useful, however the tips that were provided were considered only partly useful. Particularly the professional care givers had doubts that they would use that functionality, pointing out that it would be only useful for somebody who has not that much knowledge ore experience in dementia care.

Suggestions for improvement. Participants pointed out that the “tips” need to be more concrete and instructions need to be provided, for example *“it is not indicated how I could calm down a person and what I could do if the tips do not work”*. (Session 6) *“Concrete suggestions are missing ... examples are important.”* (Session 7)

Task 3: Train communication strategies

For most of the participants the idea of “training communication strategies” was considered useful, however it was pointed out that this should not be the main functionality of the app. Some participants even said that it is only a nice “add-on” or a “nice thing”. For the moment, the content was too trivial and the questions too easy.

Suggestions for improvement. In order to use that functionality, more valuable content needs to be provided. Within one session, participant pointed out that the functionality only makes sense if the avatar was a person with dementia. S/he referred to Naomi Feil, who often takes the role of a person with dementia to illustrate how a person could behave and to discuss how to deal with such situations.

Task 4: Meaningful activities

In general, participants considered the idea of suggestions for meaningful activities useful, however pointed out that the content that is currently provided might be only useful for somebody who has hardly any experience in caring for a person with dementia. Two person, who are taking care of their mother for example said *“We actually have a lot of ideas for activities our mother likes.”* (Session 1) In another session (4) the participants pointed out that they would need other suggestions, because the examples that are provided are not quite elaborated and not quite specific.

Suggestions for improvement. With regard to the provided example (search for suggestions to remember past activities), two informal care givers said that they won’t be able to look at photos or to go to places the person with dementia had been before, because the person they were taking care of was almost blind and not mobile anymore. They pointed out that the activities that are suggested **need to be adapted to the health status of the person and the form of dementia the person is suffering from.** (*“There are so many forms of dementia.”* Session 1) Within another session it was discussed to **consider the current context** *“It is actually wrong to simply suggest an activity, because I need to consider the current status of the person in order to decide what kind of activities could be useful. Suggestions are good however the central point is to avoid simply doing something ... this does not work for people with dementia. It is important to have help in order to decide which activity would suit for a certain situation”* (Session 3) In order to provide meaningful suggestions it was also considered important to **study the biography of a person.**

Task 5: Emotional Support

Finally, the emotional support was considered as very useful functionality, however it needs to be further developed in order to allow users to understand how this part of the app could work. Participants, were, for example not sure who could read their answers and said that it could only work if more profound questions are provided.

Suggestions for improvement. It was pointed out that links to organizations, literature, or persons were considered as valuable improvement and form of emotional support. For example, information about promotion and costs for home help, information that preventive care can be taken for up to 28 days a year and that costs for care during this time can be billed as prevention pledges, which allows caring people to go on vacation and to care for oneself.

2.5.6 ACCESSIBILITY

The main accessibility problems that were identified during the study concern the font size and contrast (visual design). All participants indicated that the font size was too small and the labeling of items (e.g., when navigating through the menu of “get guidance for specific situations”) was too small. Moreover, participants hardly recognized the “quick information” functionality. Moreover,

we could observe that particularly older users had difficulties to push the back button (too small). Moreover, the short distance between control elements (e.g., “get guidance”: back button and physical aggression button) impeded the navigation.

Summing up, get guidance and quick help were considered as central functionalities, however participants missed **links to organization, literature, support groups, etc.** they could contact to receive help and guidance, in general as well as in case of an emergency. Moreover, **personalization** was identified as an important aspect that needs to be considered, i.e., informal and formal care givers might differ in terms of their experience and expertise in caring for a person with dementia and this should be considered when providing content (background information, tips). Moreover, **the individual biography, health status, current situation and general context** of the person with dementia needs to be considered when providing tips, e.g., for activities. This was also considered as an important aspect to increase satisfaction and usefulness of the provided services. A profile needs to be implemented that allow users to indicate this basic information. Besides the help and support functionalities, the emotional support was considered as important service from which formal as well as informal caregivers could benefit. **Gamification elements** that are currently provided were not quite comprehensive and hardly motivating, hence there is potential to improvement to encourage users to make use of the app.

2.6 IMPLICATIONS AND SUGGESTIONS FOR IMPROVEMENT

Table 1: Implications 1st Lab Trial

Service/function-ality	Issue	Description	Implications
Get guidance	Information architecture	<p>Too complicated overall navigation structure – too much levels to easily retrieve a result</p> <p>Categorization is not decisive – e.g., physical sexual advances as subcategory of physical aggressive</p>	<p>Simplify navigation by, for example reducing navigation levels, to minimize users' memory load and implement the shallowest possible information hierarchy</p> <p>Allow users to search for certain behavior without the need to search for an appropriate main category (e.g. search for hitting instead of physical aggressive / aggression / anger)</p> <p>→ Search will be possible by means of a text field; results are displayed according to content type (open issue: easy operation through auto-complete and suggestions?)</p> <p>→ Filter option: based on content type</p>
	User freedom	Need to select multiple items at once to receive a result	<p>Optional: allow for multiple choice</p> <p>→ Not needed due to changes in overall navigation and filter options</p>
	Visual design	<p>Not all buttons were recognized as buttons, e.g., back-button and violet globes</p> <p>Get guidance was not associated by all participants with retrieving information about hitting, etc. → alternatively train communication and emotional support were selected</p>	<p>Design for clickable elements – consistent design</p> <p>→ Will be considered for the next prototype</p> <p>To be discussed: labelling of main categories (e.g., Help, Train, Activities)</p> <p>→ New labelling of main categories: Learn and train, Activities, Emotional Support, quick advice</p>

	Accessibility	<p>Small distance between control elements impeded navigation (users accidentally pushed two buttons at once)</p> <p>Text is too small</p>	<p>Increase distance between control elements – consider older users' needs in term of the size of buttons</p> <p>Allow users to increase the text – consider older adults' needs in terms of font size</p> <p>➔ Accessibility issues will be considered for the next prototype / first integrated version</p>
	Content	Need for concrete tips (e.g., how to behave in certain situations)	<p>To be discussed: merge information part and concrete tips</p> <p>➔ Concrete tips will be part of articles</p>
		Need for additional information - basic medical information, links to literature, books as well as organizations	<p>To be discussed: where / how to provide this information</p> <p>➔ Will be added to content elements where required</p>
		<p>Content that is currently provided might be only useful for somebody, who has hardly any experience in the field of dementia care</p> <p>Dementia has a variety of different faces – needs to be considered when providing content</p>	<p><i>Content in progress ...</i></p> <p>Allow to personalize content / indicate basic information in the profile (e.g., form of dementia, stage)</p> <p>➔ It will be possible to indicate the form of dementia in the profile</p>
Quick help	Information architecture	Typing in some text to retrieve results might be overstraining in a stressful situation	<p>Minimize users' memory load - support users to find results based on e.g., suggestions for categories, terms or situations (content needs to be discussed)</p> <p>➔ Research on alternative possibilities for a search function</p> <p>➔ In a first instance the search field will be implemented</p>
	Visual design / match between system and real world	Users could hardly find the service quick advice – text field does not fit users' mental model to retrieve quick help	<p>Make use of virtual objects that allow users to easily understand the meaning of the service (text field implies "simple search") - e.g., use a more prominent button, e.g., red button</p> <p>➔ A more prominent button will be implemented</p>

	Content	Need for “personal contact” (e.g., phone number of key person / expert) and information about organizations in the near vicinity	To be discussed: Feasibility to include phone numbers of key persons /experts or contact details about organizations in the near vicinity? → Will be not implemented; users might have important phone numbers anyway available in their contacts on the mobile phone
		Need for more concrete tips	<i>Content in progress ...</i>
Train communication strategies	Visual design / Content	The meaning of gamification elements (stars) is hardly understood / some participants do not feel taken seriously	To be discussed: What are gamification elements that fit user’s mental model for gratification in this context? → Dashboard to track progress → Quiz elements to allow users to repeat content elements
	Information architecture	How to search for certain communication strategies? What are “challenges”	To be discussed: How should the overall functionality look like? What is the role of the avatar? → When starting the application, the avatar will ask the user how s/he is doing and what s/he has done to feel good; afterwards option to work on reflection (scripts Sienna), second element: diary (motivated by the avatar, who regularly ask e.g., to perform activities
	Content	Questions that are provided are too easy / content needs to be more elaborated	<i>Content in progress ... should provide aspects of “validation”, links to courses</i>
Meaningful activities	Information architecture / Content	Categorization of activities is not decisive (music could be part of leisure as well as work) Health status or a user’s biography seem to be important factors to decide for an appropriate activity	Rework the navigation – allow to search for activities based on personal criteria, e.g., health status or a user’s biography → The profile allows to indicate form of dementia, capabilities (physical and mental) and interests – based on this, activities are suggested (requirement: tagging content elements)
	Visual design	Difficulties to recognize if further information about a certain activity is provided	Allow to better recognize clickable elements → Will be considered for the next prototype

	Content	<p>Gamification element (stars) is hardly understood by participants – not clear why they receive stars when searching for an activity</p>	<p>To be discussed: What are gamification elements that fit user's mental model for gratification in this context?</p> <p>→ See also suggestions above</p>
		<p>Current suggestions for activities are too trivial – needs to be more elaborated</p>	<p><i>Content in progress ... provide more concrete and elaborated suggestions for activities considering a person's health status, etc. (see comment above)</i></p>
Emotional Support	Content	<p>Need to personalize content (e.g., to indicate activities they would like to do)</p> <p>Users expect to receive emotional support from organizations or experts in the field of dementia care</p> <p>Need for literature, information and other forms of emotional support</p> <p>Texts are currently considered too academic</p>	<p><i>Content in progress ...</i></p> <p>To be discussed: direct links to organizations / persons who could provide emotional support – need to be discussed where / how this information could be provided</p> <p>To be discussed: how / where could we provide links to literature, information about organizations where users can get emotional support</p> <p>→ Will be part of content elements where required/useful</p> <p>→ Links to avoid that users end up on an empty page (e.g., if no further content is available)</p> <p><i>Content in progress ...</i></p>

CONCLUSION / FURTHER WORK

Summing up, the first user studies in the lab revealed a couple of potentials for improvements, in particular with regard to the overall information architecture (e.g., navigation structure) and the visual design. These issues are discussed with the technical partners and the prototype will be further developed. In parallel, new content will be elaborated. A next version of the prototype will be tested with potential end users in Austria and in Romania, addressing in total 20 formal and informal care givers.

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APPENDIX A

A.1.1. 1ST USER STUDY IN THE LABORATORY

Detailed description of tasks, content and provided screens

Task 1: Get guidance for a specific situation – training for a specific situation (based on use case 3)

Scenario (formal care giver): The last few months you have been taking care of an older lady with dementia. Although you have knowledge and experience with dementia you sometimes feel over challenged, because the lady often over-reacts to minor things and starts hitting and cursing. Moreover, you are often not sure how you should behave in terms of memory loss. The app provides guidance how you can deal with such situations.

Scenario (informal care giver): A few months ago, your mother was diagnosed with dementia. Although you have knowledge and experience with dementia you sometimes feel overcharged, because she often over-reacts on minor things and starts hitting and cursing. Moreover, you are often not sure how you should behave in terms of memory loss. The app provides guidance how you can deal with such situations.

Task:

- ➔ Please search for **respectively two suggestions** on how you could cope with somebody, who starts **hitting** and **cursing** and find tips in terms of **memory loss**.
- ➔ Afterwards, return to the home screen

Questions:

- ➔ How easily could you find the required information? / Did you miss information? (*explicitly ask participants how they experienced the navigation structure*)
- ➔ To what extent is the information useful for you? (*ask why / why not*)
- ➔ Do you have any suggestions for improvement?

Required Screens:

1. Home Screen (user selects „get guidance for specific situations“)
2. Screens for hitting
 - a. Submenu: physical aggressive; physical non-aggressive; verbal aggressive; verbal non-aggressive (user selects physical aggression)
 - b. Submenu: Aggression/Anger; Physical sexual advances (users selects aggression/anger)
 - c. Results: Biting, kicking, pushing, hitting (user selects hitting and receives more information about hitting; afterwards return to the home screen)
3. Screens for cursing
 - a. Submenu: physical aggressive; physical non-aggressive; verbal aggressive; verbal non-aggressive (user selects verbal aggression)

- b. Submenu: verbal sexual advances, suspicion and delusion, aggression/anger, false accusation (user selects aggression/anger)
 - c. Results: screaming, cursing (user selects cursing and receives more information about cursing; afterwards return to the home screen)
- 4. Screens for memory loss:
 - a. Submenu: physical aggressive; physical non-aggressive; verbal aggressive; verbal non-aggressive (user selects verbal/non-aggressive)
 - b. Results: Depression/Apathy, repetitive sentences/questions, memory loss, hallucinations, failure to recognize people (user selects memory loss and receives more information about memory loss; afterwards return to the home screen)
- 5. Reward is provided
- 6. Home screen

Content:**Physical aggressive – hitting**

Some people can feel aggressive at times because of their dementia. This may shock you and you may find it difficult to deal with. However, it is important to remember that aggressive behaviour is caused by the disease rather than the person with dementia. The person may become aggressive because s/he is frustrated at not being able to do things s/he used to be able to do. Or s/he may misunderstand what is going on. Sometimes someone with dementia may over-react to something very minor. The part of the brain which would normally control the reaction may be damaged.

Advice 1

To remain in control of the situation, it is important to try to stay calm. This will probably not be an easy task, particularly if the person with dementia trying to hit you. It might help to bear in mind that the person's actions are caused by the disease and not meant personally against you. Try to give the person plenty of space and time.

Advice 2

Try to find out what is causing the behaviour. Think about what happened right before the reaction that may have triggered the behaviour. Is the person experiencing physical pain? Is the person overstimulated by loud noises, an overactive environment or physical clutter? Did you say something that was possible to misunderstand?

Verbal aggressive – cursing

Verbal abuse is more common than physical aggression. The person may shout, curse or make accusations or threats. The person may become verbal aggressive because s/he is frustrated at not being able to do things s/he used to be able to do. Or s/he may misunderstand what is going on. This can be very upsetting and quite a shock for you. You will probably find it difficult to remain calm and not take the anger personally. You might feel hurt and sad at what seems to be a change in the person's character. It is important to try to remember that the angry outburst is most probably a consequence of the disease.

Advice 1

Try to distract their attention if they remain angry. For example, you could suggest having a drink together, going somewhere or doing something that the person likes.

Advice 2

The person with dementia might misinterpret helpful instructions, prompts or explanations, even if what you say might not sound wrong to anyone else. You might occasionally sound patronising or bossy without realising it. Try phrasing what you say differently. For example, instead of saying, “Now put your coat on”, you could say, “Here’s your coat. Let me help you put it on”

Memory loss

Memory loss is one of the most common symptoms. It is often the first sign which leads people to suspect that there is a problem and seek medical advice. However, it is important to realize that people tend to lose their memory gradually rather than all at once. The person with dementia may become more confused and ‘lost’ or disorientated. The person may forget basic facts such as who other people are, where they are and what year it is. S/he may confuse the past with the present.

Advice 1

It is often unnecessary to draw attention to mistakes. For example, when you are talking to someone with dementia, they may use an inappropriate word because they cannot remember the correct one. You may feel inclined to correct the person or even do so automatically. However, if you have understood what they were trying to say, this is unnecessary and likely to make them feel uneasy, embarrassed or annoyed.

Advice 2

In the early stages of dementia, memory aids such as lists, diaries, clocks and clear, written instructions can help jog the person's memory if they are willing and able to make use of them. As the dementia progresses, the person may become less able to understand what the aids are for.

Task 2: Guidance for specific situation – in situ guidance (based on use case 2)

Scenario 2a (formal care giver): You just arrived at your client’s home. The lady is upset and insists to go shopping. You do not have that much time this day. You start explaining that this won’t be possible this day and while you are talking the lady becomes starts cursing and hitting at you. You feel slightly overstrained in this situation and decide to search for a quick advice via the app.

Scenario 2a (informal care giver): You just arrived at your mother’s home. She is upset and insists to go shopping. You do not have that much time this day. You start explaining that this won’t be possible this day and while you are talking, your mother starts cursing and hitting at you. You feel slightly overstrained in this situation and decide to search for a quick advice via the app.

Task 2a:

- ➔ Look up some **quick advice for cursing and hitting** (the first advice that is provided is not useful for you, but can make use of the second quick advice).

➔ Afterwards you will be automatically redirected to the home screen

Scenario 2b (formal and informal care giver): After you are at home again you open your app. You receive some follow-up information regarding the in-situ advice you received that day.

Task 2b:

➔ Please *rate the usefulness of the advice* (very useful) and find out how many experience points you earned this day.

➔ Afterwards return to the home screen

Questions:

➔ How easily could you find the required situation?

➔ Could you find out how many experience points you received?

➔ What are your thoughts towards the visualization of the quick info – was it useful? (if yes/no why was it useful/not useful?)

➔ Can you imagine using this functionality in a case where you would need quick advice?

➔ Do you have any suggestion for improvement?

Required Screens (Task 2a)

1. Home Screen (user starts „in situ help“)
2. Free text form field is displayed (users are asked to indicate which wording they would choose and will be directed then to a quick info)
3. Quick info is displayed (user reads quick info and system asks if the info was useful – user indicates no)
4. Next quick info is displayed (user reads the quick info and indicates that it is useful)
5. Automatically redirect to the home screen

Required Screens (Task 2b)

1. Home Screen with question (e.g., pop up) to rate the usefulness (user rates “very useful”)
2. Home screen with information regarding experience points earned (pop up?) (user receives experience points)
3. Home screen visualizing the experience points earned (user sees experience points and returns to the home screen)
4. Home screen

In-situ guidance hitting

1. Remain calm and reassuring
2. Try to identify immediate cause

In-situ guidance cursing

1. Try to distract the person
2. Rephrase what you said

Task 3: Train your communication strategies (based on use case 4):

Scenario (formal and informal care giver): The app does not only provide information about possible behavior in specific situations, but allows you to train and expand your skills. You have already read some useful information about cursing and hitting, so the app unlocks a training challenge for you. You are curious and since you would like to strengthen your knowledge, you decide to accept the challenge.

Task:

- ➔ Please strengthen your communication skills.
- ➔ Afterwards return to the home screen

Questions:

- ➔ How easily could you find the required information?
- ➔ How useful did you experience the “dialogue” with the avatar?
- ➔ Can you imagine training you skills in a virtual dialogue with an avatar?
- ➔ Do you have any suggestions for improvement?

Required screens:

1. Home Screen (user selects train communication strategies)
2. Screen showing the challenge provided for the user (user accepts challenge)
3. 3-4 screens showing the avatar with a dialogue balloon (user goes through the interactive dialogue and answers the questions)
4. Screen that shows that the user has finished the challenge and points that have been earned (user returns to the home screen).
5. Home screen (user returns to the home screen)

Questions aggressive behavior (hitting/cursing)

Which aggressive behavior is most common?

- a) Physical aggressive behavior
- b) Verbal aggressive behavior (correct)

If the person with dementia is getting aggressive, you should try to

- a) Keep calm (correct)
- b) Restrain the person

If the person over-reacts when you say something, it's probably smart to try to

- a) Explain that they are mistaken
- b) Rephrase what you said (correct)

Task 4: Tips for meaningful activities / gamification (based on use case 5)

Scenario (formal and informal care giver): Offering activities to people with dementia can help to create meaning in their lives. Imagine that you want to provide such activities to the person you are caring for.

Task:

- ➔ **Explore the app** for suitable suggestions for reminders of the past
- ➔ **Read more about one concrete activity** you could carry out (reminders of the past)

Questions:

- ➔ How easily could you find the required information?
- ➔ How helpful / useful were the suggestions?
- ➔ Would you use such a function in your day-to-day care routine?
- ➔ What do you think about the reward provided by the app? (Do you consider the reward to be motivating?)
- ➔ Do you have any suggestion for improvement?

Required screens / content:

1. Home Screen with the main categories of the app (user selects meaningful activities)
2. Subcategories are visualized (user selects an area – reminders of the past)
3. Possible activities for a specific area are displayed (user selects an activity and reads more about it)
4. Screen with more information about one certain activity (user reads the information and indicates somehow that s/he has read the information)
5. After reading a suitable information: screen displaying a reward (user returns afterwards to the home screen)
6. Home screen

Subcategories

1. Work (examples)

- Adjust the task they used to do
- Fold clothes
- Tighten or loosen screws
- Sweep floors

- Stock supplies

2. Self-care (examples)

- Sing a song the person likes
- Hand massage
- Back rub

3. Leisure (examples)

Reminders of the past

- Look at photo albums
- Look through scrapbook
- Visit familiar places from their childhood/adult life
- Look at old movies

Exercise/ staying active

- Take a walk
- Go for a swim
- Do yoga

Animals

- Visit a farm
- Pet a dog/ cat

Arts/ Handcrafts

- Make a scrapbook by cutting and pasting colorful pictures from old magazines of things that are meaningful or pleasurable for the person with dementia. Let the person with dementia select each picture or word to be included in his/her book
- Drawing/ painting
- Making collages
- Photography

Music

- Listen to music
- Play music

Other activities

- Bake together
- Play card

4. Rest and restoration

- Quiet time in a room with music
- Spending time in nature

Task 5 Emotional Support / Gamification (based on use case 7)

Scenario (formal and informal care giver): Imagine you've had a hard day. During care, you faced some incriminating situations. You wish for a possibility to reflect upon your feelings to take care of yourself.

Task:

- ➔ Explore, in what way the app provides support for reflection (*after the user has found the area for self-reflection indicate that s/he should find out more about “rejuvenation”*)
- ➔ Return to the home screen

Questions:

- ➔ Was the information easy to find?
- ➔ Do you think a self-assessment (or similar wording) like in the app can support you in a comparable, real situation?
- ➔ Would you do something different? If so, what would you change?

Required screens:

1. Home screen with the main categories of the app (user selects the category emotional support)
2. New screen with sub-menu reflection/avoid self-stigma and organize your day activities
3. Several consecutive screens with questions for self-assessment/reflection (users will answer questions)
 - Turn card: Reflection, Resilience and Self-Compassion as a Caregiver (user selects rejuvenation)
 - Turn card: Rejuvenation (users select 2-3 self-care practices – for the purpose of the study the self-care practices are automatically selected) *Participants are asked to indicate if they missed any self-care practices*
 - Screen: “self-care practices”: Possibility to rate each of the selected self-care practices on a scale from 1 to 10, asking how often they engage in such activities (user selects a value - for the purpose of the study the rating is preselected) *Information for the participants: based on their answers for self-care practices participants will receive suggestions to engage in activities.*
 - Screen: Self-Compassion: Screen that asks participants how they would respond to a friend who really messed up (participants have the possibility to indicate how they would respond to a friend – text field – for the purpose of the study text is already filled in – *users are asked what they would answer*)
 - Screen: Self Compassion: Screen that asks participants how they would respond to themselves if they messed up (user indicates text – for the purpose of the study text is already filled in)
 - Screen: Did you notice a difference? If so, ask yourself why: Why not trying treating yourself like a good friend and see what happens?
4. Screen that allows users to end the reflection and to return to the home screen