Are elderly sufferers of dementia able to play a reminiscence game on a tablet device independently?

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Abstract

As the old population is growing older, a huge need for increased health care is needed, and the time per patient may be decreased in the future because of an increased carer burden. Many of the elderly develop some sort of dementia when growing older. In Norway 70 000 people already suffers from this syndrome. However, reminiscence is considered the process of thinking or telling others about one's past experiences, and may probably delay the aggravation of these peoples' cognitive function and dementia symptoms. In this thesis a mobile reminiscence game was developed using a strong user centered design process with five patients suffering from dementia and an expert mini-focus group. The intention was to make the game assist the patients while playing questions from the past, by giving automated instructions and feedback to the user while playing. Several usability issues regarded with the reminiscence game were revealed during this process, to suit the patients' different physical and mental skills.

An observational study was conducted in the end to observe a selected group of patients' suffering from dementia ability to play the game independently. This study found 21 of 40 given questions (52,5%) to be answered totally independent by the users. The results found the users to play more independently as they progressed in the game. The results also discovered individual differences among the users, in terms of playing independently.

Acknowledgements

This report marks the end of an interesting and exciting work together with patients, nurses and a carer. The idea of making and discovering results from something that may help others, has kept my enthusiasm and go-ahead-spirit in this project. It has been a joyful journey to develop something together with the patients, to discover possibilities as well as challenges using mobile technology.

I especially would like to thank the nurses and carer at the day care centre that willingly agreed to take part in this study. Great thanks to Thorbjørg Holthe (Aldring og Helse), Sigrid Aketun (GERIA) and Margit Gausdal (Aldring og Helse), that contributed with solid experience and knowledge to my project.

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Definition of terms

Android	An operating system for cellular telephones first developed by Google Inc [1].
Assistive Technology	Assistive technology is a generic or umbrella term that covers technologies, equipment, devices, apparatus, services, systems, processes and environmental modifications used by disabled and/or elderly people to overcome the social, infrastructural and other barriers to independence, full participation in society and carrying out activities safely and easily [2].
Carer	A family member or paid helper who regularly looks after a child or a sick, elderly, or disabled person [3].
Cognitive	The mental action or process of acquiring knowledge and understanding through thought, experience, and the senses [3].
CPU	Principal part of any digital computer system, generally composed of the main memory, control unit, and arithmetic-logic unit [1].
Dementia	Dementia is a syndrome due to disease of the brain, usually of a chronic or progressive nature, in which there is disturbance of multiple higher cortical functions, including memory, thinking, orientation, comprehension, calculation, learning capacity, language, and judgement. Consciousness is not clouded. Impairments of cognitive function are commonly accompanied, and occasionally preceded, by deterioration in emotional control, social behaviour, or motivation [4].
Ergonomist	A person working on people's efficiency in their working environment [3].
Interface	Computing a device or program enabling a user to communicate with a computer [3].
Reminiscence	a story told about a past event remembered by the narrator: *his reminiscences of his early days in Parliament* [3].
Speech-synthesis	the process of generating spoken language by machine on the basis of written input [3].

Tablet device A small portable computer that accepts input directly on to its screen rather via than a keyboard or mouse [3].

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1. Introduction

The world population is growing older. Norway is a typical example of this huge increase of elderly people. By 2050, 21% of the population will be over 67 years old [5]. Along this rapid growth there will be a tremendous amount of people suffering with mental disabilities like dementia. In Norway there are about 70 000 people over 65 years old, that already suffer from some sort of dementia [6]. In addition 10 000 people are suspected to be diagnosed with dementia every year. In fact the number of people with dementia will redouble by 2040 [7].

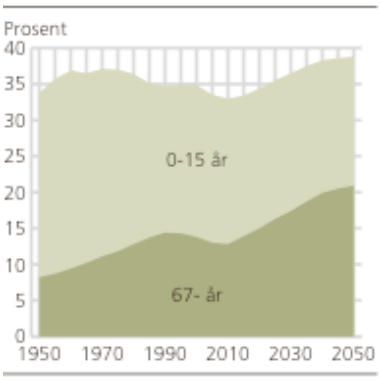

Figure 1 - Children, youths and elderly in the Norwegian population shown in percentage [5].

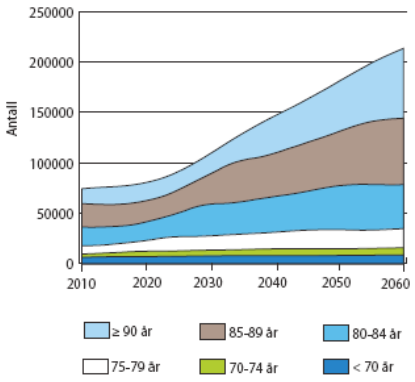

Figure 2 – Calculated cases of dementia between 2010-2060 in the Norwegian population [7].

To support the rapid growth of people suffering from dementia in the upcoming years, the Government proposes new strategies. ”Demensplan 2015 - Den gode dagen” says that all Norwegian municipalities should provide a day care centre, a nursing home, or home activity facility for this group of patients [8]. The idea is that such facilities should offer the patients both social and cognitive activities to improve their quality of life and reduce relatives’ care burden. Only 130 of 451 municipalities provided day care facility in 2007 [9]. Most of the municipalities that had a day care

offer, also said they had both indoor and outdoor activities for their patients. Still, Westberg [9] discovered the necessity to improve activities to suit the different patient's needs.

In the proposed "Demensplan 2015 – Den gode dagen", the use of technology is an important option to give better support to elderly people, their relatives and health care workers [8].

In dementia care, different technical solutions have received attentions, as they provide new abilities to assist health care personnel and patients. This could be things as switching off the oven, taking their medicine or simply help whenever falling at home [10].

Technical solutions to provide cognitive stimulus have also become a focus area. One example is the digital photo album or electronic day planner [11]. Still, most research and development has been done to ensure safety among patients, rather than improving quality of life using cognitive activities [12].

Ordinary games as puzzle boards, quizzes or bingo are well known activities to this group of people. Still, the development of mobile games has become a huge business worldwide including traditional board games in a new flavour. By 2008 mobile games sold 5800 million US dollars [13]. However the development and introduction of mobile games in dementia care have not yet received a lot of attention. There may be several reasons why this is a fact. There is definitely a usability issue with many games, because they lack a universal accessible design. Still, some known mobile game contributions have been created in science research, as the zPlay [14].

Mobile games could very well be designed to fit elderly users. North Carolina State University has developed seven design principles named "Design to everyone". This way the products may be suitable for everyone [15] [16].

Mobiles are portable. This could be a contributing factor to an accessible design. Elderly confined to their beds, could easily play games without much effort. Many of the elderly people also spend time watching television [17]. This is considered a very similar activity as the one looking into a large mobile screen.

Different manufactures have started delivering media tablets, as the Samsung Galaxy Tab [18] and Apple iPad [19]. These devices give an even better ability to provide a good visual content, as their touch-screen is of larger size than ordinary small mobile phones.

1.1. Thesis contributions

The use of assistive technology is an important area to be further investigated in the future of elderly care, especially regarding what this new technology may do to lighten the burden of health carers and the patients' families. There will be more elderly people the next decades that need carer attention. By doing research on how to assist patients using assistive technology in a reminiscence game, this thesis can give important contributions to how to give patients frequent, cognitive challenges. Even when there is a lack of health care personnel or daycare facilities for the user.

Little research has been discovered when it comes to the usability of technical aids used by people suffering with dementias in their everyday lives [20]. This thesis contributes with usability results considering mobiles and mobile gaming.

Future generations are the ones using mobile devices today. This thesis results may contribute with knowledge on both advantages and prosperities using reminiscence in mobile games with future sufferers of cognitive impairments.

1.2. Thesis delimitations

This thesis' purpose is to discover the usability in a developed prototype used by people suffering with dementia. In addition, it should also make a research of their capability of playing the developed prototype independently. The results will be revealed based upon some predefined observations.

However, this is not a thesis to discover different medical aspects regarded with the users mental or physical conditions. There are many types of dementia, causing complex behavior among people suffering from it. The user group studied in this thesis is dependent on formal assistance and care.

In this thesis a developed prototype from an earlier pre-study was redesigned to suit usability needs and different requirements for supporting independent playing.

A pre study prototype had already been made to function on an Android mobile operating system device. Due to lack of time in this thesis development process, a further redesign of this prototype was considered a better solution compared with a new prototype development that may have been suitable in other mobile devices as well. In addition, the final prototype outcome used for evaluations and observations would require less error testing, than a new development starting from the beginning. Positive results from the pre-study prototype testing would also be sustained, by further redeveloping the pre study prototype.

However, this clearly limits the usage of the game on different other mobile platforms.

In this study, a Samsung Galaxy tablet with a 7" screen tablet [18] was used.

Part of this research is to reveal results regarded with new mobile tablets used by this group of people, as there is a lack of usability results in using them to perform gaming as the reminiscence quiz game used in this thesis.

The speech synthesis and engine used in this thesis' reminiscence game have been considered proper to integrate into the game. There are no detailed requirements in terms of choosing a Norwegian speech-synthesis to hearing impaired people. They should only sound clear and accurate [21]. However, as there are different solutions in the market [22], there is no specific solution among these that is required to be used for hearing impaired people.

As no specific solution have been discovered regarded with the selection of a Norwegian speech synthesis, a proper female speech synthesis was used in this thesis' reminiscence game to be easily integrated with Android OS.

2. Background

The World Health Organization (WHO) has developed the international classification of diseases (ICD-10). In this classification, dementia has been defined as:

> Dementia is a syndrome due to disease of the brain, usually of a chronic or progressive nature, in which there is disturbance of multiple higher cortical functions, including memory, thinking, orientation, comprehension, calculation, learning capacity, language, and judgment. Consciousness is not clouded. Impairments of cognitive function are commonly accompanied, and occasionally preceded, by deterioration in emotional control, social behavior, or motivation [4].

2.1. The use of technology among people with dementia

Modern information- and communication technology has accelerated the last decade. Our homes have been filled up with electronic equipment as remote controls or mobile cell phones. Elderly people however are facing a challenge to keep up with this quick development. They are very often excluded from services offered through information- and communication technologies, as they are rarely considered target group wherever these technologies are developed [20].

Most scientific work found has confirmed how important the surroundings are to demented people's quality of life. Still, very little research has been done to investigate the usability of technical aids developed for demented people in their everyday life [20].

The complexity of modern society and the development of new technology affect the way we conduct everyday activities. The activities play an important role for demented people, but the ways they are conducted seem to be in a constant change. Using the telephone is often considered an important activity to this group, as it preserves social life, or may be used to call for help whenever needed. Nygård and Starkhammar [23] discovered that demented people often avoided using the telephone, because of the difficult experiences using it.

In 2007 Nygård and Starkhammar conducted a study to reveal user problems among while interacting with technology among people suffering from dementia [20]. There is reason to believe that technology already known to patients with dementia is considered easier to use. Still, the scientists discovered these patients had problems with both known and new technology.

In 2007, Sidsel Bjørnebye developed a manual on how to integrate user participation in technical aid development processes for people suffering with dementia [11]. She pointed out the necessity to make sure that all such technical aids should support the existing skills of the user and not things that weren't manageable. In addition, aids used by such users, should not require them to learn something unfamiliar. However, the study of Nygård and Starkhammar [20] discovered that

people suffering with dementia had problems with both new and familiar technology as well as technology that were supposed to be easily comprehended.

By using technical aids, dementia patients could support their cognitive abilities to retain or even create new activity. This may support these patients' independency, safety and self-esteem. Technical aids could also lead into an increased participation in everyday life as well as preserve social contact that may produce joy among people [11].

Most of the developed technical aids for patients with dementia have tried to improve safety and security, rather than retaining their feeling of wellness. There is also a considerable development of new technology made to support health workers in the field [12]. Still, Orpwood et al discovered the necessity of developing new technology that had the intention to improve quality of life among people with dementia.

In 2007 an overview of the available aids was distributed for these patients in Norway [11]. In this overview there were many technical aids to improve safety/security, reminiscence and time orientation. Typical examples were an alarm device for the oven, safety alarms or electronic calendars. Under the section for "Aids to be used in activities and well-being", a few technical solutions were mentioned. Some of the ones mentioned were the universal remote control or the music playing bed. Other aids belonging to this section were for instance Ludo board games, puzzle games, balls or puppets arousing feelings.

As people suffering with dementia, have problems in the relation with technical aids, Nygård and Starkhammar [20] found it important to relate the usability in offered technologies with this group of peoples skills. This is also emphasized in ASTRID, a manual on using technology in dementia care [24]. To assess technology as a support to people with dementia and their relatives, a general study and needs analysis should be presented. The usefulness of this aid should also be evaluated along the way, as people with dementia and their skills are constantly changing. If the aid is no longer considered useful to the user, it should be removed [10].

2.2. Independency and dementia

The privilege living at home is something most people take for granted through life. However, this if often a challenge to elderly people that wants to stay at home as long as possible [25]. The whole definition of what independent living means clearly changes with age. Even if being capable of living alone, many elderly would need more or less assistance in everyday tasks because of different arising impairments. A health care worker or a relative would typically do this kind of support, along with improving their quality of life and autonomy.

Patients that receive help from health care workers, especially when living alone, experience an increased level of independent living. Such health care solutions, minimize hospitalization or to live in a retirement home [25].

The rapid growth of elderly people today, increases the need for home care services. This is a clear challenge for health care organizations. Especially in finding efficient high quality methods in elderly care, that doesn't increase social security costs [25].

In 2004, the project ENABLE's intention was to investigate possibilities of an independent living for elderly people suffering with dementia [26]. In this project

technical aids and products were added to support them living alone. The project was identified by keywords as:

- Satisfaction
- Entertainment and
- Own activities

It was a joint study between countries as Finland, Lithuania, Ireland, England and Norway.

One, among other things, was a user test of a picture gramophone. This was a multimedia program developed in Finland in the nineties. While doing the testing, both incorrect touch techniques and problems in reading were revealed. Still, most participants had benefits by using the picture gramophone [26].

Even if technical aids are considered expensive investments, they can have positive effect on peoples feeling of independency or even affect relatives' emotional stress. If such aids could ensure less hospitalization, the cost of these would be rather small in comparison [10] [27].

In recent years there has been a focus on giving patients support based upon their individual needs. To people suffering with dementia, such help may be exaggerated from time to time, as they tend to look very uncertain and helpless for those supporting them. Still, if they are given the correct stimuli, people suffering with dementia sustain their functional ability much longer. This user group is a dissimilar group. Some of them enjoy being taking care off, and some would like to make tasks on their own [28].

The patients need to settle down and be given time to accomplish different tasks. Both functional ability and independency are reduced if exposed to stress. To approach this the right way, health care workers need to reflect on why they assist their patients. To better help the staff being aware of this, a hierarchical model of independency may give some support. Andersen and Holthe developed such a model. It listed different criteria all the way from a patient being self-reliant to completely needy [28]. This model is adjusted to suit this thesis research on independency using a reminiscence mobile game. The model will be further explained in the thesis method chapter.

On the background of experiences found in the TED-project [29], good technical aids used by people suffering with dementia are supposed to support independency among them.

2.3. User- centered design and dementia

Whenever a product is designed, the guidelines for a universal design should be considered at all cause, to fit different users' needs. The intention of the principles in a universal design is to ensure a product to suit all ages, different body sizes and functional abilities. In addition to the universal design principles, seven principles of "design to everyone" have been developed by North Carolina State University. These could be suitable for people suffering with dementia [15] [16].

The seven “Design to everyone” principles:

Principle 1: Equitable use

A product design should be made to suit ordinary grown up people. In addition, it has to ensure that the safety and security is taken care off whenever interacting with it. The designed product should not decrease the user’s ability to get in social contact, but rather increase it.

Principle 2: Flexibility in use

The design should be developed to be adjustable to the specific user. This is an important principle. People suffering with dementia are a mixed group with different mental and physical capabilities, and their functional abilities are in constant change as well.

Principle 3: Simple and intuitive use

Regardless of the users’ expertise, skills or the comprehension of language or concentration, the usability should be simple and easy to understand. To people with reduced cognitive functions like those suffering from dementia, the product should be used with a minimal or absent learning time. The user group should rather feel familiar to the product, to avoid confusion and stress, and consequently feel motivated. Motivation could also be handled by making positive feedback solutions, while being used.

Principle 4: Perceivable information

All the important information should be placed within the field of vision to the user, using words that are understandable and simple. It is important to catch the user’s attention. This could be done by a combination of several elements. One example is the combination of proper/suitable images, sounds and colors to help the user complete a given task.

Principle 5: Tolerance for error

The design should ensure error reduction, quick usage and reliability. Even if errors should occur, the product should be designed to give positive feedback to the user, not warnings.

Principle 6: Low physical effort

The product should not demand a high physical effort in order to use it effectively and comfortably. It should be usable in any natural occupied positions. This is considered an important principle, as people suffering with dementia experience difficulties coordinating their movements along with their reduced every so often physical strength.

Principle 7: Size and space for approach and use

It is recommended that the designed product has an appropriate size and «space» to suit both an approach and usage regardless of the user’s mobility, body size or posture. Different hand sizes, their handgrip abilities and whether or not they’re confined to their beds, sit or even stand upraised. These issues should always be important considering usability [16].

Mäki and Topo [16] used universal design principles along with the additional seven "Design to everyone" principles. In their opinion, the use of both universal design and the "Design to everyone" principles would make new technology as Internet, different mobile technologies and touch screens more useful.

A lot of developed assistive technologies are made to solve a problem, rather than understanding the users' need. The research has been done in a technological perspective. If engineers or people with technical backgrounds design products without being aware of the needs for people suffering with dementia, the final outcome could give a very bad result [30].

Users suffering with dementia are often willing to assist developers in the design process wherever they can. This is often considered a good experience to the developers as well, since such an interaction between user and developer often tend to be motivating and lively [30].

Developers also often experience this group of people's desire to use their functional disability in a positive way, as it may be helpful to other people in the same situation [30].

These patients often want to contribute to other people in the same situation by using their disability in a positive way. Consequently both the developer and the patients benefit during the process [30].

Orpwood [30], points out the necessity for designers to work closely to people suffering with dementia, to discover their needs. Working closely with this user group is an unquestionable requirement to make a successful assistive design.

2.4. Reminiscence and dementia

In 2008 Harmer and Orrell discovered that demented people found reminiscence to be the most meaningful activity together with family and social life, music and individual activities [31]. Reminiscence has been defined in Cappeliez[32] as:

> "..a process of thinking or telling others about one's past experiences."

In 2009 a study in Denmark tried to find the consequences by using reminiscence with people suffering with dementia. The results found evidence that reminiscence had a potential benefit to both patients and nurses at a day care centre. The study also discovered that reminiscence could probably delay the aggravation of their cognitive function and dementia symptoms. In addition, health personnel could experience a probable improvement in well-being and professional [33]. Health workers confirmed the usage of reminiscence as a good working tool, and that they did better in communicating with the patients. There is nothing in the study that indicates any harm by using reminiscence with both patients and health personnel. There are also no problems discovered by integrating reminiscence in the daily care for the demented patients in Danish health units. However, the health care workers need support from the management, as well as different reminiscence materials, to make this succeed [33]. The Norwegian Health Authorities, found this study to have a solid transferable value to the Norwegian dementia care situation [34].

2.4.1. Technical reminiscence aids used by demented people

Several studies have tried to reveal elderly people interacting with computers. Still, there is little research on the field of interaction between elderly and mobile cell

phones. However, scientists in this area have discovered benefits in developing mobile technology with elderly people [35].

Literature that contains reminiscence used on mobile platforms, are very rare. In 2004, the CIRCA project (Computer Interactive Reminiscence and Conversation Aid) had a goal on designing a technological multimedia tool that could support reminiscence, by offering a problem free and user friendly technology. Demented patients were supposed to interact with the system using a 20" touch screen in cooperation with either a nurse or a relative. The study discovered demented people to enjoy interacting (physically) on their own. In addition, patients being diagnosed with dementia for a period of time also managed to interact with the system. Even without any skills on computer technology. However, one of the challenges revealed were considered with ergonomical problems. By sitting in a wrong position while using the touch screen, a loss of engagement could occur [36].

ZPLAY was a game developed in 2010. This game was designed for the web, and its intention was to treat people suffering with dementia. ZPLAY had two versions; the @lab, designed for diagnostics, and @home to challenge demented patients engagement. The latter could be played remotely [14].

As people suffering with dementia have different stages of mental functionality, this game was designed in a simple and easy way in order to make them understand and reconfigure. The graphical interface of the system, offered a set of stimuli games by challenging the user in cognitive motor control response. In the back end of the system, engines logged data from the person while playing. There were also some brain exercise games suitable for people in an early stage of dementia. Very few games have been developed to measure demented people's ability to react as they did in ZPLAY [14].

There is no treatment to stop the process of dementia. Still, the developers of ZPLAY thought the game could collect useful information in its data log and engage the demented patient into a level of independency that may improve their quality of life [14].

2.5. Assistive Technology

There are various definitions of Assistive Technology (AT). Still, in this thesis, the definition provided by Hersh and Johnson [2] has been chosen to describe the term in a best possible way:

> «Assistive technology is a generic or umbrella term that covers technologies, equipment, devices, apparatus, services, systems, processes and environmental modifications used by disabled and/or elderly people to overcome the social, infrastructural and other barriers to independence, full participation in society and carrying out activities safely and easily.»

Cognitive Assistive Technologies (CAT) that can support both individuals and their caregivers, are considered very important in future dementia care. Still, there is the need to provide legitimate proof of benefit by simply test and evaluate their usefulness in promoting independent living [37]. Different assistive technologies have been developed through the years, and could be used to support people suffering with dementia into an independent living [11].

2.5.1. Speech synthesis and text interfaces

A typical speech and text interface would consist of a visual part (texts) and auditive part (speech). Together they form a combined interface to support both hearing- and visually impaired users. The idea of this combination is to have it adjusted for different user needs simultaneously.

These interfaces have proved to be successful in the interaction process with people suffering with dementia. In 2007, Ortiz et al. discovered that 75% of their selected users suffering with Alzheimer disease interacted successfully with a text and speech interface that gave instructions [38].

Speech synthesis is an approved auditive technology used in different interfaces. This technology is regarded with artificial generated speech output from a computer or a device. Most of the synthesis is generated by ordinary or phonetic text converted into speech. This is why they are often referred to as text-to-speech synthesis [39]. Such synthesis stimuli has been found equally understandable as normal voice rrecordings, as long as the prompted texts are well designed, use familiar words and has contextual cues [40].

In Norway there is some developed Norwegian synthesis, to be used by different speech application solutions. However, there are no specific formal requirements regarded with developing Norwegian speech synthesis in terms of quality, natural voice recognition or pronunciation accuracy. Still, solutions made for Governmental purposes are required to have a universal design and thereby suit different user needs. The Government use two Norwegian speech-synthesis solutions, and one in English. These are all developed by the Acapela-Group [41]. By visiting MediaLT website, it is possible to investigate the different Norwegian speech synthesis available [22].

Google's Android, included a new speech synthesis capability in their API Level 4, which enabled Android devices to "speak" text of different languages. One of its capabilities was to prerecord and store sentences locally that were often used by an interface. In this way it was possible to ensure a natural and accurate pronounced instruction, by simply investigating the most proper text to be processed accurately and normally. Another option was to let the speech engine read predefined constructed texts on the fly. The difference between these two was to make sure developers had an ability to consider the most suitable solution regarded with CPU performance or storage requirements if the sentences were prerecorded. The option considered with processing text on the fly, did not require storage, but may be influenced by processing performance, as the sentences had to be rendered every time processed by an application. It would be beneficial to prerecord such constant sentences, as they would not change [42].

2.5.2. Touch screen

People suffering from dementia or older people in general are not used to interacting with technology. By using touch screens there will be a feasible way to make this group more comfortable with technical items/aids [43] [44] [45]. Still, there has not been much research upon the usage of new mobile screen technologies in the interaction with people suffering from dementia.

However, a pre-study conducted by IT-funk [46], discovered resistive screens to be more suitable for people suffering from dementia, than the new highly responsive ones [43]. However, capacity touch screen technologies used in devices as Apple Ipad and Samsung Galaxy Tab seem to be the preferred future touch screen technology

because of its multitouch capability [46]. In addition, new highly responsive touch screen technologies as capacity screens, may be beneficial in cases where the user have experienced dysfunctions in using strength while conducting a fingertip pressure.

2.5.3. Wording

Words are the most important linguistic element when designing a voice-interface. Both words and sentences being integrated in the design phase of a system will be the actual words that the user will hear or see when he or she interacts with it. By knowing this, it is a clear advantage to use time in the design phase on what words and terms or sentences that should be used to best suit and support the system's target user group [47].

Making understandable sentences are consequently considered very important [48]. Just reading simple sentences, is a process consisting of several elements. These elements are the grammar, the understanding and meaning of each word and cognitive components as attention and memory, all together the comprehension of the text. Several studies have discovered that patients suffering from dementia clearly have problems with understanding sentences [49] [50].

2.6. Prestudy prototype

During the prestudy a prototype reminiscence game was developed to be deployed in an Android tablet device. The reason for this prestudy was to investigate elderly people suffering from mild dementia ability to play a mobile reminiscence game. The game had both a question and an answer mode, and a results mode. Different usability issues regarded with the prototype were revealed during the prestudy. In addition, new problems arose during the testing; problems that made the prototype seem unfinished and non-suitable for this group of people.

Different usability and independency design requirements have been listed as the start up requirements and needs criteria in the Development Cycle Model found in the user testing in chapter 3.4.1.

2.7. Problem description and research questions

The prestudy prototype revealed new undiscovered usability and independency issues to be further investigated. Based upon the introduction and background literature in this thesis, the following question is to be further investigated by this thesis:

> "Are elderly sufferers of dementia able to play a reminiscence game on a tablet device independently?"

In order to give an answer to this, two research questions will be answered in the thesis:

1. Can we develop an interface that players are physically and mentally capable of using?
2. Are the players capable of playing the game independently?

To be able to answer research question one, a mobile reminiscence game was developed with a strong user-centered design methodology.

To be able to answer research question two, a structural observation study of patients suffering from dementia playing the game was conducted.

3. Methods and results

A scientific method tells us something of what we should do to collect or check knowledge.

We can give reasons to a chosen method, when we think it will provide us with useful data to illustrate our question in a professional and interesting way [51].

The theory of methods helps us taking reasonable choices. By using the experiences from other scientists, we can avoid to only learn doing experimenting and failing. By choosing the different alternatives, methods give an overview on different procedures and consequences. If we decide to follow these advices, we get help to resist the use of non- scientific ways to get the results as we like them to be [52].

3.1. Scientific point of view

This thesis is about developing a mobile reminiscence game to patients suffering from dementia. That is – technology used in an interaction with human beings. The scientific point of view is therefore a combination of both technical- and social science.

Science- Technology-Society studies (STS), is an academic field that analyze technology as social constructions. Jensen et al [53] says STS could be used in a technical development process, where there is user participation.

One perspective within STS is Social Construction of Technology, SCOT. This direction within STS came as a result of criticism aimed at technology determinative studies. Here it was presumed that the technology was autonomous and developed separately from society and social relations. In SCOT there are arguments that support the idea of not dividing technology and society from one another. Rather they mutually affect each other [53].

The starting point to SCOT, is that technology is what is it is, in relations to a determined group of people. SCOT provides its technical understanding in a political aspect. Technology does not develop itself, but always as a result of political processes [53].

The reminiscence game for the cognitive impaired, is developed on the background of the rapid growth of elderly people in the population, and consequently the Government's proposal of activating the elderly suffering from dementia [8]. This can confirm SCOT's arguments on technology being a result of political processes.

It is also worth noticing that the game has been developed with the users participating, and that it is what it is in relations to this specific group of people. The reminiscence game had been developed differently if there was another group that would use it.

3.2. Research design

By choosing STS as a scientific point of view, the approach in our method goes in a qualitative direction. Berg et al [54], gives a reason for this, based on the users being involved in the development of technology in health care, and that a qualitative approach was being used.

A qualitative approach tries to thoroughly investigate different properties in a phenomenon to get a deeper understanding of it. The quantitative method is about quantity and amounts, and tries to give a more broad opinion.

During field studies it is possible for the scientist to use different methods. One example is using observations and interviews. This is done to validate the data collection. It is also possible to combine both qualitative and quantitative methods to see the scientific area in different perspectives.

When different methods are being used in the process of data collection, we call it method triangulation [52].

3.3. Development of the prototype

3.3.1. A user centered approach

As described in the problem description the focus of this Thesis was to develop a mobile reminiscence game together with patients suffering with dementia. This was done to later on observe how self-reliant the patients would be, while using the prototype game. The results regarded with independency performance are to be found in section 3.6.

In the line of a social-technical perspective and Berg et al [54] opinions, it was natural to choose a strong user centered approach in the development of the prototype game. It was important that the user's needs would be the goal of this development, to avoid a bad final outcome of the prototype [30].

There are three principles for a user-centered approach:

1. **Get an early focus on the users**
   In this Thesis, the users were patients suffering with dementia. In particular it was necessary to understand both their physical and mental limits, along with the more general limits of elderly people.
2. **Do an empirical measurement**
   While the users interacted with a developed prototype, the situation and their reactions would be closely observed and analyzed.
3. **Do an iterative design process**
   Whenever a problem occurred through user testing, it would lead into a re-design of the prototype. New observations and tests would then be conducted, to find out if the re-design would have an effect [55].

3.3.2. The four steps of the interaction design process

There are four general activities within interaction design. As these activities are so general, they are also found in other design directions. This thesis' prototype was designed using those four activities, and the interaction design process had four steps within [55]. This process could be presented as a Development Cycle Model (DCM), to illustrate the development and evaluation of a prototype.

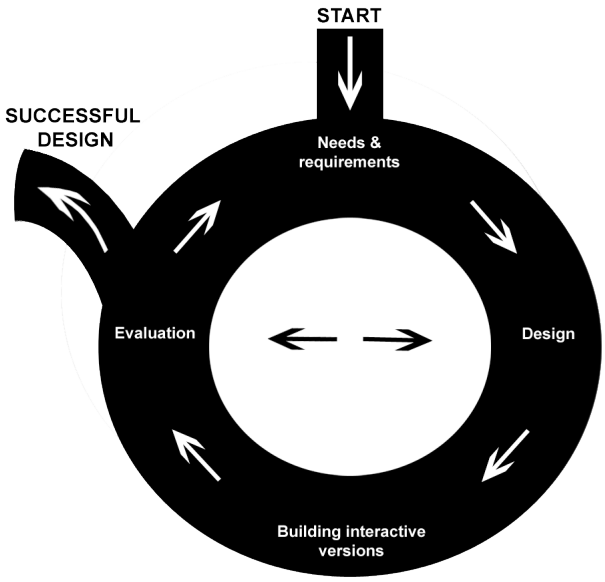

Figure 3 – Development Cycle Model (DCM)

The four activities described in the DCM are:

1. **Identifying needs and establishing requirements for the user experience**

Whenever we design to support people, it is necessary to know who will be the target group, and what the product should support. The target group's needs and demands would be the fundament in both a user centered approach and interaction design [55].

Both needs and demands in relation with people suffering from dementia, would be the starting point to the first step in the DCM. They were all discovered during the pre-study conducted, and also in additional relevant literature.

By using the background of these defined goals and demands, different design criteria were prepared.

2. **Developing alternative designs that meet those requirements**

Bringing up propositions and ideas in what may support the users need, is the main activity when you design. This activity can be divided into two sub categories: *Conceptual* and *physical design*.

Conceptual design describes what the product needs to do, what it should look like, and how it should act. Physical design describes the details around the product, as for example colors', images being used, and how the menu is designed [55]. In the first round of the cycle, the design criteria were based on the pre and relevant literature.

In later rounds of the interaction design process, new criteria were added based on the conducted user testing observations with the prototype.

3. Building interactive versions of the designs

Interaction design means designing products that are interactive. The best way the users would be able to evaluate this design, would be to interact with it. However, it will require a developed version of the design to do so. Normally it is not necessary to develop software. Paper based prototypes can be an alternative as well. The latter alternative is both inexpensive and fast to develop, and can be effective to reveal problems in an early phase of the design [55].

However, in this thesis, much time was spent developing an application to be evaluated by the patients suffering from dementia. It was assumed that this user group would not be capable to do good evaluations of an interaction design that was only made on a piece of paper, because of the complexity with the users mental and physical capabilities.

4. Evaluation on what is being built throughout the process and the user experience it offers

Interaction design means, as mentioned earlier, a high level of user participation. Through evaluations, we would try to find out if the design fits the user and if he would accept it or not. This can be measured through different criteria. There would be for example two important criteria like the number of times pressing a button the wrong way, or to what extent the user likes a visual design.

In addition, it is important to find how well the preliminary result matches the needs and demands set in the first step of the interaction design process. Evaluation of interaction design can give useful feedback to a redesign or future design.

This is all called iteration, and has earlier been described as a principle to a user-centered approach [55].

The evaluation of the developed prototype was conducted in the two first rounds of the DCM, by using user testing observations and feedback from an expert mini-focus group.

User testing and feedback from this expert mini-focus group had a qualitative approach.

3.3.3. Methods used in evaluation of the Development Cycle Model

Observation testing

The most important participants in an evaluation process are the user [56]. This thesis is based upon a strong user-centered approach. Because of this, it was natural to evaluate the prototype doing user-testing observations. That would require a real system and real users to interact with the product. Prototype testing could be conducted outside a test laboratory [57]. In the two first evaluations within the DCM, the testing was conducted at a daycare center with patients that fit the target group.

Benyon et al [56] discovered the same as Jakob Nielsen. There should be about 3-5 representative persons to be part of an evaluation. Some scientists found this number a bit too short, but Benyon et al [56] discovered too many difficulties in getting a decent selection of more than 3-5 persons.

In this thesis study, five different persons participated in the prototype user test observations. They were all selected based upon selection criteria given to the nurses in advance.

As mentioned earlier in this main chapter, a software prototype was developed, to better suit the user in evaluating the interaction design. The patients were given a task. They were told to play the game, and the evaluation came as a result of the observations while playing, asking questions and being in dialogs with the users to investigate five important usability criteria found in LoPresti [58].

a) Visual; the user's ability to see the different texts displayed along with images.
b) Auditive; the user's ability to hear and understand the speech synthesis.
c) Orientation; the user's ability to orientate himself in the interface.
d) Learn ability; the users ability to understand the instructions of how to play the game.
e) Environmental; discover any important ergonomical issues to be able to play the game

Expert panel evaluation

It's not always easy to get enough participators in a user testing. By involving a lot of participators you would get a very costly and time-consuming scenario as well. To deal with this problem, it is possible to do evaluations using an expert panel. An expert, in this thesis study, would typically be a person who had experience in the field of usability and interaction design.

A combination of users and experts can enhance an evaluation. The expert very often puts himself into the user's role during evaluation. In this way he can come up with suggestions on typical problems the user would experience interacting with the technology. The experts could be used both in the beginning and in the end of a design development process [55].

In this thesis, an expert panel evaluated the prototype. The panel consisted of three ergonomists with knowledge on dementia and technology assistive aids. The data was collected in a mini focus group setting, where the panel answered predefined questions, and I being the moderator to keep the group interview to the target. This is said to be an effective method to generate data, because interview data is collected from several informants at the same time [59]. A mini focus group is proposed by Krueger et al 1994 in Tjora [59], to be specialists within a field of investigation, and may also share the same job. In my case they were all ergonomists.

The questions answered by the panel covered the five aspects of the game; visual-, auditive-, orientation-, learning- and environmental issues.

The questions used in the user testing, are put as an appendix 1 in this thesis.

3.3.4. User observation environment

When a user-test observation is to be conducted, it is important to make the environment suitable for the technology being used [56].

The first test was conducted in a daycare living room. All the participators were sitting around a table, but only one participator was playing at a time. In addition to the patients, a carer, a nurse and myself, were observing them playing. The carer chose the most engaged patient to start playing, to make the other participators curious and eager to try as well.

The second test was conducted in a daycare center activity room with both nurse and carer present. There were two participators, sitting at the table and with the prototype in front of them.

3.4. Results of prototype using the DCM

3.4.1. ROUND 1

STEP 1

The questions and answers used in the prestudy prototype were being used, as they were questions from the past, and thereby supporting a reminiscence scenario. The questions have been put as an appendix to this thesis. The images that belonged to these questions were also being used, and had an image size of 6cm x 4,5cm size. The pre study prototype did also remove incorrect answers during the play as they were pressed upon. This way the user did not need to answer the same answer twice. This usability problem was solved in the pre-study.

To support independent playing, textual instructions were considered an important feature to be implemented in the prototype game.

As a result, the first need and requirement for the game was identified as:

1. The game should have readable and understandable text instructions and feedback.

However, this assistive feature was not considered appropriate alone. By making the prototype speak, the effect of the textual instructions was considered more solid. Especially in terms of keeping focus in the game.

Still, it would be necessary to determine an appropriate speech solution without the need to do a lot of manual recordings.

The second need and requirement for the game was identified as:

2. The game should support satisfying audio speech prompts instructions by using an understandable and low cost speech solution.

Observations in the pre study had observed the users with difficulties navigating in the game. While playing it, they had to press a button to proceed after giving their answer to a question. However, the users were not capable of doing this, because they did not understand how to press the software button.

As a result, a third need for the game was identified as:

3. The game should have an automated navigation.

STEP 2

During the design process, the three requirements identified for the game, were carefully planned. It was necessary to determine where and how they should be integrated in the user interface.

1. Textual instructions and feedbacks:

The instructive part telling the user «How to play the game», were considered most appropriate implemented in the start of the game to present the user to the game and how to play it. When these instructions ended, the user should then be automatically navigated to the first question.

The feedback given when answering the questions should come immediately after pressing an answer. Four different feedbacks were identified for the game questions:

1. Correct answer
2. Incorrect answer
3. Repeated question and answers
4. Question time out

In addition the instructions and feedbacks were set into different views (mode) in the game, to better separate them:

All instructions or feedbacks displayed to the user should fill the screen with a white background and the instructions or feedback clearly presented on top. The question should be set on a grey background to clearly separate it from both the image and the answering options. The text-size should be large, and above 12 pt [15], and the text lines should have proper line spacing. There were four different text modes identified in this part of the game design:

1. The instructions mode (when the game started)
2. The questions mode (giving questions, (a related image) and answering options)
3. The feedback mode (giving feedback on correct/incorrect answer and time outs)
4. The results mode (to inform the user that he had finished the game)

In addition to these, a feature to repeat the question and answers given in the question mode was considered appropriate. This repetition should occur after a certain time given.

3. Auditive instructions:

The auditive instructions were considered most appropriate if they processed the text currently displaying on the screen. Both text and audio speech prompts were considered best implemented if they were done simultaneously and consistently through the design. This would also benefit too visually and hearing impaired simultaneously.

Two audio options were considered in terms of implementing audio speech prompts:

1. Manually recorded speech instructions
2. Text-To-Speech (TTS)

TTS, was chosen based upon the following assessment:

- TTS is more dynamic:
  If the audio solution should give instructions, feedbacks, questions and answers, it would need to be very dynamic. A manual recording approach would demand more effort and time to redo a recording, and then implement it. In TTS a sentence with a bad pronunciation, could be fixed by simply edit the text to be read by the TTS engine. The new result could be listened to immediately afterwards.

- TTS in Android can generate speech, based on phonetic given sentences:
  As manual recordings would sound more natural and accurate, TTS used in Android has the ability to read phonetic sentences.

By knowing this, some of the natural language accuracy, could be compensated. At the same time it would be possible to choose the most low cost solution by integrating TTS speech solution into the game.

To support the user with the most proper speech solution in the game, a research on requirement standards in different potential Norwegian organizations, were conducted. This discovered no specific requirements to the speech synthesis. As a result of this, a solution delivered from the speech synthesis developer SVOX [60], was considered appropriate to be used in the game.

A small program was developed for Android tablet using the SVOX Text-To-Speech engine to investigate proper phonetic Norwegian sentences. It took text as input in a text field and processed it when pressing the “START SPEAKING” software button. This program’s processed speech would make it easy to determine the input sentence’ natural and accurate pronunciations.

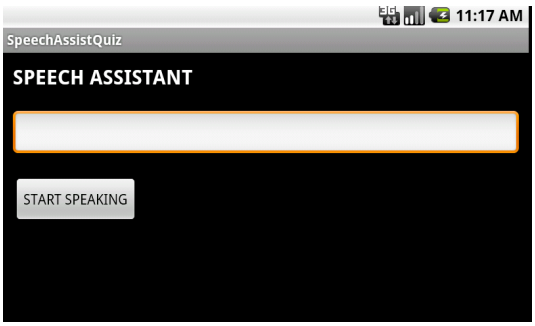

Figure 4 – Software to investigate proper phonetic Norwegian sentences.

3. Automated navigation:

As the navigation should be done in an automated way, several aspects were considered on how the user should be navigated through the game:

a) A fully linear navigation based on only one option to answer the question

By doing this, the user would be navigated to a feedback screen giving the result of the question, and then automatically redirect the user to the next question. A validation should keep track of how many questions left, to make sure the user was navigated to the results page if no one left.

b) A semi linear navigation based on multiple options to answer an incorrect answered question

This would give the user ability to answer the same question immediately, until he answered it correctly. All answers would be validated. Correct answered questions would redirect the user to the next question. Wrong answered questions would redirect the user to the same question again. If the validation found no more questions to be asked, the user was navigated to a final results page.

c) A non-linear navigation based on multiple options to answer an incorrect answered question.

All the wrong answered questions would appear later in the game, to be retried by the user. The user would make it to the results page when all questions were validated correctly answered.

Option b was chosen, as it was considered to give a semi linear approach, giving the user ability to keep answering the question until the correct answer was given.

A model was created to illustrate this approach. The question&answers mode would either be the same question or a new question, depending on an incorrect or correct answer from the user.

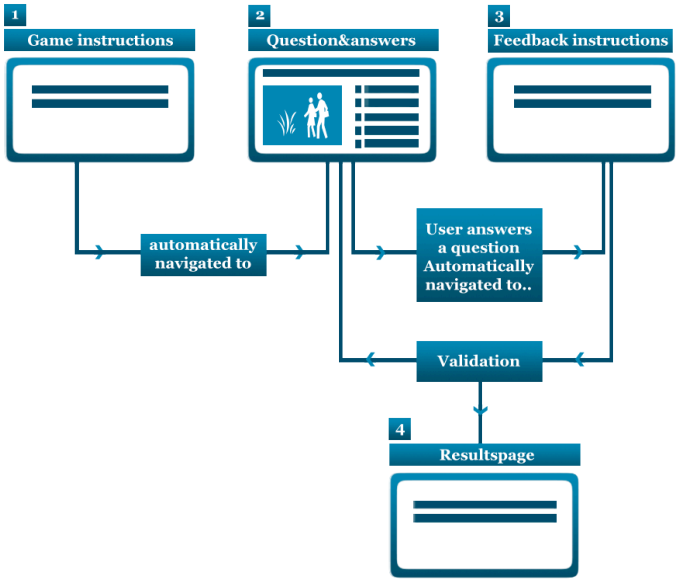

Figure 5 - An illustration of the design model b.

Two scripts run by a timer, would be integrated to the game, to handle the automated navigation:

The first script would display new text instructions whenever the speech had stopped.

The second script would control feedbacks in the game based on the timer. The four different feedbacks would be set on different time parameters. As a start, each feedback were displayed to the user in the following amount of time, as it was assumed that the users needed much time to read and understand the text given:

1. Correct answer – 20 sec
2. Incorrect answer – 20 sec
3. Repeated question and answers – 1 minute
4. Question Time out – 2 minute

STEP 3

In this step, additional codes were developed and implemented in the prototype from the prestudy.

The code regarded with the instruction-, question&answers-, feedback and timeout mode mode can be found in appendix 2.

The code regarded with automating the navigation, is also found in appendix 2

A final visual outcome of the instructions-, question&answers-, feedback- and timeout mode are presented in the figures below as output from the automated navigation using a Samsung Galaxy Tablet device 7” screen.

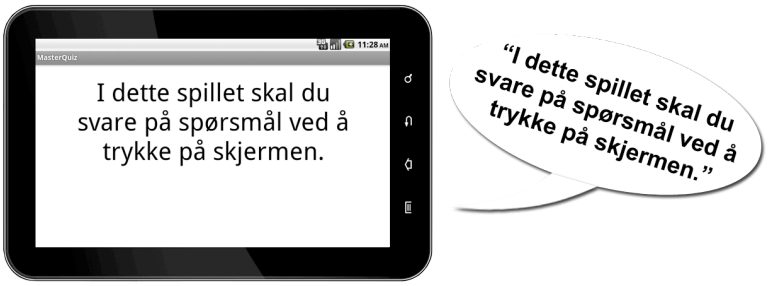

Figure 6 – One of the instructions in the instruction mode.

Figure 7 – The question&answers mode.

If the user answered correctly in the question&answers mode, then the feedback mode would pop up, and finally send the user to a new question. If the user answered incorrectly, a text telling the user to try once more would pop up instead. In the latter occasion, the user would be sent back to the same question.

Figure 8 – The feedback mode.

If the user didn't answer the question at all within the time limit, the timeout mode would be displayed instead of the feedback mode. Then the user would be navigated to a new question.

Figure 9 – The timeout mode.

A final results page came up in the end, if the user had finished all of his questions.

STEP 4

Evaluation

In the user observation the implemented features based on the criteria were evaluated. There were three users to test the features and find possible new usability issues. These are the discoveries based on the three criteria:

1. **Textual instructions** – The users confirmed that the text in the instructions and in the game was readable, but it was hard to reveal how well they were understood. This part would be left out for an expert mini-focus group to decide.

2. **Auditive instructions** – The users confirmed to hear the audio instructions and what was being said. One user however, was observed to pay attention to the game whenever the speech started, as he had lost focus somewhat before.
   Some words in the questions and answers were a bit unclear, as they occasionally were mispronounced. Once, a social interaction between the prototype speech synthesis and one of the users was observed. When the speech synthesis asked the user: "Are you ready", he confirmed with a "yes".

3. **Automated navigation** – The users had no difficulties with the navigation, as this was automated. They all made it to the end. However, 20 seconds display of the feedback mode, was obviously too long. The users read and perceived the feedback quiet quickly, and this indicated that the next question should be displayed even faster.

<u>Other discoveries found with the design:</u>

One of the three users had difficulties touching the screen correctly from time to time. In the pre study some of the users had used resistive screens. This game had a study on capacity screen only.

In a few occasions one patient were pressing the button incorrectly. This was caused by a too long pressure onto the screen, rather than a quick tap whenever answering. It was not considered a consistent problem, but rather an exception.

The game started the instructions immediately after initiating the game. This gave less time for the user to prepare. A better approach would be to initiate the game, and then present a startup page with a large button saying «Press here to start the game». Consequently the user would know what was expected to come, and would have the time to prepare for the instructions that were coming.

Some of the questions were hard to answer understand, as the users would not know how to answer them.

The field notes of the user testing can be found in appendix 3.

3.4.2. ROUND 2

STEP 1

While playing, one of the users had some difficulties pressing the screen correctly. Two things were considered as an approach to this problem. These were identified as:

1. The user should be facilitated with an aid to press the capacity touch screen
2. The user should be given a speech feedback from the prototype whenever a misplaced press onto the screen occurred. This should inform the user, that despite doing a correct pressure to the screen, he did not press his finger onto the answering buttons area on the screen.

Making new questions to fit the actual users in the user testing was not considered an option. Still, the wording problems in the questions could be adjusted to make the questions more understandable. The expert mini-focus group used in the last DCM evaluation was considered appropriate to investigate the wording problems in the questions.

The last discovery was the problem of a too long feedback time. The following criteria were considered to solve this problem:

3. A correct feedback time should be stored in a configuration panel to support an adjustable feedback time settings.

STEP 2

Finding proper aids to press the touch screen

As many stylus pens are available in the market, these two items were considered the most appropriate to be further tested in the prototype.

Figure 10 - A HTC stylus capacity pen formed as a pen with a hard flat angled pointer surface. [61].

Figure 11 – A HTC stylus capacity pen with a small rubber air pillow as the pointer surface. [62].

The smallest one (figure 9) was formed as half the size of a pen, and had a rubber pillow filled with nothing but air. This pillow tried to simulate the fingertip and could be directed in different angles on to the screen, to press successfully.

The second stylus pen was designed as an ordinary pen, and had a flat angled press point at the end. It would have to be pressed on the screen in a correct angle to give the intended effect/result.

Two things were considered an approach to solve problems regarded with pressure accuracy or incorrect press techniques on the touch screen:

1. Two different stylus capacity screen pens to choose between
2. A speech prompt should be initiated, whenever the user does a correct, but misplaced screen pressure. It should tell the user to press on the screen answering buttons.

Implementing a configurations panel to adjust feedback response time.

The configuration panel should not be made available to the user, but rather made available through a hidden menu option in the game. The panel should be designed to take input numbers for minutes and seconds on the different feedback instructions, and store them. This would ensure an adjustable time configuration approach to suit the user and his need of time to read and understand the feedback given.

The minute and seconds parameters should be stored in a configuration text file on the device. This file would then be read each time the game started to sort out how long the timer should display the feedback mode to the user.

STEP 3

The code for registering screen pressures that are not on answering options target, are put in appendix 2

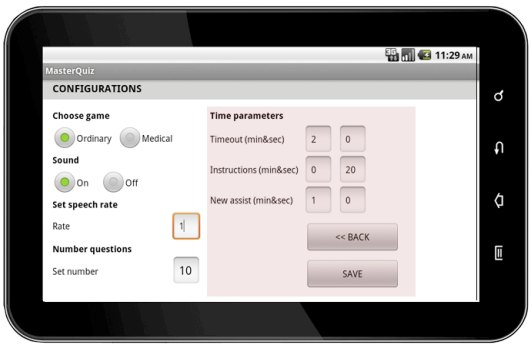

Figure 12 – Configuration panel. The light red area indicates the features to set time parameters regarded with the feedback and timeout mode, as well as repetitions of question and answers.

STEP 4

Evaluation

In this second round evaluation, two users tried out the game. Both users did not do very well with the stylus pens, and improved better when not using them. Mostly this came as a result of wrong usage, either wrong angle or not pressing the screen hard enough. Using such aids to press the screen did not work as intended.

However, the adjustable feedback time set in the configurations panel of the game came out well during testing. An appropriate time of 15 seconds was found

This gave just enough time for the speech synthesis to end until the display changed to the questions&answers mode again.

The field notes of the user testing and feedback can be found in appendix 3

3.4.3. ROUND 3

STEP 1

To be certain that the game was usable to the users, an expert mini-focus group of three ergonomists were told to give an opinion of the game based upon the five different usability criteria found in LoPresti [58].

a) Visual; the user's ability to see the different texts displayed along with images
b) Auditive; the user's ability to hear and understand the speech synthesis
c) Orientation; the user's ability to orientate himself in the interface
d) Learn ability; the user's ability to understand the instructions of how to play the game.
e) Environmental; discover any important ergonomical issues to be able to play the game

STEP 2

The five usability criteria were put into an interview guide, to be used during and after the game were tested by the expert mini-focus group.

STEP 3

Nothing was changed in the code before the evaluation.

STEP 4

The results from the expert mini-focus group gave the following response to be further investigated:

Audio

The panel discovered that the audio in the interface needed proper wording to facilitate a more understandable speech. If the interface could support instructions with understandable wording, this would give the audio speech prompts a higher quality as well.

The panel found the audio tempo to be proper for the target group. It also had a proper speech rate. The voice of a female was considered better recognized among hearing impaired people, rather than lower rates as in a male voice.

However, a repetition of the question and answers should only occur if the user had not started answering the question already. Otherwise they assumed he had heard the question.

Text instructions

It was important that the game had precise textual instructions. To help out improving this aspect, the group agreed to contribute with preferable text instructions

containing better wording. Some questions were either removed or edited for a better comprehension.

Whenever the user reached the last question of the game, they felt that the user should be told this.

The patient could also benefit from knowing how many questions that were left. This could be placed in a discrete screen position.

The user should not be given an option like «I don't know the answer» option, as this might appeal to a stimuli resignation.

However, they considered it a good solution that the wrong answers were eliminated whenever pressed upon, a good solution.

The user should be given a simple feedback whenever the answer was wrong. One of the examples being: «Please try again».

In the game instructions starting the game, it should rather say: «Welcome to this brain game exercise», rather than “Hi! Now we will try to play a game on this screen…”

The questions asked should be easy in the beginning and more difficult as the users progressed.

Aids to press the screen correctly

The two stylus pens presented were not considered appropriate enough to be used by elderly demented. A special developed solution would have been a better choice, to be used for example as an extension on their finger as it would also support those with bad grip abilities.

This indicated the complexity in making an accessible design to everyone.

Environmental conditions

It is important to have good lighting conditions while playing. The background should be in one color only, as in the game (white). The device should be vertically placed on a table in front of the user. It should be solidly placed to withstand pressures on the screen. There should be no direct light from the ceiling to make reflection in the screen.

Alternatively, the user could hold the device. It would then be beneficial to keep it inside a case that would hide the hardware buttons as they could easily terminate the game.

The final questions used in the prototype game could be found in appendix 4

The summary of the group interview can be found in appendix 5.

3.5. Methods used to develop an independent playing

A triangular method was chosen to get a better understanding of the observations done. This means doing two or more methods in together to get a better perspective of the data collected. To give answers to the second research question a structured observation study, an interview and stored game data log was being used. In addition relevant literature on answering parts of the question was also useful.

3.5.1. Structural observation

After conducting the development process of the game, a structural observation was made to finally, in a more accurate way, determine independent playing among the selected patients.

The observation study was chosen because of the possibility of a close inspection of the user group. Johannesen et al. finds observations to be conducted whenever it is not possible to collect data otherwise [52]. In this thesis, as mentioned earlier, the observation study was considered the most suitable method to collect data while the participators were using the prototype.

One of the principles used to describe a user-centered approach, involves observing the user while interacting with the prototype. This principle is called, *empirical measurement*. This defends the use of observation as an evaluation method.

A structured observation was chosen. In that kind of observation, the observer knows exactly what he is looking for, using good knowledge and skills on the area being observed [63]. This makes it possible to determine some fixed categories on what should be observed and registered. These registered data are put into a field study form called a track sheet [52]. It is possible to do quantitative registry of the observation when a track sheet is being used [63].

The way to determine a user's level of independency while playing was based upon five independency steps found in the book "Fra selvhjulpen til hjelpetrengende". These different steps intention were to guide nurses and carers on how much assistance they should offer to a patient whenever trying to do a given task. A typical example would be whenever the patient tried to brush his own teeth's [28]. However, the five steps were somewhat edited to fit the game environment for this thesis observational study. They were finally put into a track sheet as different structural observations, to be checked whenever they would occur. A carer would help giving the assistance to the users playing. The five observations regarded with level of independency were:

A) The user needs no help answering the question.
B) The user is either given an explanation to the question, the correct answer or is asked to "take a guess"
C) The carer gives instructions either orally or visually on how to answer the question.
D) The user indicates or asks the carer to be helped physically pressing the correct answer onto the screen.
E) The user indicates or asks the carer to physically answer the question on the tablet device.

Observation A, D and E could only be counted once per question. Observation A would be the only observation considered with being totally independent. B and C could be counted many times per question, as these observations were considered with the carer's frequent assistance during a question. Both D and E observations could only be counted once, as both of them initiates the correct answer to the question.

Four other issues should be observed in the structured observation in addition to the A-E observations mentioned above. These were:

- **Observations on how the user started the game and interpreted the instruction mode**
  This observation should reveal the users approach to the game at the very start of the game.
- **Game focus**
  How focused would the user be on the interface while playing?
- **Pressure technique**
  How many times would the user have problems pressing the options in the screen correctly with his fingertip?
- **Question difficulty**
  This observation was considered with what If the question were not interpreted correctly

The observational study selection strategy is described in chapter 3.7.
The track sheets used for this thesis can be found in appendix 6

3.5.2. Issues regarded with an independency observation study

A particular problem with the observational study was regarded with how it should be conducted. Having a carer participate in the room could influence the observations and start up conversations between the carer and the user involuntarily. Still, it was not considered appropriate to let the users be left alone in the room, as there was not a lot of time to make them adjust into the game setting scenario. By having the carer in the room it would be feasible to avoid complications regarded with the fairly new scenario. In addition, it would be of great interest to discover to what degree the questions would keep the users from interacting with the prototype independently. This could be useful information to give results regarded with wording and question complexity compared with independency.

The carer needed to be instructed carefully, to specifically give help whenever it seemed needed or when the user would specifically indicate it. This was assessed on the fly while observing.

The carer was told to give the answer before the question time out, if this was assessed to be the only reason for the user being reluctant in interacting with the game.

Before the game started, the carer was also told to give an orally message to the user to explain what the user was participating into, and briefly how to play the game. This was made to ensure the user would feel well about the situation, and had the ability to ask questions if something was not understood.

The observations were done by observing the situation in every question, and then take field notes. As the observations were mostly predefined, it would be easier to keep up with observing each question. Still, useful observations might not be tracked doing such a sample observation approach, as some time would be needed to do the field notes along the way.

3.5.3. Interview

Along with the observational study, an interview consisting of two different parts was conducted. The first part was done before the prototype testing, and the second one afterwards. In the first part, the main goal was to create a user profile based upon

the user's general interests, their interest in watching TV (visual), listening to the radio (audio), reading (text) and dialing telephones (pressure).

In addition this interview tried to reveal their technical skills using the TV and radio. Did they manage to switch them on or off by themselves? It also revealed the complexity of understanding and giving answers to the questions in general. Another benefit was the opportunity to create reliance between the user and I as the observer, to make sure the observational study would be less intimidating to the user.

The second part of the interview tried to determine how well their reading and hearing ability was, based upon game instructions and feedback, along with their overall assumption of the game. Their ability to press the screen correctly was being revealed during game.

Benyon et al, found short individual interviews performed after user testing to be very useful in confirming observations [56]. Designers often use semi-constructed interviews in this task. This means that interview guides or questions are created before the interview takes place. Still, the interviewer is free to ask other questions if they are considered natural.

Beuscher and Grando [64] discover an increasing interest in conducting qualitative research with demented patients. Still, there is little literature to be found regarded with all the challenges in such research.

During interview, some of the questions had to be repeated, or rephrased on the fly as the participators didn't understand them, didn't answer specifically or needed them repeated because they lost focus.

Still, it was considered a better approach to do this, rather than leaving an unanswered question. Some of the questions asked were finally understood and answered when they were repeated or rephrased.

The first part of the interview was recorded. The recordings for this part

3.5.4. Data log

The game stored data on the user performance. This log consisted of quantitative data on parameters as:

- Time used per question.
- Wrong answers.
- Total points.
- Number of repeated questions.
- The amount of questions that were timed out.
- The amount of misplaced screen pressures outside the answering option area.

The data log was used to reveal and support observations that were done. Relevant results from the log have been presented in the chapter of results of independent playing.

The total result from the log is put as an appendix 7 in this thesis.

3.5.5. User observation environment

The observation study was conducted with a carer and me as the observer in the room, in addition to the patient. The observation was done in a room at the daycare center. In the figure below, the general position to each participator (observer, carer and patient) is illustrated.

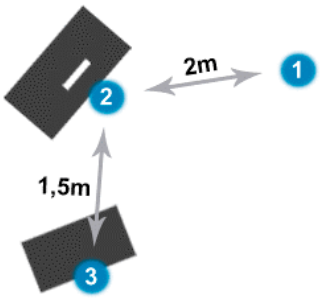

Figure 13 - The default position of each participator during the game observation. 1) The day carer 2) The user playing the game on the table 3) The observer.

3.6. Results of independent playing

Before the observational study was conducted, a redesign based upon the expert mini-focus panel had been done. The following things had been added:

1. The instructions, feedbacks and parts of the questions and answers had been edited or removed based upon feedback forwarded by the expert mini-focus panel
2. A script was integrated into the code to make sure the repetition of the questions and answers only were given if the user had not started to press the screen yet.

In addition to this, the stylus pens were not used in the observation because the panel didn't recommend them. There was no solution to the problems that had occurred regarded with incorrect screen pressure technique. Still, this was a structured observation that would investigate the complexity of this problem regarded with using a high responsive touch screen.

In the individual presented chart bar results below, the frequency of B-E observations is put in the Y-axis, and the different questions are indicated in the x-axis. All questions without any frequency registered, are the ones registered with an A observation.

Any B-C observation being observed could occur more than once per question during the observational study.

All the A-, D- and E-observations could only be counted once per question.

In addition to the observations, user screen pressures and time outs were registered in the data log. The registered pressures, are the ones considered correctly performed with the finger, but not within the target area of the answering options on the screen. These were used in both the individual and total results, to reveal how the users performed using a high responsive screen, as the capacity screen on the Galaxy Tablet.

The time outs are considered to indicate how often the user was timed out on a question. These data may be beneficial in addition to observed or registered issues regarded with pressuring the screen as well as question difficulty.

The calculations of the individual and total A-E observations are found in appendix 8.

The interview transcriptions are found in appendix 9.

The repeated structured observations, as mentioned in chapter 3.5.1, used to observe level of independency playing the game:

A) The user needs no help answering the question.
B) The user is either given an explanation to the question, the correct answer or is asked to "take a guess"
C) The carer gives instructions either orally or visually on how to answer the question.
D) The user indicates or asks the carer to be helped physically pressing the correct answer onto the screen.
E) The user indicates or asks the carer to physically answer the question on the tablet device.

In addition to these, incorrect screen pressure technique was observed, along with the user's focus on the game interface while playing and question difficulties.

3.6.1. Presentation of individual results

USER A – Gender: Man

Interview summary before playing

The user seemed to have a motor dysfunction and needed assistance in getting seated with the game. He told he had been a musician and liked to play piano as his main interest. The user liked to play quiz games, watch TV and listen to the radio as well. He confirmed being able to switch both TV and radio on or off by himself. He sometimes liked to read, and only used his glasses as an aid when doing so. The user confirmed making own phone-calls using the telephone himself.

Track-sheet information

The following chart describes how independently the user played based upon our predefined A-E observations. The questions left with no observation are considered A-observations.

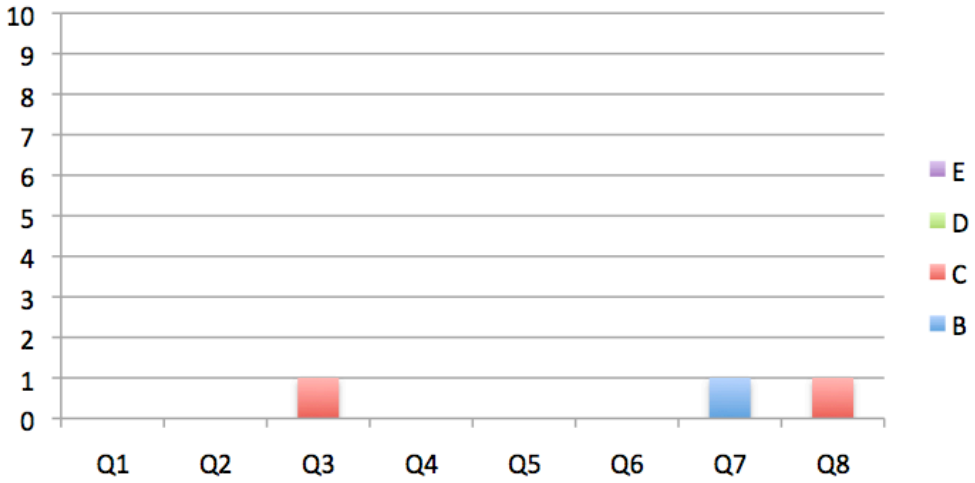

Figure 14 - The non-independent frequency describing what kind of observation and its frequency (how many times the user needed physical assistance). Questions left without any observations are considered A-observations.

Observations registered besides observation A-E:

Observations on how the user started the game and interpreted the instruction mode

The user started the game without any help, by pressing the "Click here to start the game" software button. He was focused during instruction mode, and did not have any observed interventions to the carer.

Game focus

The player was focused on the game on each question and when the instructions were given. There were no registered interventions on the feedbacks given between the different questions as well.

Question difficulty

In two of the questions the user indicated he didn't know the answer to the question. In the first one, he managed to proceed by pressing the answering options until he got the correct answer, without any assistance.

However, on the second one, he was very reluctant and did not approach the tablet for a long while, as he indicated he did not know the answer. The carer instructed him "to take a guess". Still, this particular question timed out before he managed to answer. The same thing happened on question 3, but he was not given an answer by the carer, and the question timed out.

Problems pressing the touch screen answering options

The user had three misplaced screen pressures registered in the data log. This resulted in 17% of the total pressures during the game, to be incorrectly positioned from the answering option area. However, the data log reveals that the user managed the questions eventually before a question time out. This indicated that he understood the problem not doing an accurate positioned pressure, and did a second try to make a

correctly placed pressure. Despite shivering hand movements, there were no observed problems for the user doing correct pressures. This indicated he had the right touch technique when using his fingertip onto the screen.

Interview and observations after playing

During the interview after playing the game, the user on request read the readable lines in the start-up instructions and in the first question as presented. There were no observed problems in reading both of these instructions. During the audio test, the user only repeated parts of the instructions given, when asked to. He only repeated parts of the first question and answers as well.

USER B – Gender: Woman

Interview summary before playing

User B, entered the room in a wheel chair. A nurse was pushing the wheel chair. The user could not specify any particular interests or activities while staying in the daycare center. The user hesitated, but gave a final positive answer on how she found quiz games amusing. Still, there was no hesitation while asked about if she enjoyed watching TV. However, the user had no particular interest in listening to the radio, or to read. In addition, the user didn't think she needed any aids to read.

The user also did not use the telephone.

Track-sheet information

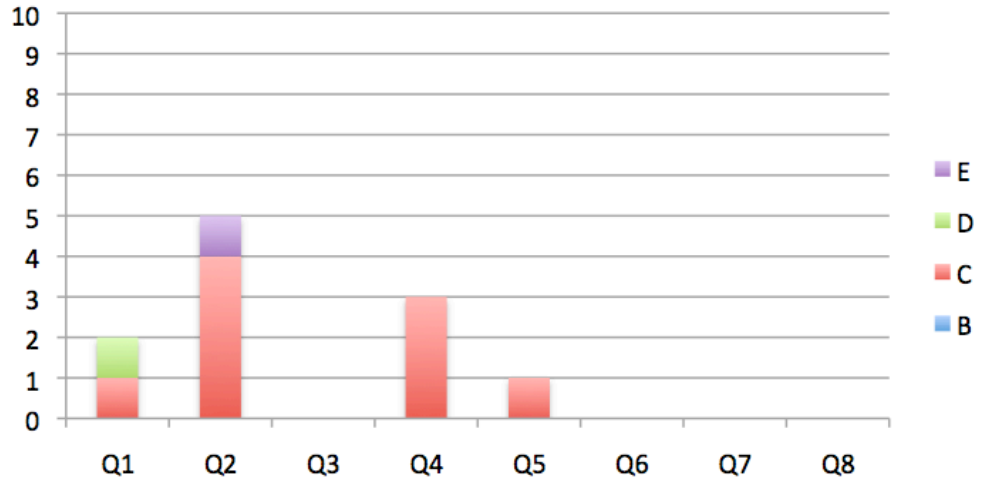

Figure 15 - The non-independent frequency describing what kind of observation and its frequency (how many times the user needed physical assistance). Questions left without any observations are considered A-observations.

Observations registered besides observation A-E:

Observations on how the user started the game and interpreted the instruction mode

The user was told to press the "Start the game" software button, and managed to do so. The user did not give any interruptions while going through the instruction mode. When asked by the speech synthesis:"Are you ready", she confirmed with a "yes".

Game focus

The user was focused on the game in the last four questions. In the first four questions, all the instructions from the carer along with her own inaccurate screen pressures made her focus more on the carer. However, in the last four questions, she was focused with the game.

Question difficulty

When the first question came up, she indicated not knowing what to do, and the carer gave game instructions, to make sure she knew how to perform in the game. Still, she did not manage to answer more than once correctly before the question timed out. According to the data log, this was the only question being timed out during the game.

On both question 2 and 5, the user clearly indicated she didn't know the answer, and the carer told her to push one of the answering alternatives seen on the screen several times. The user seemed confused whenever not knowing what to answer in the game. However, question 3, 6, 7 and 8 were answered without any assistance.

Problems pressing the touch screen answering options

The user had some problems pressing the answering options in the start of the game. According to the data log, ten misplaced pressures were registered, and they were all done during the first two questions. One final misplaced pressure was logged in the third question. There were no observations that found the user to perform with an incorrect screen pressure technique onto the screen. This indicated the user performed using a correct pressure technique. Still, 44% of all the screen pressures the user did during the game were misplaced on the screen.

Additional observations discovered with this user

A particular interesting observation was revealed with this user, not part of the actual observation. A strong connection between the carer and the user was observed during the game. The carer stood beside the patient in the two first questions and sat down with her on the three last ones. In the first questions, a conversation between the user and the carer took place, because the user had difficulties in knowing what to do, because she didn't know the answer. During the three last questions however, the user managed to play independently without the help from the carer, even when sitting next to her.

The interview and observations after playing the game

After playing the game, the user indicated that she liked to play this type of game. Still, she responded negatively on using it in a later occasion. The user did not find the voice in the game to be of any help as well. She did read both instructions and questions and answers correctly, without any hesitation or observed sight problems. However, the user was only able to repeat parts of the speech synthesis played to her.

USER C – Gender: WOMAN

Interview summary before playing

User C, arrived by herself into the room, and sat down at the table. She didn't mention having any particular interests and could not give a solid answer whether she liked playing quiz games or not. However, the user confirmed that she liked watching TV and listen to the radio. She enjoyed reading and told she only needed her glasses as an aid while doing so. She did not use a telephone, and told her kids would call instead.

Track-sheet information

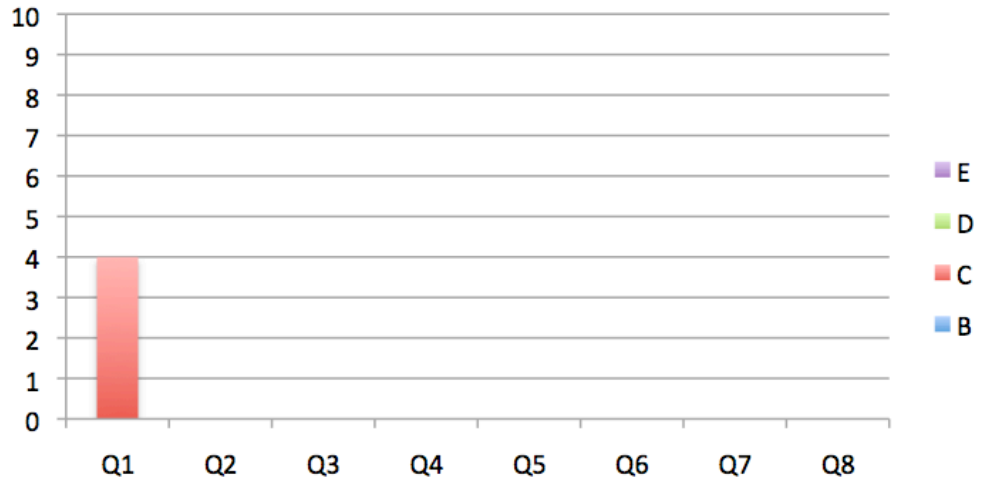

Figure 16 - The non-independent frequency describing what kind of observation and its frequency (how many times the user needed physical assistance). Questions left without any observations are considered A-observations.

Observations registered besides observation A-E:

<u>Observations on how the user started the game and interpreted the instruction mode</u>

The user managed to press the "Click here to play" button in the start of the game, when told by the carer. However, in the instruction mode, she misunderstood the synthesis and text game instruction. This particular instruction was meant to instruct

the user on what to do when the questions appeared. Still, she interpreted it as something to be done immediately on the screen.

The user was given three instructions in the instruction mode because of this, to ensure she understood how to play the game.

Game focus

The user was focused with the game during playing. In the first question however, it was necessary to point out how to actually answer the question, as the question mode had appeared on the screen, and it was easier to give an example for the carer.

Question difficulty

In the first question, the user was told how and where to answer the questions. The user data log presents 10 wrong answers during question 2 – 8. Still, the user didn't ask for any assistance regarded with the questions. She rather played the game and took a guess whenever insecure.

Problems pressing the touch screen answering options

The user held her finger very near to the screen, while playing. In addition, the user shivered on her hand. This may in two cases have led to a wrong answer being pushed, because of the high responsive screen. There were no registered problems on an incorrect fingertip pressure onto the touch screen. Still, the user had 5 misplaced pressures onto the screen. This resulted in 19% misplaced pressures of the total screen pressures registered.

The interview and observations after playing the game

The user said it was nice to try out the game, but that she felt it complicated.

Further, the user read the instructions and questions very well, without hesitation. The user could only repeat parts of the audio instructions, but indicated to have understood the main part of it – to press the screen when giving an answer. Still, she couldn't answer whether or not the audio instructions would be useful in the game.

USER D - WOMAN

Interview summary before playing

User D entered the room in a wheel chair. She had a hearing impairment, and needed a hearing aid. The staff communicated with her through a microphone that was connected to a headphone she was wearing.

During the interviews the user occasionally needed a confirmation from the carer on her whereabouts and what situation she was put into.

The user answered she didn't have any particular interests. She could not remember to have played or enjoyed quiz board games as well. She confirmed to watch TV and listen to the radio. However, the user didn't have any interest in reading as she felt being too old. Whenever reading, she did not know if she needed any aids like glasses. The user could not confirm if she dialed the telephone on her own whenever talking to relatives.

Track-sheet information

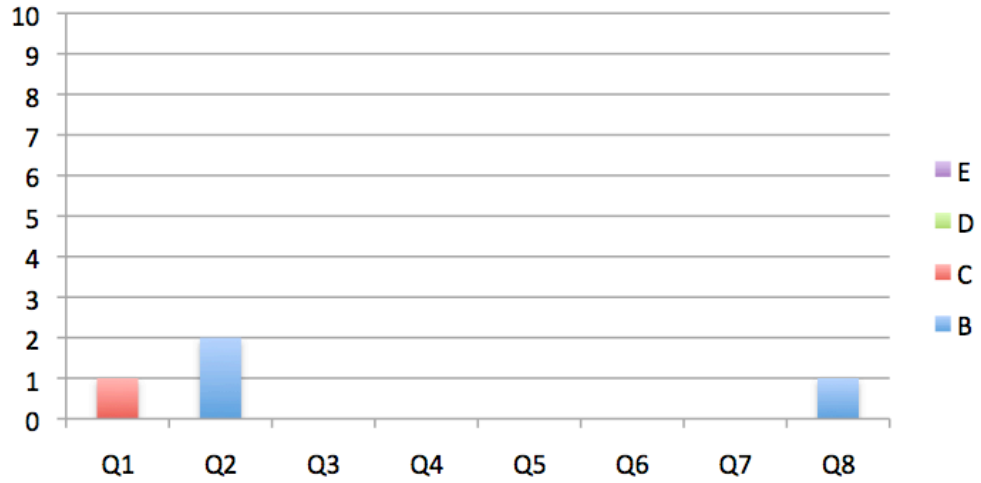

Figure 17 - The non-independent frequency describing what kind of observation and its frequency (how many times the user needed physical assistance). Questions left without any observations are considered A-observations.

Observations registered besides observation A-E:

Observations on how the user started the game and interpreted the instruction mode

The user microphone was put next to the loud speakers in the game device. There was a tiny sound coming from her hearing aid while playing. Still, she kept on playing. The user managed to start the game pressing the "Click here to begin the game" software button, when told to do so. In the first question, the user asked for a confirmation from the carer whether pushing the screen or not. While given the second question, the user indicated she didn't know the answer. The carer gave her an instruction twice to take a guess, and this made her complete the question.

Game focus

The user stayed focused on both the game and with the carer in the two first questions. After these two questions, the user focused entirely on to the game and played without giving any interventions to the carer until the last question.

Question difficulty

The user indicated that she did not know the answer to question 1, question 7 and question 8. On question 7, she proceeded while still not knowing the answer. On the other two questions, she was given help. This made her complete them as well.

Problems pressing the touch screen answering options

The user didn't have any observed problems in pressing the screen using a right press button technique. According to the data log, only one misplaced touch on the

screen was registered. This indicated that only 6% of the total screen pressures were misplaced by the user.

The interview and observations after playing the game

The user could not remember playing the game when asked about it. She could not remember touching the screen device and doing a quiz as well. She replied with a question wondering what she was participating in? Further, the user only repeated parts of the first audio instructional speech. Still, in the second approach, she repeated the instruction, as it was supposed to be understood.

The user read all the text instructions, questions and answers without hesitation as well.

USER E - WOMAN

Interview summary before playing

The user entered the room by herself, and sat down calmly at the table.

The user could not specify any particular interests, but indicated that she felt it was fun to participate in all sorts of things and considered herself to be a curious person. When she was asked about her enjoyment in playing quiz games, she didn't give an answer to it. She rather pointed out that she was no good with questions and answers.

She also watched television if there was nothing else to do. She confirmed that she had no problem switching it on or off by herself. The user did like to listen to the radio, but answered not to have listened to radio for a while. The user liked to read, and used her glasses as an aid. She did not use the telephone.

Track-sheet information

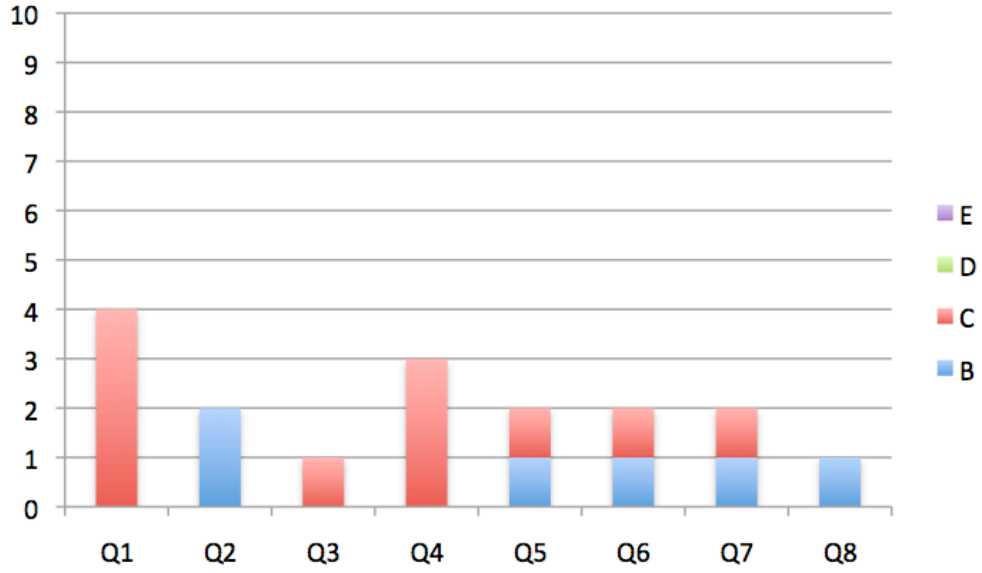

Figure 18 - The non-independent frequency describing what kind of observation and its frequency (how many times the user needed physical assistance).

Observations registered besides observation A-E:

Observations on how the user started the game and interpreted the instruction mode

The user started the game by clicking the "Click here to start the game" software button, when given three instructions by the carer. She had one intervention during the instructions, as she misunderstood the game instruction telling the user to press onto the screen answering options when a question was given. However, her perception was to press immediately at the screen. When the question&answers mode were displayed, the carer told her to press the answering options displayed on the screen.

Game focus

During the game, the user didn't lose focus on the game, even if she was given assistance several times from the carer.

Question difficulty

The user orally indicated that she had misunderstood the first question, as she thought the question was dealing with her own condition. This also happened with another user, and the question was clearly not interpreted the way it was supposed to.

To make her understand it correctly, the carer had to give several instructions. The data log also shows this was a problematic question, as the user was timed out eventually.

Problems pressing the touch screen answering options

The user had problems in two of the questions, regarded with pressing the screen answering options. This led to a higher frequency of communication between carer

and the user, especially in question 4. In this question the user struggled 3 times to press the answering option correctly on the screen. In question 5 the problem occurred once. The user was observed not using her fingertip, but rather her fingernail to do screen pressures. By using the nail, the pressure didn't get precise and hard enough to initiate the chosen option.

The data log did not register any correct screen pressures that was misplaced from the answering options. This user's problem seemed to be related to a correct screen pressure technique.

The interview and observations after playing the game

The user found the game useful, and said the game was ok to play. She pointed out there was some difficulty on knowing the correct answers to the questions. The user hesitated occasionally when reading the instructions and questions given.

In the first part of the audio test, the user didn't manage to repeat it. However, she understood the second part, by simply repeating the instructions in a way that revealed that she must have understood what was meant after all. The user felt the voice was supportive while playing as well.

3.6.2. Presentation of total results from the selected user group

The first bar chart in figure 16 presents the total independent observations per player. This indicates how independent the individual users played the reminiscence game. In example,

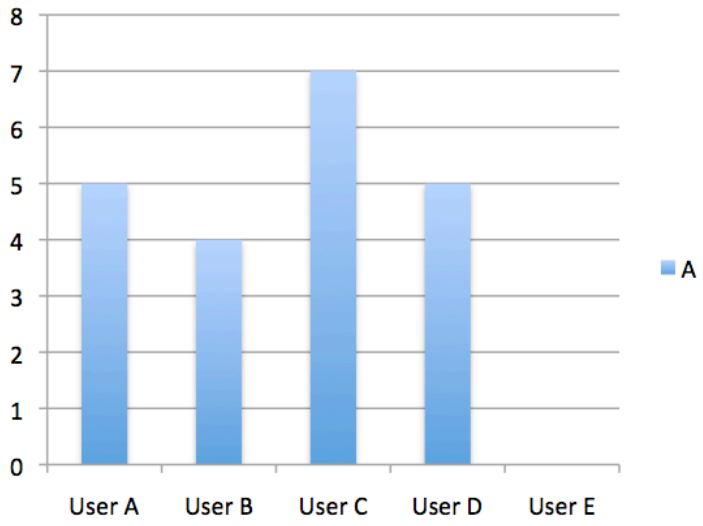

Figure 19 - The total independent playing from each user put in a chart

52,5% managed to play the game without any assistance.

The chart in figure 17 reveals an estimate of 12,2% problems considered with orally not knowing the answers or understanding the questions (B). In addition, 32,9% needed physical assistance while playing (C). Only 1,2% was not able or willing to

touch the screen while playing. (D or E observations). The results also found great problems with the questions for user E, as 21 of 24 B observations belongs to this user.

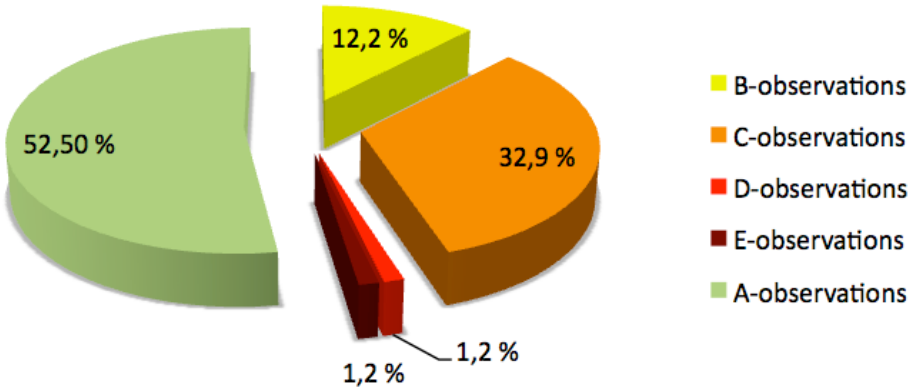

Figure 20 - Independent and non-independent observations given in percentage.

The chart in figure 18 reveal all non-independent frequency (y-axis) observations (47,5% of the questions in total) based on each question (x-axis). It reveals that the carer's assistance on how to play was reduced as the users progressed. It indicates that they were capable of learning how to play the game.

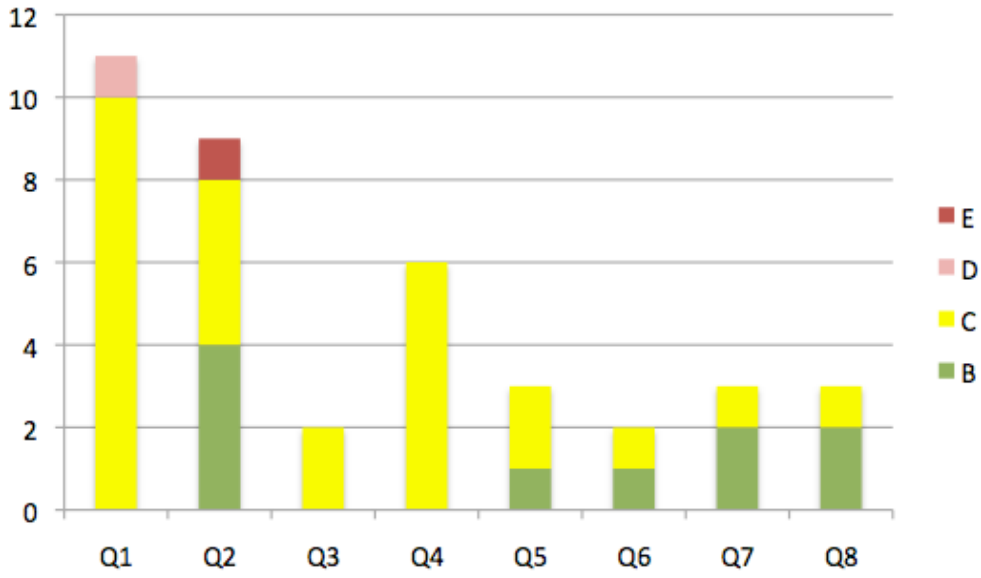

Figure 21 – A chart of non-independent chart describing the different frequency of B-C observations. D and E are only counted once per question.

The last illustration presents the data log's registered misplaced screen pressures when trying to press an answering option:

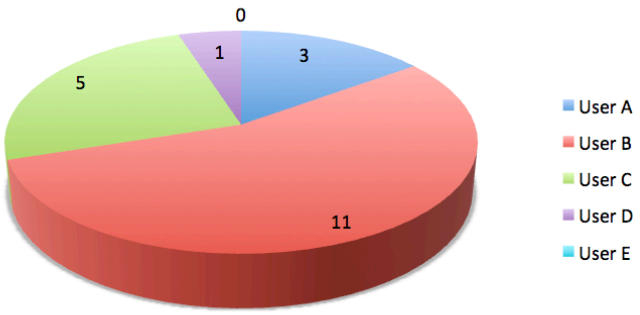

Figure 22 - Amount of misplaced screen pressures.

3.7. Selection strategy

3.7.1. Usertesting and observational study

To do a solid user testing, there was a need to get a relevant selection of elderly patients suffering with dementia. Two departments in the daycare center participated in the study. The first department was a full-time department, and the other one was a part-time solution for elderly patients that didn't live at the center.

During the presentation of the study, two nurses in charge or the carer were given orally guidelines on the desired selection needed for both the user testing and final observational study. These were the guidelines given:

1. The users should be aged 65 or older
2. The users should preferably have been diagnosed with dementia.
3. The users should be assessed to whether or not being capable of participating in the study.

A nurse and a carer at the day care center chose the final samples.

3.7.2. Expert panel

The expert mini-focus group was selected by one of the ergonomists participating, after being presented to the study and its intentions. All the three participators were working as ergonomists within elderly care.

3.8. Ethical judgements

Ethical principles and legal guidelines are both central in research. Ethical issues arise when research affects people directly. This happens especially when the research results are summarized in a data collection, either as a result of an interview or an observation. The national research ethical committee in Social Science and humaniora (NESH) has agreed on some research ethical guidelines. These guidelines especially

involve three considerations that are important when doing research: The right to self-determination and autonomy, respect to privacy and to avoid damage [52].

In this thesis the research ethical guidelines have been pointed out by:

1) Handing out an informed consent to the participators of the study to be signed upon (nurses and user). The expert mini-focus group gave an orally agreement to participate and have their data being used in this thesis.
2) During interview, all participators agreed to be tape-recorded as well, after being informed orally about the reason why this was done.

The template used to make the informed consents given to both nurses and users can be found in appendix 10.

Results from the data collection were anonymized in the research. This was also told to the patients participating, through the informed consent. As the data collection doesn't contain any confidential information as name, age or mental condition, it has not been necessary to report this to the NSD (Norwegian Social-science Dataservice) [52, page 96].

Ethical matters considering the user group have also been considered in this thesis. One of the main challenges to people suffering with dementia is regarded with reminiscence skills and the ability to possess new knowledge. Still, this reminiscence game was developed on a mobile device that may already be a user challenge. In addition, the question would require a correct answer to proceed to the next one.

This could be a dilemma to the user, as it may influence their self-esteem and dignity. Quiz games with correct and incorrect answers, could easily become a threat to the user, as they reveal their cognitive disability. By not knowing the answer, the users may feel mentally exposed.

It has been an important factor through the project, not to harm the patients, but rather respect their dignity and integrity. Technology that has been developed to answer the questions in this thesis can help persons with dementia to do something meaningful [29].

3.9. Reliability and validity

3.9.1. Reliability

In science, reliability concentrates on studied data, what data is being used, and how they are collected and processed [52].

The data collection in this thesis has been done through several methods. Interviews have been tape recorded and transcribed. Data logs and track sheet from observation studies have been prepared.

Feedback from an expert mini focus group has also been written down. In addition, a literature research table reveals the strategy for searching relevant literature to be used in this thesis. This table has been attached in appendix 13.

It's been difficult to know how to present the interviews. This has been caused by the challenge of getting usable answers out of the questions that were provided. As seen from the transcription of the interviews, many answers are misunderstood or not answered at all. This led to a decision of presenting the data as summaries from each

patient. The idea was to briefly present the participator, his interests and current technical skills.

Even if the interview was a difficult way to get a decent data collection, other methods were considered less feasible. A typical method not considered appropriate, was a quantitative or qualitative survey. In some cases a carer would eventually have to help or assist the users, and this might be reflected in their answers. As the users' integrity and dignity were highly considered, an interview was chosen as the best method to determine a user profile. This way the user could answer by himself.

As the interview method was considered complex and difficult, the additional observation study would help confirm issues in the interview. The observation study also revealed results to be used in answering the research question. The interviews revealed the complexity in the user group as well.

One of the main problems using an observational study is the probability of having observations that could be wrong interpreted. The study was not videotaped, and important parts of the observation could consequently have been left out of the results.

However, video recording was found inappropriate as it was considered a distraction to the patient. In order to reduce stress that could influence their independency, video recording was left out.

In addition the observational study was fairly new to the patients, and due to the time available, they had to adapt the situation and room environment quickly. The tape recorder used in the interviews was placed very anonymously, but it may still have had an impact on the answers. Still, the biggest barrier in the room would be myself as the interviewer. There was not much time during observation and user testing, to get to know the patients. This may also have had an impact on the final results. Especially in user testing, where the users were told to give feedback on the game.

The amount of participators in the observational study, were six persons. Still, as one of them accidently terminated the game during the observation both the data log and observations were not completed with this user. This user's results may have been different if he had been allowed to start over. By knowing this, the results of this user were rather rejected from the thesis results.

In the interview done before the observational study, some of the questions tried to reveal the users familiarity with known technical devices as TVs, radios and telephones. This approach was considered to get answers regarded with the users' skills in using technical items that would already be known to them, as well as revealing potential problems regarded with the users reading- and hearing abilities. A probable alternative would have been to ask the user to do random technical tasks with the tablet device in front of them. Still, it was considered more appropriate if the users was questioned about known things, that the users had been using or did use in their everyday lives. In addition question tasks regarded with the tablet, might have affected the users view upon the tablet, before we started the observations. Such affections might influence the user's way of playing independently, as they might be negative as the user didn't physically manage all the task questions given.

3.9.2. Validity

Validity used in science is mostly related to the selection of populations and information types. A proper question to ask in validating the research is:

Do we measure what we think we measure?

At the same time, we could also ask ourselves if a chosen method actually investigates what it's intended to do [52].

Method triangulations can help support the research validity. By collecting data using several methods, we can get a more broad and diverse material to be used in answering the research questions. Both qualitative and quantitative methods are used, in addition to different user groups as people suffering from dementia and ergonomists. This helps strengthen the results of this thesis, as different angles of the problem area are being revealed.

An additional possible way to strengthen the results in science is to let the informants or other scientists confirm the results [52]. In this thesis it would be almost impossible to check the results with the informants suffering from dementia, because of their mental condition.

However, it would have been possible to get a confirmation from the expert mini-focus group. As the final observation study had to be conducted very late in the project, it was not feasible to schedule a new meeting to see this through with either the mini-focus group or other scientists.

Could the results from this thesis be transferred to a relevant phenomenon?

Some of the results could be transferred to similar projects, as the focus has been on developing the game on user preferences. It may still be difficult to transfer results revealed from this thesis user group, to another group of participators suffering from dementia. The specific group selected for this thesis study is very complex, as it has proven to have many individual differences.

Still, more time to continue the development cycle model would have been desirable, especially to improve the game, by using the results from the independency observation and expert mini-focus group.

Despite this, the collected data have been good and on spot to answer this thesis problem area and research questions. The validity is assessed to be satisfying.

4. Discussion

This is a discussion of the results based upon the two research questions given in this thesis:

1. Can we develop an interface that demented players are physically and mentally capable of using?
2. Is the demented player capable of playing the game independently?

Nygård and Starkhammar discovered that people suffering from dementia tend to avoid technical aids if they find them to difficult to use [20].

In this prototype's user testing, several usability results regarded with the users' mental and physical capability were revealed. The prototype was developed and evaluated together with actual users, and this may have resulted in a more suitable prototype, less difficult to use.

Five different criteria were used to reveal usability issues with the interface [58].

In the user testing the participators read the text on the screen successfully and without any observed complications. This was also later confirmed in the observational study, where the users were told to read instructions or questions seen on the screen. Hagen and Bjørnebye's proposed large font sizes to be used on screens, to make it easier for visually impaired users to read the text. The minimum size should be of 12 pt. [15]. However, all the text sizes used in this reminiscence game were above this limit. The user ability to read the text may also have been caused by using a good contrast between the text colour and background colour. In the different modes, the text had been given line spacing to separate the lines from each other as well. This may also have supported the participators in reading the text successfully.

Another visual content assessed by the users, was the image shown together with each question. Because of the small screen size in the device, the suitable image size was limited. Still, there were no interventions observed regarded with the image size or understanding its content, when asking the users.

Both image and text were the visual parts of this reminiscence game's interface, and they were both found satisfying to the user's participating in this study. Still, this result may not be generalizable, as the interface was only assessed by patients without an observed strong visually impairment. This could have resulted in a different result in terms of the game's visual part.

During user testing and the observational study the chosen Norwegian speech synthesis used by the reminiscence game, was recognized by several users. Both in the user testing and observational study, two of the users interacted with the synthesis as well. They orally confirmed being ready, when the voice command asked them:"Are you ready?" One of the users also recognized the speech as a woman's voice during the game observation. In addition, a strong hearing-impaired person also repeated the speech successfully when played to her. Even when using a headphone and microphone in addition to her hearing aid.

The chosen synthesis used in the prototype was both recognizable and found supportive by some of the users in the user testing. In addition it may have been beneficial in terms of keeping focus in the game as well as support social interaction between the user and the game. The design principles found in Mäki and Topo [16]

supports social interaction, as it is important not to decrease the users ability to get in social contact.

Audio put together with visual text, made a concise and redundant solution in this reminiscence game, and such a redundant approach is confirmed suitable in the design principles found in Mäki and Topo[16].

During the observations some problems were discovered regarded with the user's interaction with the touch screen. One of the users had problems answering two of the questions, because she used an incorrect pressure onto the screen. Still, the problem was caused because of her long fingernails. The issue regarded with incorrect pressure technique, was not observed with the other participators. Everyone performed using a correct pressure on the capacity touch screen. Still, a great diversity in the users' individual performance with misplaced screen pressures was found. One of the users had more misplaced pressures than all the other ones together. This revealed the complexity of some of the physical skills among them [4]. However, in an ENABLE project using a picture gramophone, several problems with touch screen pressures were revealed. Still, most of the users in that project found the device beneficial despite the problems [26]. In this prototype, the users managed to play the game regardless of the misplaced pressures.

However, the prototype was only tested with five user test participators and five observed patients on an independency observational study. A different outcome regarded with the use of high responsive screens has been found in a pre study conducted in 2010 [46]. In future works the prototype could be tested with a resistive screen, to reveal better answers regarded with the usage of either resistive or capacity screens with people suffering from dementia. In the CIRCA project, a 20" touch screen were investigated, but the results were not considered with the type of screen technology being used [36]. Still, this study has revealed the potentials in using high responsive screens with people suffering from dementia.

In the prototype, some of the instructions, questions and answers were occasionally either not understood or misinterpreted, and may have challenged the user's mental capability in using the interface. Despite a wording evaluation conducted by an expert mini-focus group, some of the questions were still not understood during the observations. It all revealed the complexity on how to develop correct wordings to make understandable sentences for people suffering with dementia. Wording is a difficult area to be used by this user group [49] [50], and this issue should be further explored as a problem area of its own. Some wording complications were also found with the instructions given in the start of the game. Almost all of the users either tried to press onto the screen immediately or asked if they should do so, when the prototype initiated the instruction telling them how to answer the questions in the game. This proved that they interpreted the instruction as something to be done immediately.

The question problems revealed with this prototype indicates the difficulty in making information perceivable for every user, as found important in the design principles in Mäki and Topo [16].

Except from the issues dealing with understanding some of the questions, the users overall learn ability was good. The users did manage to do what they were told both in user testing and the observational study. The automated navigation may have helped to make an easy learnable interface, as it assisted the user to make him only consider the question to be answered in the game, rather than additional options as how to proceed to the next question. Hagen and Bjørnebye, points out the necessity to

let technical aids comply with the users technical skills [15]. This navigation supports the idea of making a simple and intuitive interface as found in North Carolina State University design principles [16].

During user testing and observations, the game was placed upraised in front of the user on a table. The users were sitting in front of the game. There was no bad game performance observed using this game environment. The upraised position made the users able to look straight into the screen while sitting. In the design principles found in Mäki and Topo, it is found good practise to keep important information within the field of vision [16]. In the CIRCA project however, a loss of engagement could occur if the patients sat in a wrong position [36]. This thesis results might have been affected, if the users had played the game using another position as the one used in both user testing and the observational study.

The different users' capability to play independently using the interface was observed in a structural observation. There were 40 total questions given to the users (8 per user), and 21 (52,5%) of them were performed without any help given from the carer.

The other 19 questions (47,5%) were considered with non-independent observations. By investigating them, 12,2% was observed to be either to challenging or too difficult, and 32,9% of them were observed with assistance during the game. There may be many reasons behind these results. The users' performance might have been affected by the new game scenario and all the expectations before the user were told to start playing. Patients suffering from dementia need to settle down and be given time to accomplish different tasks. Both functional ability and independency are reduced if they are exposed with stress [28].

In this game scenario, they didn't have any experience using this new mobile game. Still, Nygård and Starkhammar, discovered that both new and old technology didn't make any difference to people suffering with dementia [20].

By having the game available for some time, the independency results might have been improved. After all, results proved their learning capabilities to be increased while playing the game (figure 21).

For some users, a more manageable screen technology could also have improved the performance in terms of independency, as well as more proper wording in the game.

This thesis observational study may also have influenced the user's performance while playing, and affected the final results. In particular those users clearly indicating they did not know the answer, or those often requiring help from the carer may have felt the situation slightly confusing or embarrassing. The latter one may also be explained due to different personalities. Some persons like to be more independent than others [28].

The results discovered during this study game observation are not generalizable. Only 5 users participated in the study. Still, this is far from a homogeneous group of people, as their great diversity in mental and physical capabilities are so complex [28].

There was a clear difference between the ways the users performed independently in the game. In particular, User B struggled in the two first questions as the data log gave results regarded with misplaced touch pressure 10 times. In addition to accomplish these questions, this user needed orally or visually instructions (C) from the carer 5 times during the observation.

The first question was interpreted the wrong way by two of the participants. These users thought the misinterpretation was caused by their mental condition, even when the question asked was this:”What may dispril prevent?”

Three of the users, A, C and D played without much assistance from the carer. In particular user D, which had a strong hearing impairment, performed surprisingly well regardless of her impairment? The user also didn’t remember her playing the game when asked about it afterwards. This proves that such a game may be suitable for persons one might not expect being mentally or physically capable to perform.

The results in the data log discovered that all participants made it through the game without being 100% automatically and passively navigated by the game.

5. Conclusion

The purpose of this thesis has been to reveal whether or not elderly sufferers of dementia are able to play a reminiscence game independently on a tablet device.

This reminiscence game was developed using a strong user-centered design process with five different users suffering with dementia. In addition an expert mini focus-group with three ergonomists, participated with their knowledge.

This process revealed several usability issues regarded with the users physical and mental capabilities to play the game independently. Five different criteria were used to reveal usability issues with the interface; Visual, auditive, orientation, learn ability and environmental.

The users confirmed to read the text and see the image content on the screen during the game. The speech-synthesis used in this prototype had a social effect to the users, and may also have helped keeping focus in the game. The instructions and questions however were occasionally misunderstood by the users, and this proved the complexity of making understandable sentences for sufferers of dementia.

During the observations some problems were discovered regarded with the user's interaction with the touch screen. In this prototype, the users managed to play the game regardless of the misplaced pressures.
Still, this study has revealed the potentials in using high responsive screens with people suffering from dementia.

The users overall learn ability with using the game was good. The automated navigation may have helped to support an easy learnable interface, as it assisted the user to make him only consider the question to be answered in the game.

The game was performed by having the tablet on standing upraised on a table in front of the user. This kept the important information within the field of vision to the user, as he could see straight into the screen.

A final observational study discovered the users to have a greater potential of playing the game independently, rather than being assisted by a carer. Results also revealed the users playing more independently as they progressed in the game.

There were 40 total questions given to the users (8 per user), and 21 (52,5%) of them were performed without any help given from the carer.

12,2% was observed to be either too challenging or too difficult, and 32,9% of them were observed with carer assistance during the game.

However, the results found great individual differences among the users, when it came to play independently. This might have been caused by their great diversity in mental and physical skills.

Because of the great mental and physical differences, such a prototype may not be suitable to everyone. Still, everyone should be given a fair chance to try it out.

5.1. Future works

There are many ways this prototype could be further explored. There's a clear medical interest regarded with the data log discoveries and complexity in questions and answers given to the user during the play. An interesting point of view is to

develop a web interface to facilitate the input and storage of personalized questions and answers suitable for each user's mental capability.

These questions and answers could be downloaded into the game to better facilitate independency and possible new aspects as social and cognitive benefits between relatives, health care workers and the patient. Another approach could be to find new benefits in deploying the game in a web interface. This could make it more flexible regarded with screen size and operative systems.

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Appendix 1 – Questions used in the prototype user testing

Text put in the parantheses are only given with speech synthesis (no visual text).

Introduksjonstekster i spillets instruction mode:

1. **Hei!** Nå skal vi prøve å **spille** et spill på denne skjermen
2. I dette spillet skal du prøve **å svare på noen spørsmål**
3. Du kan svare ved **å trykke på skjermen**
4. **Nå kommer spørsmålene** du kan prøve å svare på. Er du klar?

Spørsmålene i question&answers mode:

1) Har du vondt i magen så gå til? (bilde av dispril)
(Alternativene er)
Mor
(eller)
Per i Hagen
(eller)
Carl I Hagen
(eller)
Legen
(eller)
Far

2) Hva kan dispril hjelpe mot? (bilde av dispril)
(Alternativene er)
Hodepine
(eller)
Meslinger
(eller)
Hoste
(eller)
Magesår
(eller)
Oppkast

3) Hvor mye kostet Alle Kvinner på 50-tallet? (bilde av Alle Kvinner bladet)
(Alternativene er)
40 øre
(eller)
2 kr
(eller)
10 øre

(eller)
50 øre
(eller)
5 kr

4) Hvilken skøyteløper ble kalt Hjallis? (bilde av skøyter)
(Alternativene er)
Hjalmar Andersen
(eller)
Sverre Farstad
(eller)
Knut Johannesen
(eller)
Reidar Liaklev
(eller)
Odd Lundberg

5) Hva kan denne brukes til? (bilde av hjulvisp)
(Alternativene er)
Kinne smør
(eller)
Presse saft
(eller)
Elte brøddeig
(eller)
Blande farse
(eller)
Vispe vaffelrøre

6) Hvilke av disse var ikke et tobakksmerke? (bilde av tobakk)
(Alternativene er)
Teddy
(eller)
Benny
(eller)
Hobby
(eller)
Blue Master
(eller)
Frisco

7) På hvilken dag faller alltid Kristi Himmelfartsdag? (bilde av bibel)
(Alternativene er)
Søndag
(eller)
Torsdag

(eller)
Fredag
(eller)
Onsdag
(eller)
Mandag

8) Hvor lenge før påske er faste? (bilde av bibel)
(Alternativene er)
1 dag
(eller)
7 uker
(eller)
1 måned
(eller)
2 uker
(eller)
5 måneder

Repetisjon av spørsmål (etter 1 minutt)
(Nå skal jeg lese spørsmålene og svarene på nytt for deg) + spørsmål og svar

Tilbakemelding i spillet dersom brukeren avgir et svar

Ved riktig svar:
RIKTIG! Du svarte: Her står riktig svar uthevet
Vær klar! Nå kommer snart neste spørsmål.

Ved feil svar:
Prøv en gang til.

Tilbakemelding i spillet, dersom spilleren ikke avgir svar på et spørsmål (etter 2 min):
Nå går vi videre til neste spørsmål. Er du klar?

Slutt-tekst når spillet er ferdig:

Gratulerer! Du er i mål!

Ved feiltrykk på skjermen
(Prøv å trykke på svaret)

Appendix 2 – Codes

All codes are available on attached zip file to this thesis. The most important codes have been put in this appendix.

The code and comments to initiate the instructions mode in the game:

```
package com.hig.quiz;

/*
 * GENERAL INFORMATION
 * This code is used for the instructions and corresponding audio narrations using a Text-To-Speech
engine.
 * The engine being used for this game is downloaded together with a norwegian language package from
Android Market from
 * the software developer SVOX. This should be downloaded to the device in advance. When first
deployed, a pop-up
 * window in the game asks for the engine to be used. You should select the SVOX engine for this
purpose. Along with this,
 * the game needs to be adjusted manually in the engine outside the game, by simply clicking its icon
in Android. It should be
 * setup with norwegian language in this configuration. A text instruction is switched to the next
one, whenever its corresponding phonetic
 * text string is successfully spoken by the TTS. This is done by using an utterance listener. Every
time a sentence is finishe spoken,
 * a sentence, the listener change to a new id that identifies the new utterance/sentence to be
spoken. When this shift is happening the
 * text instruction is changed in the display as well. This way both text and audio is simultaniosly
displayed/heard.
 *
 * CODE BEING EXPLAINED BELOW
 *
 *
 */

import java.util.ArrayList;
import java.util.HashMap;
import android.app.Activity;
import android.content.Context;
import android.content.Intent;
import android.media.AudioManager;
import android.os.Bundle;
import android.os.Handler;
import android.speech.tts.TextToSpeech;
import android.speech.tts.TextToSpeech.OnInitListener;
import android.speech.tts.TextToSpeech.OnUtteranceCompletedListener;
import android.text.Html;
import android.widget.TextView;
import android.widget.Toast;

public class ProgramQuiz extends Activity implements OnUtteranceCompletedListener, OnInitListener {
  /** Called when the activity is first created. */
  private static final String TAG = "QuizProgram";
  // ui components
  public TextView introduction;
  //
  private String type = "";
  private int questNmb = 3;
  // default configurations to the feedback and question mode - (how long it
  // should be displayed)
  private int timeoutMin = 2;
  private int timeoutSec = 0;
  private int instructTimMin = 0;
  private int instructTimSec = 20;
  private int assistMin = 1;
  private int assistSec = 0;
  private boolean ex = false;
```

```
	private boolean stopped = false;
	private Intent intent;
	// TTS related ones
	private static final int REQ_TTS_STATUS_CHECK = 0;
	private int uttCount = 0;
	private int sen = 0;
	private int lastUtterance = -1;
	private HashMap<String, String> params = new HashMap<String, String>();
	private ArrayList<String> tts_instructArr;
	private ArrayList<String> view_instructArr;
	private TextToSpeech mTts;
	private boolean qu = false;
		// instructions as found them suitable using developed audio test-software:
		private String instructFeedback_start = "Velkommen til litt hjernetrim!";
		private String instructFeedback_start_phonetic = "Velkommen - til litt hjærne-trim!";
		private String instructFeedback_startContinued = "I dette spillet skal du<br />svare på
spørsmål ved å trykke på skjermen.";
		private String instructFeedback_startContinued_phonetic = "I dette spillet - skal du svare -
på spørsmål - ved å trykke på skjermen.";
		private String instructFeedback_finished = "Er du klar?";
		private String instructFeedback_finished_phonetic = "Er du klar?";
		// AudioManager to make sound available in the device
		private AudioManager am = null;
		private String audio = "";
		private float rate = 1;
		final Handler mHandler = new Handler();
		private int id;
		     // instance of class reading through configuration file regarding amount of
		// questions, feedback and question mode time:
		private ReadConfig rc;
		private ArrayList<String> arrVals;

		@Override
		public void onCreate(Bundle savedInstanceState) {
		  super.onCreate(savedInstanceState);
		  // set view based upon layout setup in programqu xml file
		  setContentView(R.layout.programqu);
		  // make audio available
		  am = (AudioManager) getSystemService(Context.AUDIO_SERVICE);
		  arrVals = new ArrayList<String>();
		  introduction = (TextView) findViewById(R.id.TextViewIntro);
		  tts_instructArr = new ArrayList<String>();
		  view_instructArr = new ArrayList<String>();
		  // add instructions to the arrays
		  view_instructArr.add(instructFeedback_start);
		  view_instructArr.add(instructFeedback_startContinued);
		  view_instructArr.add(instructFeedback_finished);
		  tts_instructArr.add(instructFeedback_start_phonetic);
		  tts_instructArr.add(instructFeedback_startContinued_phonetic);
	    tts_instructArr.add(instructFeedback_finished_phonetic);
	    // make the user select a TTS engine at first time opening the game
	    Intent checkIntent = new Intent();
	    checkIntent.setAction(TextToSpeech.Engine.ACTION_CHECK_TTS_DATA);
	    startActivityForResult(checkIntent, REQ_TTS_STATUS_CHECK);
	    // run the method checkConfigurations() to look into stored .txt file
	    // for time details (how many minutes or seconds) regarding how long
	    // the feedback should be displayed before navigating to question //mode
	    // or a final results mode (finished).
	    checkConfigurations();
	  }
	  public void checkConfigurations() {
	    // get an instance of the class ReadConfig - see ReadConfig file
	    rc = new ReadConfig();
	    // check for a .txt file stored on the device
	    boolean f = rc.getFile();
	    if (f == true) {
	      // if f is true there are some values in the stored .txt file
	      // regarded with time and how many questions to be
```

```
   // asked during the game (also possible to be set in the config
   // panel in the game)
   arrVals = rc.retValues();
   // set parameters to instance variables:
   if (arrVals.size() > 0) {
     // type discovers what game to start. Type = 1 starts up the
// quiz. Other numbers could deploy another game (further
// explorations)
type = arrVals.get(0).trim();
// should the game start up with audio or not? Found in this
// value
audio = arrVals.get(1).trim();
// if not possible to do any of the try/catch underneath - start
// collecting errors in int
int error = 0;
try {
  // this option was not regarded with the thesis, and is left
             // for further explorations. It's
             // intention was to set the voice with different voice
             // rates.
             // This is left for further or more complex audio analysis
             // to say something about appropriate voice output regarded
             // with people
             // suffering with dementia. The audio part was not
             // considered that complex in this thesis.
             rate = Float.parseFloat(arrVals.get(2).trim());

             } catch (NumberFormatException e) {
                   error++;
           }
           try {
             // set the value saying how many questions to be asked
             // during the game:
             int p = Integer.parseInt(arrVals.get(3).trim());
             questNmb = Integer.parseInt(arrVals.get(3).trim());

            } catch (NumberFormatException e) {
              error++;
            }
            try {
              // set the value saying how many minutes each question
              // should be left unanswered before a timeout
              // is given to the user.
              timeoutMin = Integer.parseInt(arrVals.get(4).trim());
            } catch (NumberFormatException e) {
               error++;
            }
            try {
              // set the value saying how many seconds each question
              // should be left unanswered before a timeout
              // is given to the user.
              timeoutSec = Integer.parseInt(arrVals.get(5).trim());
             } catch (NumberFormatException e) {
         error++;
       }
       try {
         // set the value saying how many minutes the feedback mode
         // should be displayed to the user.
         instructTimMin = Integer.parseInt(arrVals.get(6).trim());
       } catch (NumberFormatException e) {
          error++;
       }
       try {
         // set the value saying how many seconds the feedback mode
         // should be displayed to the user.
         instructTimSec = Integer.parseInt(arrVals.get(7).trim());
       } catch (NumberFormatException e) {
          error++;
```

```
}
try {
  // set the value saying how many minutes before an audio
  // repetition of the question should be given .
  assistMin = Integer.parseInt(arrVals.get(8).trim());
 } catch (NumberFormatException e) {
    error++;
  }
  try {
     // set the value saying how many seconds before an audio
     // repetition of the question should be given .
      assistSec = Integer.parseInt(arrVals.get(9).trim());
    }
    catch (NumberFormatException nr) {
      error++;
     }
     if (error == 0) {
       // if no errors discovered - make sure all the values are
       // set. This method can be called upon to
       // double check this..
       setValuesExist(true);
                   }
                 }
                 else {
                 }
               }
               else {
               }
               // this method starts setting up the necessary parts for the
               // introductional instructions and simultanious audio.
               setActivityConfigAdjustments();
              }
              public void setActivityConfigAdjustments() {
                // the method adjust settings regarded with the values found in the .txt
                // file found in the checkConfigurations() method
                // first - check if they were all successfully downloaded. If not, the
                // program uses the default ones set on the top of this code..
                if (getValuesExist() == true) {
                  // adjusting sound volume
                  if (audio.equals("off")) {
                    am.setStreamVolume(am.STREAM_MUSIC, 0, 1);
                    am.adjustVolume(am.ADJUST_LOWER, 1);
                  }
                  if (audio.equals("on")) {
                    am.setStreamVolume(am.STREAM_MUSIC,
                    am.getStreamMaxVolume(am.STREAM_MUSIC), 1);
                    am.adjustVolume(am.ADJUST_RAISE, 1);
                   }
                   // not successfully interpreted yet, and left out for this thesis..
                   if (rate != 1) {
                      if (mTts != null) {
                        boolean r = false;
                        if (rate <= 2) {
                           int rt = mTts.SUCCESS;
                           int rtNo = mTts.ERROR;
                           float k = mTts.setSpeechRate(rate);

              }
            }
          }
        }
              else {
            // default values are set..
        }
       }
       public void setValuesExist(boolean ex) {
         this.ex = ex;
       }
```

```
                public boolean getValuesExist() {
                  return ex;
                 }
                 final Runnable mUpdateResults = new Runnable() {
                   public void run() {
                      updateResultsInUi();
                    }
                 };
                 private void updateResultsInUi() {
                   setSentences(tts_instructArr, getSent());
                 }
                 private void setStopped(boolean t) {
                  if (t == true) {
                    mHandler.removeCallbacks(mUpdateResults);
                  }
                }
                private boolean getStopped() {
                 return stopped;
                }
                protected void onActivityResult(int requestCode, int resultCode, Intent data) {
                // method as set in the onCreate method at the top to determine if the
                // user needs to check for what
                // TTS-engine installed on the device. The code also discovers problems
                // regarded with bad audio data
            if (requestCode == REQ_TTS_STATUS_CHECK) {

                        switch (resultCode) {

                          case TextToSpeech.Engine.CHECK_VOICE_DATA_PASS:
                            // if the voice data pass through successfully - make an
                            // instance of the TextToSpeech class in Android.
                            mTts = new TextToSpeech(this, this);
                              break;
                          case TextToSpeech.Engine.CHECK_VOICE_DATA_BAD_DATA:
                            break;
                          case TextToSpeech.Engine.CHECK_VOICE_DATA_MISSING_DATA:
                            // output error message in display if missing data to do the
                            // audio
                            Toast.makeText(this, "Missing data..", Toast.LENGTH_LONG)
                            show();
                            break;
                           case TextToSpeech.Engine.CHECK_VOICE_DATA_MISSING_VOLUME:
                             // missing data - install it - set a default error message..
                              introduction.setText("Error! Need language to function properly: "
+ resultCode);

                              Intent installIntent = new Intent();
                              installIntent.setAction(TextToSpeech.Engine.ACTION_INSTALL_TTS_DAT
                    A);
                              startActivity(installIntent);
                              break;
                            case TextToSpeech.Engine.CHECK_VOICE_DATA_FAIL:
                            default:
                              // display default failure message if any error with the audio:
                              Toast.makeText(this, "Voice DATA fail..", Toast.LENGTH_LONG)
                                show();

                          }
                        }
                      }

            // this method displays a new text instruction after the TTS completes
            // processing the sentence
            // currently displayed..
            public void setSentences(ArrayList<String> sentence, int index) {
              if (getSent() < sentence.size()) {
                introduction.setText("");
                try {
```

```
 // using Html.fromHtml to be able to format the instruction:
 introduction.setText(Html.fromHtml(view_instructArr.get(index)));
  // an utterance id is set to keep track of what utterance being
  // processed at the current moment
  params.put(TextToSpeech.Engine.KEY_PARAM_UTTERANCE_ID,
  String.valueOf(uttCount++));
  // making a two second silence before the TTS speaks the text
  // instruction given
  mTts.playSilence(2000, TextToSpeech.QUEUE_ADD, null);
  // the actual text instruction (sentence.get(index)) to be
  // spoken by the TTS system
   mTts.speak(sentence.get(index), TextToSpeech.QUEUE_ADD, params);

 }
      catch (Exception e) {
  }
}
     else {
  try {
    // not part of the thesis code, but a further project to be able
    // to tell the system to deploy other games,
    // than the quiz. A medical game ("med") is another one, and
    // would set of a different game after instructions.
    if (!type.equals("")) {
       if (type.equals("med")) {
         intent = new Intent(this.getApplicationContext(),
         DementiaQuiz.class);
       }


                  else {
                    // the quiz is fired of and an activity with the
                    // additional configuration values found in the
                    // method checkConfigurations() are put in an intent
                    setRunQuiz(true);
                    intent = new Intent(this.getApplicationContext(), Quiz.class);
                    intent.putExtra("type", type);
                    intent.putExtra("audio", audio);
                    intent.putExtra("rate", rate);
                    intent.putExtra("questNmb", questNmb);
                    intent.putExtra("timeoutMin", timeoutMin);
                    intent.putExtra("timeoutSec", timeoutSec);
                    intent.putExtra("instructTimMin", instructTimMin);
                    intent.putExtra("instructTimSec", instructTimSec);
                    intent.putExtra("assistMin", assistMin);
                    intent.putExtra("assistSec", assistSec);
                   }
                 }
                 else {
                   // default time and question amount values are being sent in
                   // the intent as no configuration .txt file were found:
                   setRunQuiz(true);
                   intent = new Intent(this.getApplicationContext(),Quiz.class);
                   intent.putExtra("type", type);
                   intent.putExtra("audio", audio);
                   intent.putExtra("rate", rate);
                   intent.putExtra("questNmb", questNmb);
                   intent.putExtra("timeoutMin", timeoutMin);
                   intent.putExtra("timeoutSec", timeoutSec);
                   intent.putExtra("instructTimMin", instructTimMin);
                   intent.putExtra("instructTimSec", instructTimSec);
                   intent.putExtra("assistMin", assistMin);
                   intent.putExtra("assistSec", assistSec);
                  }
                  // starts the activity (the quiz begins)
       startActivity(intent);
      }
      catch (Exception e) {
```

```
    }
  }
}
public void setRunQuiz(boolean t) {
  this.qu = t;
}
public boolean getRunQuiz() {
  return qu;
 }
public void setSent(int i) {
  this.sen = this.sen + i;
}
public int getSent() {
  return sen;
}
public void onInit(int status) {
  if (status == TextToSpeech.SUCCESS) {
    // if the TTS is successfully installed and initiated - a listener
    // to keep track of what
    // string sentence being processed currently is initiated
    mTts.setOnUtteranceCompletedListener(this);
    // start up with the instruction and audio:
    setSentences(tts_instructArr, getSent());
        }
 }
// this method keeps track of what instruction string is currently being
// processed. This way a new text
// instruction are automatically displayed whenever the TTS engine finishes
// "speaking" the sentence. By changing
// to a new text-instruction every time the id changes in this listener, the
// text and audio could be simultaniously
// displayed/heard on the screen:

              public void onUtteranceCompleted(String uttId) {
                lastUtterance = Integer.parseInt(uttId);
                if (lastUtterance >= 0) {
                  try {
                    setSent(1);
                    mHandler.post(mUpdateResults);
                  }
                  catch (Exception e) {
                  }
                }
              }
              // methods to be run if the game is paused or closed/destroyed
              @Override
              public void onPause() {
                // if we're loosing focus, stop talking
                if (mTts != null) {
                  mTts.stop();
                }
                super.onPause();

              }
             @Override
             public void onDestroy() {
                // try to stop TTS speaking if the user leaves the game in the
                // middle of the instructions/feedback/questions...:
                if (mTts != null) {
                  mTts.stop();
                  // TTS are also shut down - common practice when using TTS in
                  // Android
                  mTts.shutdown();
                 }
               super.onDestroy();
             }
```

```
    @Override
    public void onUserLeaveHint() {
      // try to stop TTS speaking if the user leaves the game in the middle of
      // the instructions/feedback/questions...:
      setStopped(true);
      if (mTts != null) {
      mTts.stop();
    }
    super.onUserLeaveHint();
  }
}
```

The code and comments to initiate the question mode:
Part of method code in quiz.class considered with displaying the question mode and make the speech engine speak the question and answer options given:

```
    public void processAr(int k, TextView q, RadioButton a1, RadioButton a2,RadioButton a3, RadioButton
a4, RadioButton a5) {

    [.. code left out as not part of thesis ..]

      else {

        // display and hide components to make the question mode appear (hides different modes by using
get
        // and setVisibility parameters.)

         if(questionLayout.getVisibility()==8) {
          questionLayout.setVisibility(0);
        }
        if(instrLayout.getVisibility()==0) {
          instrLayout.setVisibility(8);
        }
        […. code left out as not part of thesis ..]

        //display the image
        im.setVisibility(0);
        //if the feedback mode is on, then hide it
        if(textViewInstruct.getVisibility()==0) {
          textViewInstruct.setVisibility(8);
        }

        // getRunAgain() checks if user needs to get same question again. If same question given again
        // because he didn't answer correctly, then start the timer from were it was paused
        // when pressing the incorrect answer option. (A total of two minutes per question is given)
        if(getRunAgain()==false) {
                          // new question resets the minutes and seconds in the timer.
          minutes = 0;
          second = 0;
        }
        else {
          // timer continues from where it stopped whenever the user answers incorrectly. (When minutes
and
          //second variable
          // hits two minutes (2:00), the timeout mode is initiated)
          minutes = getMinute();
          second = getSecond();
        }

        // displays answering option components (radio buttons) if they are hidden in the display to set
of
        //the entire question mode
        if (getAr() != null && fd.getCount() > 0) {
          if(rButtonGroup.getVisibility()==8 || rButtonGroup.getVisibility()==4) {
```

```
            rButtonGroup.setVisibility(0);


          }

          len = fd.getCount();

        }
        else {
         // no questions..
        }
          // the following part puts out the questions, image and answer options as well as makes the TTS
          //engine speak:

        if (len > 0) {
          try {
          // timer starts running for the question currently displaying
          startTimer(true);
          String quest = (String) getAr().get(0).get(p);
           try {
            if(mTts1!=null) {
              // if the TTS speaks //unexpectedly then make it //stop to be able to process the question
         // currently displaying
         mTts1.stop();
            }

            if(getReady()==true && mTts1.isSpeaking()==false) {
              // if repetition of questions and answers needed //and TTS not currently speaking then
start                 //"speak" a 3 second silence

                      mTts1.playSilence(3000, TextToSpeech.QUEUE_FLUSH, null);
                      // set of method to explain to the user there will // be a repetition of the
                      //questions
                  setSpeach("Nå skal jeg - lese spørsmålene - og svarene - på nytt for deg. Er du
klar?");
                  // speak the question and answering options
                  mTts1.speak(quest, TextToSpeech.QUEUE_ADD, null);
                  setSpeach(quest);

                  mTts1.playSilence(2000, TextToSpeech.QUEUE_ADD, null);

                  mTts1.speak(" Du kan svare, ", TextToSpeech.QUEUE_ADD, null);
                  setSpeach(" Du kan svarer, ");
                }
                else {

                    }
              }
              catch(Exception e) {

                   }

                   String imageUrl = "";

              String correct = "";

              imageUrl = (String) getAr().get(1).get(p);
                // what is the correct answer among the five answer options?
              int riktig = Integer.parseInt((String) getAr().get(7).get(p));

              // set answer text to the different radio buttons
              try {
                // check if the answer value is there..
                if (!getAr().get(2).get(p).equals("null")) {
                // check if user isn't sent back to the same question again
                          if(getRunAgain()==false) {
                          // display the radiobutton
```

```
                        a1.setVisibility(0);
                }

                // set an answer text to the radio button:
                a1.setText(" "+(String) getAr().get(2).get(p));
                if(getReady()==true && mTts1.isSpeaking()==false && rButtonAnsw1.getVisibility()==0 )
{
                  // make the TTS speak this answer option

                        setSpeach((String) getAr().get(2).get(p)+"?");

                        mTts1.speak((String) getAr().get(2).get(p)+"?", TextToSpeech.QUEUE_ADD, null);
                }
              }
                   else {
                // remove this radiobutton if it was pressed and contained an //incorrect answer  Only
                to happen if question
                // run over again...
                a1.setVisibility(4);
              }
                 }
                 catch (NullPointerException s) {
              // if no value found - remove this radiobutton
              a1.setVisibility(4);
                 }

    /*
    * Same process goes for the other radio buttons a2, a3, a4 and a5 as commented for the a1 above
    *
    **/
    }
```

The code running a timer with minutes and second parameters, to keep track of what mode to be displayed:

```
    // The timer for this quiz that is constantly running. The seconds and minutes parameters are
constantly
    // reset or tracked to be used for different purposes through navigation and time spent per question.
In the code below the seconds and minutes parameters are constantly increasing before some other code
resets them again to 0. Two examples show the ability to use the timer parameters  with the time values
stored in the configuration panel by a user.

    private Runnable mUpdateTimeTask = new Runnable() {
      public void run() {
        // uses the device system clock

        long millis = SystemClock.uptimeMillis();

        int seconding = (int) (millis / 1000);
        seconding = seconding % 60;

        [ ..more code.. ]
        // seconds and minutes being counted in a runnable method to get seconds from system
        //clock and use them with the minutes and second parameters. Default they start at
0.
        if (second == 59) {
          minutes++;
          second = 0;
        }
        else {
          second++;
        }
    // check if parameter Boolean is true in getInstrBox(bool b). If true – the feedback
mode //should be displayed to the user
    if(getInstrBox()==true) {
      // validate configuration panel values set by user. If minutes or second passes the feedback mode
time
```

```
  //limit, then hide feedback mode again and display question mode again:
  if(minutes>=tidInsSetMin && second>tidInsSetSec) {
    tidInsSetSec = getS();
    second=0;
    [ not considered with thesis  ]
  else {
    try {
      if (mTts1 !=null) {
        mTts1.stop();
      }
      instrBox(false);
      if(getRunAgain()==true) {
        // set the iterator -1 to put up the same question again if getRunAgain is set true..
        setIterator(-1);
      }


      processAr(getIterator(), textViewQuestions,rButtonAnsw1, rButtonAnsw2, rButtonAnsw3,
rButtonAnsw4, rButtonAnsw5);
     // make it right again with the iterator - add one to be on track if user answers correctly
              setIterator(1);
              } catch (Exception e) {

              }
            }

          }
         }

        // whenever minutes and second parameters currently running equals configuration values set
             //by user in configuration .txt file stored at the device,
        // then fire of a repetition of the questions and answers displaying the question mode

            if(minutes==tidAssSetMin && second==tidAssSetSec && mTts1.isSpeaking()==false) {
         [ .. more code ..]

            // (default 2 minutes before time out of the question).
       if(minutes==timeoutMin && second==timeoutSec && mTts1.isSpeaking()==false) {
         [ .. more code ..]



            // timer goes in seconds
       mHandler.postDelayed(this, 1000);
              }
     };

// a method to start or stop the timer using a Boolean parameter as input
public void startTimer(boolean b) {
  if(b==true) {
    if (mStartTime == 0L) {
      Log.d(TAG,"Started the timer");
      mStartTime = System.currentTimeMillis();
      mHandler.removeCallbacks(mUpdateTimeTask);
      mHandler.postDelayed(mUpdateTimeTask, 100);
    }
   }
   if(b==false) {
     Log.d(TAG,"Stopped the timer");
     mHandler.removeCallbacks(mUpdateTimeTask);
    }
   }

  [ ..more code.. ]
```

The code for registering the touch on touch screen that were misplaced:

// method to capture all successful touch on screen that are not pressed within the answering area (radiobuttons //with answers) the data found, are kept for the datalog.

```
@Override
public boolean onTouchEvent(MotionEvent event) {
   int action = event.getAction();
     if (action == MotionEvent.ACTION_DOWN ) {
      if(getInstrBox()==false) {
        // find x-pos on screen
        int x = (int) event.getX();
        // find y-pos on screen
        int y= (int) event.getY();
        String xvl = Integer.toString(x);
        String yvl = Integer.toString(y);
        // Coordinates parsed to string variable
        String coor = xvl+","+yvl;

        [.. code not used for this thesis ..]

        // arrays to hold values the coordinates for the answering options
        int[] k = new int[2];
        int[] l = new int[2];
        int[] m = new int[2];
        int[] n = new int[2];
        int[] o = new int[2];


        int radius = 0;
        // puts the different radiobuttons position on the screen into a given int array
        if(rButtonAnsw1.getVisibility()==0) {
          // the five radio buttons with answering options:
          rButtonAnsw1.getLocationOnScreen(k);
     rButtonAnsw2.getLocationOnScreen(l);
          rButtonAnsw3.getLocationOnScreen(m);
          rButtonAnsw4.getLocationOnScreen(n);
          rButtonAnsw5.getLocationOnScreen(o);
     radius = rButtonAnsw1.getHeight()/2;
        }
       else {
         [.. code not used for this thesis ..]
        }

       // discovers whether or whether not the pressure on screen is inside or outside //answering
       //options
       boolean t = true;
       if(x>(a[0]-radius)&&x<(a[0]+radius)&&y<(a[1]+radius)&&y>(a[1]-radius)) {
         // inside answering button 1 area. Boolean value t should be false, because this pressure
         //should not be registered. It is after all on target.
         t=false;
       }
       if(x>(b[0]-radius)&&x<(b[0]+radius)&&y<(b[1]+radius)&&y>(b[1]-radius)) {
         // inside answering button 2 area. Boolean value t should be false, because this pressure
         //should not be registered. It is after all on target.
         t=false;
       }
       if(x>(c[0]-radius)&&x<(c[0]+radius)&&y<(c[1]+radius)&&y>(c[1]-radius)) {
         // inside answering button 3 area. Boolean value t should be false, because this pressure
         //should not be registered. It is after all on target.
         t=false;
       }
       if(x>(d[0]-radius)&&x<(d[0]+radius)&&y<(d[1]+radius)&&y>(d[1]-radius)) {
     // inside answering button 4 area. Boolean value t should be false, because this pressure
        //should not be registered. It is after all on target.
         t=false;
```

```
    }
    if(x>(e[0]-radius)&&x<(e[0]+radius)&&y<(e[1]+radius)&&y>(e[1]-radius)) {
      // inside answering button 5 area. Boolean value t should be false, because this pressure
     //should not be registered. It is after all on target.
  t=false;
    }
    if(t==true) {
      // here all misplaced x,y coordinates are set
      counts++;
      xyVals.add(coor);
      // if the user does a wrong pressure, make TTS process a sentence to tell the user
      //he has misplaced his finger-tip pressure from the answering options..

 String ansPhon="Prøv å trykke på svaret.";
 // do a two second pause afterwards (2000 = milliseconds)..
      speak(ansPhon,2000);
     }
   }
 }
 else
   return super.onTouchEvent(event);

return true;
}
```

The rest of the prototype game code can be found in additional zip file attached with this thesis:

Appendix 3 – User testing field notes

First evaluation in DCM

Discoveries in GUI Testing

Audio

Could you hear the voice loud and clearly?

1. participant → loud, not so clearly
2. participant → heard the voice, and confirmed whenever the voice told the user to get ready.
3. participant → heard the voice, and confirmed whenever the voice told the user to get ready.

Would you prefer the audio rather than shut it off?

1. participant → yes, I'd prefer it be switched on
2. participant → yes (nod)
3. participant → yes

Image size

Can you see the content in the image on the screen (presenting image)?

1. participant → yes
2. participant → yes
3. participant → yes

Text size

Is it easy to read the text in the game?

1. participant → yes
2. participant → yes
3. participant → no answer – observation: didn't pay to much attention on the visual parts on screen. Did try to answer whenever speech was finished. This may indicate that the participant had some eye contact on the screen.

Some questions turned out to be somewhat unclear and hard to understand. Should be investigated by someone with experience on the field. Especially wording.

Answer options

1. participant → found the option to be pressed without any assistance. Had almost no problems pressing the radiobuttons.
2. participant → Managed to start answering on the radiobuttons without any help. Did great on tapping the screen (carer told he was a pianist). Had some difficulties with some of the questions.

3. participant → Had difficulties touching the answer correctly with the finger. Did not use the fingertip as supposed to. Better off with a stylus pen? (to be checked out for next session).

Tapping the screen on-spot, but no onclick triggered should set of an assist : "please try again - I didn't register your answer".

Instructions

The instructions should also log coordinates, as some user thought they could do some tap here... Alternatively, it should be observed in later user testing.

Feedback on wrong question: "Det var nære" should be replaced as it doesn't always indicate that you are very close to the correct answer.

Repeated instructions should not interfere if the user already being spoken to by the system.

Start instructions should instruct the user to use his finger-tip.

Time

Somewhat long time to wait for next question when telling the user "we'll proceed to the next question."

Others

Background light should stay on in med questions quiz

Quiz should be adjusted on categories to be better suited for man/woman and interests. Might keep a better engagement. To be investigated in future works?

The observational study should also cover how well the user understands the question being asked. Some control question should be asked somewhat after the question has been read to the user regarding hearing and reading abilities.

How to resume in the game if pressing HOME button or BACK button (can we trigger the back button to not being invoked?) Not an easy task... A stylus pen might help the user not touching the device and trigger off unwanted hardware buttons.

Percepted user capabilities (physically/mentally) of the users in this testing:

1. participant → relative clear minded and with no big orientation problems

2. participant → slow movements and reaction, but clear mind and no big orientation problems on screen

device.

3. participant → slow movements and reaction, but able to answer, yet still not sure understanding the question.

Follow up questions inside the quiz?

Engagement is observed to be very high when the users are actually using the game. The elderly seem to "go back" to their natural state when they are finished using it.

Second evaluation in DCM

Is the speech you did hear from the game loud enough?

USER 1: yes
USER 2: yes

Do you understand what the speech prompts are telling you?

USER 1: yes
USER 2: yes

Is it easy to read the text on the screen?

USER 1: yes
USER 2: yes

Do you find the text easy to understand (questions and instructions)?

USER 1: yes, but some questions we can't relate to? Norsk ukeblad instead of 'Alle kvinner', and 'Globoid' rather than 'Dispril'.
USER 2: yes, but some of the questions we can't relate to. How to move on if we do not know the answer..? The user tried to press his finger on the image rather than the answer options (Question: Who was the person called Hjallis?)

Do you think the game moves on to fast?

USER 1: No, it should move even faster (especially with the instructions given)
USER 2: No, it should move even faster (especially with the instructions given)

How did you like using the stylus-pen?

USER 1: No, this don't work for me. Maybe a bigger size pencil would be better
USER 2: Yes, but user couldn't press hard enough. Was told 'press the correct answer' many times

Other field notes and observations:
- Nurse pointed out the need for a bigger screen as it could relate more to the ordinary television they use a lot...

- User number 2 had a mobile phone, and was interested in technology
- User number 1 had no interest in using such a game. She would rather knit in her spare time..
- What about an option, "I do not know this answer, please proceed"
- Problems in taping the screen. USER 1 had to long fingernails, and problems using the pen as well (did not press the touch screen hard enough)
USER 2 tried to press the correct answer, but had problems hiting the correct answer.

- USER 1 thought the questions were too easy.
- Need to define whether the user likes quiz games or not.

Appendix 4 – Questions used in the observational study

Text put in the parantheses are the instructions only given with audio (speech synthesis - no visual text).

Introduksjonstekster i instruction mode:

1. Velkommen til hjernetrim!
2. I dette spillet skal du prøve å svare på spørsmål ved å trykke på skjermen
3. Er du klar?

Spørsmålene i question&answers mode:

1)Hva kan dispril hjelpe mot? (bilde av dispril)
(Alternativene er)
Hodepine
(eller)
Meslinger
(eller)
Hoste
(eller)
Magesår
(eller)
Oppkast

2) Hvor mye kostet Alle Kvinner på 50-tallet? (bilde av Alle Kvinner bladet)
(Alternativene er)
40 øre
(eller)
2 kr
(eller)
10 øre
(eller)
50 øre
(eller)
5 kr

3) Hvilken skøyteløper ble kalt Hjallis? (bilde av skøyter)
(Alternativene er)
Hjalmar Andersen
(eller)
Sverre Farstad
(eller)
Knut Johannesen
(eller)
Reidar Liaklev
(eller)

Odd Lundberg

4) Hva kan denne brukes til? (bilde av hjulvisp)
(Alternativene er)
Kinne smør
(eller)
Presse saft
(eller)
Elte brøddeig
(eller)
Blande farse
(eller)
Vispe vaffelrøre

5) Hvilke av disse var ikke et tobakksmerke? (bilde av tobakk)
(Alternativene er)
Teddy
(eller)
Benny
(eller)
Hobby
(eller)
Blue Master
(eller)
Frisco

7) På hvilken dag faller alltid Kristi Himmelfartsdag? (bilde av bibel)
(Alternativene er)
Søndag
(eller)
Torsdag
(eller)
Fredag
(eller)
Onsdag
(eller)
Mandag

8) Hvor lenge før påske er faste? (bilde av bibel)
(Alternativene er)
1 dag
(eller)
210 dager
(eller)
30 dager
(eller)
14 dager

(eller)
40 dager

Repetisjon av spørsmål (etter 1 minutt)
spørsmål og svar

Tilbakemelding i spillet dersom brukeren avgir et svar

Ved riktig svar:
RIKTIG! Du svarte: Her står riktig svar uthevet
Vær klar! Nå kommer snart neste spørsmål.

Ved feil svar:
Prøv en gang til.

Tilbakemelding i spillet, dersom spilleren ikke avgir svar på et spørsmål (etter 2 min):
Vi går videre til neste spørsmål. Er du klar?

Slutt-tekst når spillet er ferdig:

Gratulerer! Du er i mål! Du klarte … av 8 riktige!

Ved feiltrykk på skjermen
(Trykk på svaret på skjermen)

Appendix 5 – Group interview summary

SPØRSMÅL - EKSPERTPANEL

1) Dere hørte en stemme som instruerte og oppga spørsmål i spillet. Hvordan kan lyden i spillet best tilpasses for bruk mot spillere med kognitiv svikt (forståelig uttalelse, tempo, volum)?

Lyden bør tilpasses etter riktig setningsoppbygning. Det er viktig å se på gode og enkelt formulerte setninger i spillet, slik at stemmen blir mer assisterende enn forvirrende. Lange formuleringer gir ofte grobunn for utydelighet. Lyden virker passende i tempo . Det er viktig at det er en kvinnestemme, for dette er bevist mer tilpasset for demente enn eksempelvis dypere stemme.
Dersom brukeren har begynt å svare, bør det ikke være behov for repetisjon av spørsmålet. Kjerneinformasjonen må frem i instruksen, ikke ekstra ting.

2) Spillet hadde en instruktiv tekst som samkjørte med lyden. Hvordan kan teksten i spillet best tilpasses for bruk mot spillere med kognitiv svikt (tekst størrelse, kontrast, uthevninger, innholdsforståelse)

Det er viktig at en presis informasjon kommer ut i instruksjonene. En trenger ikke tilsløre med masse ekstra. Ekspertpanelet ønsker å bidra med setningsoppbygning og tilpasninger på instruksjonene og spørsmålene. Ved slutten bør det fremkomme at dette var siste spørsmål. Det kan også være bra at pasienten kan følge med å se hvor mange spørsmål som er igjen.
Det er ikke noen poeng at et av svarene skal ha en ”VET IKKE” muliget for å lett taste seg videre. Utfordring er bedre. Feilsvar elimineres etter hvert, og det er bra.
VET IKKE appellerer også gjerne til stimuli resignasjon.
At spillet sier ”PRØV IGJEN” er godt nok som feedback på feilsvar.
Instruksjon bør si : ”Velkommen til dagens hjernetrim” Heller ”trykk for å svare” enn hva det står nå.
Instruksjon: Fjern ”Nå kommer spørsmålet snart.”
Etterlyser bedre kontrast i bildene for å se hva det er.
Spørsmålene burde blitt kategorisert på ordtak og fakta. En enkel begynnelse med vanskeligere spm etter hvert, ville være en god innfallsvinkel.

3) Spilleren kan svare på spørsmålene med en stylus penn, eller med fingertuppene. Hva kan anses som en fullgod løsning for å avgi svar på en slik type skjerm?

Alternativene som er fremlagt er ikke gode nok. En spesialtilpasset løsning ville være bedre, gjerne noe en kan feste på fingertuppen som responderer like bra. Gode lysforhold med ensfarget bakgrunn er viktig.

4) Spillet spilles ved å sette mobilenheten på bordet, og la brukeren trykke å skjermen for å svare. Hvilke generelle fysiske forhold bør ligge til rette for at en spiller med kognitiv svikt kan best mulig spille et slikt spill alene (rom, miljø, tid)?

Spillet bør settes opp på høykant, alternativt holdes i hånda med tildekning av hardwareknappene (en slags ramme rundt). Dersom spillet settes på høykant, bør det like noe tungt inni som holder spillet på plass. Et alternativ kunne være en egen holder å sette spillet i.

5) Er det andre momenter i spillet som bør tilrettelegges for at brukeren skal kunne spille spillet mest mulig på egen hånd?

Spillet bør ikke promoteres som MasterQuiz, men som ”Hjernetrim” eller ”Spørrespill”

Appendix 6 – Track sheets used during observational study

USER A
Gender: Male

Observations	intro	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Actual field notes
										Bruker startet spillet på egen hånd.
A	x	x	x		x	x	x			Q3: feil - prøvde seg 1x, klarte ikke svare tidsnok
B								x		Q6: vet ikke svaret.
C				x					x	Q7: vet ikke svaret. Aktivitør ber han gjette
D										Q8: aktivitør gir hjelp - forklarer hva han må gjøre.
E										
Focused	x	x	x	x	x	x	x	x	x	
Question inter										
Question answ							x	x		
Question guess								x		
Wrong press										

Transcribed field notes:

Bruker starter spillet selv ved å klikke på knappen - uten hjelp fra aktivitøren
Brukeren venter med å svare på spørsmål 3, og rekker kun å avgi et svar før spillet går videre auto-
matisk, siden han ikke indikerer behov for å vite svaret.
På spm syv indikerer bruker at han ikke kan svaret. Aktivitør hjelper, ved å svare at han må prøve "å gjette"
Han rekker ikke svare før det gåes videre til neste spm. Timeout inntreffer etter 2 minutt. Brukte for lang tid.
På spm 8 forklarer aktivitøren hva han må gjøre for å svare.

USER B
Gender: Female

Observations	intro	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Actual field notes
										Starter spill selv, men aktivitør må forklare
A	x			x						Q1: Sliter å forstå. Timeout. "Er klar". Kun ett svar.
B										Q2: "usikker, vet ikke hva jeg skal svare". Mye samtale
C		x	xxxx		xxx	x				Q4: aktivitør gir instruks
D		x								Q5: "vet ikke hva jeg skal svare"
E			x							Q6: aktivitør sitter ved siden. Klarer spørsmål alene
Focused	x					x	x	x	x	
Question inter										
Question answ										
Question guess										
Wrong press										

Transcribed field notes:

Brukeren klarer å starte spillet etter å ha blitt fortalt å trykke på startknappen.
På spm 1 klarer brukeren kun å avgi et svar. Hun har problemer med å forstå hva hun skal gjøre, etter instruksen.
Dette tar lang tid, og akt rekker ikke å gi hjelpe med å svare før timeout. Hun responderer imidlertid til stemmen
at hun "er klar" under timeout sekvensen.
På spm 2 trenger brukeren flere instrukser fra aktivitør for å forstå hva hun skal gjøre. Hun indikerer at hun ikke vet hva hun skal svare, og hun tar ikke initiativ. Aktivitør ber henne trykke et svar på skjermen. Dette resulterer i samtale mellom aktivitør og bruker, som igjen gir flere repetisjoner av hva brukeren skal gjøre for å svare.
På spm 4 må aktivitør gi flere instrukser om å trykke på skjermen muntlig, da bruker ikke klarer foretar seg noe.
På spm 5 indikerer brukeren at hun ikke vet hva hun skal svare. En instruks om å trykke et svar på skjermen blir gitt.
På spm 6-8 setter aktivitøren seg ved siden av brukeren.

USER C

Gender: Female

Observations	intro	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Actual field notes
										Starter spillet selv (forklaring av aktiv.)
A			x	x	x	x	x	x	x	intro: Prøver trykke når står. Akt forklarer
B										Q1: Aktiv. Sier trykke på prikk el setn. hvis svare
C	xxx	xxxx								Q2: rister på hånda, klare å avgi svar
D										Q4: klar med fingeren hele tiden
E										Kommerbort i svaralt. med finger p.g.a skjelvingen. Er for
										nær skjerm m finger.
Focused			x	x	x	x	x	x	x	
Question inter										
Question answ										
Question guess										
Wrong press										

Transcribed field notes:

Brukeren klarer å starte spillet etter å ha blitt fortalt å trykke på startknappen.
I spm 1 blir brukeren fortalt hvordan hun skal trykke på skjermen for å avgi et svar. Enten på radioknappen eller på setning
I spm 2 klarer brukeren å svare på tross av mye skjelving på hånda
I spm 4 observeres det at brukeren har klar pekefingeren nesten inntil skjermen for å avgi svar.
Det er uvist hvilket spm, men brukeren klarte å avgi et svar p.g.a. Kombinasjon av skjelving på hånda og pekefinger for nær til skjermen.

USER D

Gender: Female

Observations	intro	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Actual field notes
										intro: spør om hun skal trykke på skjermen.
A				x	x	x	x	x		Q1: akt instruerer å trykke på prikken el setning
B			xx						x	Q2: kan ikke svaret. Akt må repetere "bare gjett" 2x
C	x	x								Q7: sier hun ikke har peiling, men forsøker
D										Q8: vet ikke svaret. Prøver. Akt må gi svaret.
E										
Focused		x	x	x	x	x	x	x	x	
Question inter										
Question answ			x							
Question guess										
Wrong press										

Transcribed field notes:

Brukeren klarer å starte spillet etter å ha blitt fortalt å trykke på knappen av aktivitør
I spm 1 må aktivitør forklare brukeren at hun må trykke på svarknappene for å svare på spørsmålet.
I spm 2 sier brukeren at hun ikke kan svaret på spørsmålet. Da repeterer aktivitøren 2 ganger at hun må prøve å gjette.
i spm 7 indikerer brukeren at hun ikke har peiling, men fortsetter likevel å prøve.
I spm 8 vet ikke brukeren svaret. Hun prøver en gang. Aktivitør gir svaret til slutt.

USER E

Gender: Female

Observations	**intro**	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Actual field notes**
										Intro: brukeren tror kan trykke und instruksj.
A										Q1: klarer ikke lese teksten. Misforstår spm - tror det er
B			xx			x	x	x	x	henne d gjelder
C	x	xxxx		x	xxx	x	x	x		Q2: Kan ikke svaret. Akt. Sier må gjette x2
D										Q3: leser spm. Sier ikke følger m på sport. Akt. Sier "bare
E										trykk"
										Q4: probl trykke riktig. Aktivitør "trykk hardere". Lange
										negler årsak.
Focused										Q5:Har ikke peiling på svaret. Akt. :"du får gjette". Trykket
Question inter		x					x			feil, selv om svar gitt. 1x feiltrykk
Question answ			x			x		x	x	Q6: Klarer lese teksten. Akt. "prøv å trykke da" Skjønte
Question guess			xx							ikke spm som ble opplest. "Bare jeg hadde huska det"
Wrong press					xxx	x				Q7: Vær så snill å trykke for meg. Akt instruerer og gir
										svaret.
Transcribed field notes:										Q8: probl med å skjønne spm. akt gir svaret

Brueren klarer å starte spillet når hun blir fortalt hvordan hun skal trykke på start knappen av aktivitør
I spm 1 misforstår brukeren spm og tror det gjelder hennes tilstand. Akt må forklare slik at hun tolker spm riktig. Hun skjønner ikke hva medisinen dispril er, og det blir enklere når hun får oppgitt medisinen paracet.
I spm 2 ber aktivitøren henne om å gjette to ganger, siden hun sier hun ikke kan svaret
I spm 3 klarer hun spm, men hevder hun ikke er god i sport
I spm 4 har brukeren probl med å trykke riktig på skjermen. Hun bruker neglen og det går ikke. Aktivitøre sier hun må trykke hardere 3 ganger.
I spm 5 får hun oppgitt svaret, men trykker feil ved første forsøk. Det registreres en feil trykkteknikk.
I spm 6 Vet ikke svaret på spm. Brukeren blir da bedt om å trykke noe.
I spm 7 sier brukeren til aktivitør: "Vær så snill å trykke for meg". Aktivitør assisterer med å forklare hvordan hun må trykke
I spm 8 Brukren skjønner ikke teksten. Aktivitør korrigerer et ord hun misforstår, og gir svaret.

Appendix 7 – Total data log registries by prototype

Datalog

USERS:	USER A	USER B	USER C	USER D	USER E
totalquestions	8	8	8	8	8
points	6	7	8	8	8
wrong answer	9	7	14	8	5
wrong qst 1	1	1	4	0	0
wrong qst 2	0	3	3	3	1
wrong qst 3	2	1	0	0	0
wrong qst 4	1	0	2	0	0
wrong qst 5	3	0	1	0	2
wrong qst 6	1	1	0	2	2
wrong qst 7	1	0	1	3	0
wrong qst 8	0	1	3	0	0
1=answered within time of 2 min, 2 = the question was timed out - user did not perform the correct answer within time.					
qst1	1	2	1	1	1
qst2	1	1	1	1	1
qst3	2	1	1	1	1
qst4	1	1	1	1	1
qst5	1	1	1	1	1
qst6	1	1	1	1	1
qst7	2	1	1	1	1
qst8	1	1	1	1	1
times the question was repeated					
qst1	0	1	0	0	1
qst2	0	0	0	0	0
qst3	0	0	0	0	0
qst4	0	0	0	0	0
qst5	0	0	0	0	1
qst6	0	0	0	0	0
qst7	0	0	0	0	0
qst8	0	0	0	0	0
Total Average time per question					
	01:13	00:53	00:28	00:45	01:11
Time spent on each question					
qst1	00:37	02:00	01:22	00:30	01:27
qst2	00:50	01:26	00:41	01:11	00:55
qst3	02:00	00:24	00:09	00:09	00:40
qst4	01:06	00:47	00:22	00:27	01:14
qst5	01:25	00:44	00:14	00:34	01:55
qst6	01:01	00:32	00:11	01:06	01:48
qst7	02:00	00:31	00:22	01:15	00:33
qst8	00:52	00:45	00:25	00:54	01:02
Wrong tap on touch screen while playing					
qst1	1	4	2	0	0
qst2	0	6	0	0	0
qst3	0	0	0	0	0
qst4	0	1	1	0	0
qst5	2	0	0	0	0
qst6	0	0	1	1	0
qst7	0	0	0	0	0
qst8	0	0	1	0	0

Appendix 8 – Calculations for individual and total observations

Misplaced screenpressure in percantage per user: (Total pressures found from data log)

	User A	User B	User C	User D	User E
Wrong screenpressures (x)	3	11	5	1	0
Total pressures onto the screen (y)	18	25	27	17	13
Misplaced of total pressures on screen (x/y)	17 %	44 %	19 %	6 %	0 %

Calculations of A observations

To be put in pie chart (figure 20):

$$\frac{\text{amount of A observations from all users (21)}}{\text{total amount of questions (40)}} * 100 = \mathbf{52{,}5\%}$$

Calculations of B-E observations

To calculate how big percentage each B-E observation needed of the 47,5% pie piece seen in figure 20 - each B-E observations were calculated like this:

$$P = \frac{\text{amount of x observation}}{\text{total B-E observations from all users}} * 100$$

$$\mathbf{O = P * 0{,}475}$$

x = either a B,C,D or E observation

The different calculations to be put in pie chart (figure 20), seen in O:

	Amount	P	O
Total B observations with all users	10	25,6 %	**12,2 %**
Total C observations with all users	27	69 %	**32,9 %**
Total D observations with all users	1	2,6 %	**1,2 %**
Total E observations with all users	1	2,6 %	**1,2 %**
Total B-E observations from all users	39	100,0 %	**47,5 %**

Appendix 9 – Interview transcriptions

Bruker A:

Del 1

Observatør: Det som jeg egentlig lurte på det var bare litt sånn spørsmål hva du syns er gøy å holde på med? Har du noen spesielle interesser.
Pasient: Ja, pianospilling.
Observatør: Pianospilling? Sier du det ja.
Pasient: mm
Observatør: Har du spilt lenge eller?
Pasient: Hva?
Observatør: Har du spilt lenge piano?
Pasient: Ja, fra jeg var 14 år.
Observatør: Ohoi. Spiller du litt her på stua da eller?
Pasient: Ja, enkelte ganger.
Observatør: Akkurat.
Pasient: Ikke så ofte.
Observatør: Det er vel gøy å holde på med?
Pasient: Ja da.
Observatør: er det noen andre spesielle interesser du har da eller?
Pasient: Jeg er musiker.
Observatør: Musiker? Ja. Så musikk - det er ok. Det liker du.
Pasient: mm
Observatør: Ja (bekreftende). Så bra da.
Observatør: Så da er det det du helst holder på med når du sitter litt sånn aleine så gjerne spille litt piano eller?
Pasient: Ja da.
Observatør: Ja, så bra så bra. mm
Observatør: Så lurte jeg litt på sånne spill med spørsmål.
Pasient: Ja?
Observatør: Har du..Liker du sånn noe? Å spille spill med sånne spørsmål og svar
Pasient: Ja ja
Observatør: Liker du det?
Pasient: Ja.
Observatør: Det liker du. mm . Så bra då.
Observatør: Og så lurte jeg litt på sånn TV og sånn - liker du å se på TV?
Pasient: Ja da.
Observatør: Det kan du like.
Pasient: Ja da..
Observatør: Pleier du å slå på TV'en selv da eller?
Pasient: Ja da.
Observatør: Gjør du det også ja…yess.. Javel, javel - så bra.
Pasient: Og så er det sånn radio da.

Pasient: Hva?
Observatør: På radio? Liker du å høre på det?
Pasient: Ja jeg gjør på samme måten jeg.
Observatør: Ja, det liker du også. Og så slår du den på også, eller er det noen som hjelper deg å slå på radioen?
Pasient: Nei
Observatør: Du slår han på selv…så bra.
Observatør: Skal vi se - nå er vi straks ferdig. Hvordan er det med lesing da. Liker du å sitte å lese?
Pasient: noen ganger så.
Observatør: Noen ganger? Mm…Trenger du noen sånn hjelpemiddel for å få lesti bøker og sånn?
Pasient: Hva?
Observatør: Bruker du noe hjelpemiddel for å klare lese teksten? Må du ha noe ekstra…
Pasient: Jeg ser på teksten på fjernsynet.
Observatør: Ja, du ser den. Du trenger bare brillene da?
Pasient: Ja.
Observatør: (fortsetter) ..så er det nok?
Pasient: Ja
Observatør: Mm. Ja.
Observatør: Eh..når du skal snakke med familien din eller vennene dine, pleier du noen ganger å ringe til dem i telefonen? (stille..) eller?
Pasient: Det er jeg så lite …
Observatør: Det er ikke så ofte du ringer, eller pleier du ikke ringe når du skal snakke med noe ..noe venner eller familie ..? Pleier du å ringe noe til de eller pleier du bare å møte de her eller?
Pasient: Det er begge deler.
Observatør: Begge deler. Når du ringer da på telefonen, gjør du det selv da eller. Ringer du og trykker nummer på telefonen.
Pasient: Ja da.
Observatør: Akkurat. Jeg skjønner.

Del 2

OBSERVATØR: Hvordan synes du dette var?
PASIENT: Bra!
OBSERVATØR: I spillet vi spilte på skjermen, hørte du en stemme. Nå skal jeg sette på spillet igjen, og så må du fortelle meg hva som ble sagt:
PASIENT: "…til hjernetrim" "…trykke på skjermen" (gir bruddvis tilbakemelding på hva som blir sagt)
OBSERVATØR: Synes du stemmen i spillet var til hjelp?
PASIENT: Ja
OBSERVATØR: Kan du lese disse tekstene som kommer nå for meg?
PASIENT: (leser første og andre instruks uten synlige problemer).
OBSERVATØR: Kunne du tenkt deg å spille et sånn spill seinere?
PASIENT: Ja.

Bruker B

Del 1

OBSERVATØR: Det som jeg egentlig lurer på vet du. Jeg er skolestudent jeg, men jeg synes det er veldig gøy å vite hva dere holde på med for noe - eller hva du liker å holde på med for noe? Hva er det du synes er gøy å gjør for noe - sånn interesse?
PASIENT: Hæ?
OBSERVATØR: Har du noen interesser?
PASIENT: Nei, jeg vet ikke jeg (mumler noe)
OBSERVATØR: Ingen interesser?
PASIENT: Nei
OBSERVATØR: Har du ingenting du syns det er gøy å holde på med når du er her eller hjemme eller?
PASIENT: Nei, ikke noe nå.
OBSERVATØR: Ingenting du syns er artig.
OBSERVATØR: Ikke å for eksempel å strikke eller..
PASIENT: Nei
OBSERVATØR: Ikke det.
PASIENT: Nei.
OBSERVATØR: Mm..
OBSERVATØR: Og sånne spill. Har du.. Like du å spille spill?
PASIENT: Nei, ikke noe særlig. Nei, jeg gjør ikke det.
OBSERVATØR: Ikke like..Liker ikke å spille spill, eller sånn spørsmålspill og sånn ? Liker du spørsmålspill?
PASIENT: Spørsmål? Naeeii (drar på det)
OBSERVATØR: Spørsmål og svar
PASIENT: Jahaha...(ler)
OBSERVATØR: Er det artig?
PASIENT: Ja
OBSERVATØR: Det kan du like?
PASIENT: Ja (nølende)
OBSERVATØR: Javel.... mm..
OBSERVATØR: Skal vi se. TV da. Liker du å se på TV?
PASIENT: Ja (bestemt)
OBSERVATØR: Det liker du?
PASIENT: Ja.
OBSERVATØR: Ja...Pleie du..
PASIENT: (avbryter) ..så sant den er på så..
OBSERVATØR: Ja, og så sant den er på...du pleier ikke også slå den på selv?
PASIENT: Nei
OBSERVATØR: Nei. Akkurat.
OBSERVATØR: Og radio. Liker du å høre på radio?
PASIENT: Ja, før, men ikke noe særlig nå.
OBSERVATØR: Ikke noe mer nå? Før? Før gjorde du?
PASIENT: Ja da.

OBSERVATØR: Ja..
OBSERVATØR: Skal vi se. Er det noen grunn til at du ikke liker å høre på radio lenger?
PASIENT: Nei, det er ikke det.
OBSERVATØR: Nei, det er ikke noen spesiell grunn?
PASIENT: Nei, da det er ikke det.
OBSERVATØR: Nei
OBSERVATØR: Så iurte jeg på om du like å lese?
PASIENT: Ikke noe særlig.
OBSERVATØR: Ikke noe særlig?
PASIENT: Nei.
OBSERVATØR: Nei
PASIENT: Jaja…jeg leser avisen og sånn, men ikke nå.
OBSERVATØR: Nei, ok.
OBSERVATØR: Trenger du noe hjelpemiddel for å lese?
PASIENT: Nei.
OBSERVATØR: Nei.
OBSERVATØR: Når du skal snakke med familie og venner, pleier du å ringe til de?
PASIENT: Jeg har ingen familie jeg (kontant).
OBSERVATØR: Du har ikke noen venner da?
PASIENT: Nei, jeg mener jeg har en på [stedsnavn oppgis]. En dame bare.
OBSERVATØR: Ja? Pleier du å ringe til henne da eller?
PASIENT: Nei.
OBSERVATØR: Ikke det?
PASIENT: Nei
OBSERVATØR: Nei.

Del 2

OBSERVATØR: Hvordan synes du dette var?
PASIENT: Det var bra. Ja, det var gøy.
OBSERVATØR: I spillet vi spilte på skjermen, hørte du en stemme. Nå skal jeg sette på spillet igjen, og så må du fortelle meg hva som ble sagt.
PASIENT: (nevner) "Klar til å spille.."
OBSERVATØR: Synes du stemmen i spillet var til hjelp?
PASIENT: Nei, den var ikke til hjelp.
OBSERVATØR: Kan du lese disse tekstene som kommer nå for meg - (fremviser første og andre introduksjonstekst)
PASIENT: (leser teksten klart)
OBSERVATØR: Ville du spilt et slikt spill hvis du fikk mulighet?
PASIENT: Nei

Bruker C

Del 1

OBSERVATØR: Se det. Det som jeg lurte på skjønner du, det var lit på hva du syns som er gøy å holde på med av aktiviteter eller interesser?
PASIENT: Nei, jeg syns jeg .. eh.. det er.. eh..fint..eh.. å med den denna der... Jeg er jo somregel om sommeren å ..
OBSERVATØR: Der du snakka om? På hytta? Var det det du tenkte på eller?
PASIENT: Ja..ja..det å sitte på ...før det nå ble bygd om da..
OBSERVATØR: Ja.
PASIENT: Det er jo gjort allerede, og vi var der om formiddagen.
OBSERVATØR: Ja, akkurat. Ja
PASIENT: Da var det helt forandret fra det forrige gang jeg var der (ler)
OBSERVATØR: Ja..(ler)
PASIENT: Ja
OBSERVATØR: Akkurat. Noe spesielle ting du like å holde på med når du er her?
PASIENT: Ja
OBSERVATØR: Har du noen spesielle ting du liker å sitte med..?
PASIENT: Nei, ikke det annet enn at jeg har ..jeg har barn og...
OBSERVATØR: Ja..
PASIENT: (fortsetter) ..er det noe dem sier dem jeg gjerne vil at jeg sk....så så.. "åh, mormor kan ikke du det?" (ler)
OBSERVATØR: Ja Ja.
PASIENT: ..sånn er..
OBSERVATØR: Kommer de på besøk.
PASIENT: Ja ja ja.
OBSERVATØR: Ja vel ..mm..
PASIENT: Så..
OBSERVATØR: mm
OBSERVATØR: Sånn eh.. sånn spørrespill og sånn. Liker du å sitte med det?
PASIENT: Hva?
OBSERVATØR: Sånn spørsmålspill. Liker du det når du sitter på sånn..på stua og så spør de
PASIENT: Nei, jeg er ikke noe...
OBSERVATØR: Er du glad i å sitte med sånn?
PASIENT: Ikke med spill.
OBSERVATØR: Nei.
OBSERVATØR: Ikke i spill?
PASIENT: Nei, det er på grunn av hodet mitt det at..det
OBSERVATØR: Ja
PASIENT: at jeg ... må ha så lang tid til å finne ut noenting og da..
OBSERVATØR: Ja ja..mm
PASIENT: Da er det..
OBSERVATØR: Skjønner.

PASIENT: Ja jeg var der da jeg gikk på skole…
OBSERVATØR: Ja
PASIENT: (fortsetter) ..da var vi her oppe der nedpå …Nei (ser seg om..)
OBSERVATØR: Åja.
PASIENT: Er du? Du er her? (ser på aktivitør bak) (litt forvirret og redd). Er du det?
AKTIVITØR: Jeg er her jeg (bekreftende)
OBSERVATØR: (ler)
PASIENT: Ja, jeg mener det var deg som var der.
OBSERVATØR: Ja . ja
PASIENT: Nei jeg…
OBSERVATØR: Du er ikke så glad i spille spill altså?
PASIENT: Hm?
OBSERVATØR: Du er ikke glad i å spille sånn spørrespill?
PASIENT: Ja ja ja ja (ikke oppfattet)
OBSERVATØR: Liker du det, eller liker du det ikke?
PASIENT: Joda jeg syns det er moro jeg altså
OBSERVATØR: Morsomt med spørrespill?
PASIENT: Ja, for at jeg sier at hvis vi skal noe, så må jeg gå et sted en kan få bruke litt av det en kan.
OBSERVATØR: Riktig. Hvordan er det med TV da?
PASIENT: Hm?
OBSERVATØR: Liker du å se på TV?
PASIENT: Ja, se på TV det det gjør jeg jo, men det er ikke det at det er…. Jeg kan ikke huske når jeg så på noe på TV (ler) nesten..
OBSERVATØR: Å nei (ler) nei
PASIENT: (ler)
OBSERVATØR: Så du ser ikke så ofte på TV?
PASIENT: Hm?
OBSERVATØR: Ser du ofte på TV?
PASIENT: ja ja ja…Nei, jeg er ikke
OBSERVATØR: Ikke så ofte.
PASIENT: Jeg har ikke sett jeg, jeg har mere heller radio. Radio på.
OBSERVATØR: Ja. Akkurat . Akkurat
OBSERVATØR: Når du sitter å ser på TV da, pleier du å slå på TV'en selv?
PASIENT: Ja, det gjør jeg.
OBSERVATØR: Slår du den på selv?
PASIENT: Ja Ja ja Ja
OBSERVATØR: Ja vel
OBSERVATØR: Men men radio da. Liker du å høre på radio?
PASIENT: Ja (drar på det), litt sånn.
OBSERVATØR: Litt?
PASIENT: Litt ja.
OBSERVATØR: Pleier du å sette på radioen selv?
PASIENT: Jeg har.. Ikke bestandig, men jeg har jo barn.
OBSERVATØR: Ja - er det de som setter på radioen for deg?
PASIENT: Ja, dem setter..ja
OBSERVATØR: mm
OBSERVATØR: Ja… Å lese da. Liker du å lese?

PASIENT: Ja, jeg er glad i å lese.
OBSERVATØR: Trenger du noe hjelpemiddel når du lese. Må du ha briller eller har du noe annet?
PASIENT: Ja nå får jeg ikke…Får jeg ikke lest…
OBSERVATØR: Nei?
PASIENT: (fortsetter) for det at jeg har mistet brillene mine..
OBSERVATØR: Åh?
PASIENT: (fortsetter) ..og jeg aner ikke hvor jeg har gjort av dem så..
PASIENT: Det sa jeg til venninnen min nå at jeg…eh… jeg får vente til jeg blir så jeg kan klare å skrive ned allting…
OBSERVATØR: Ja.
PASIENT: …(fortsetter) .. uten å må ha noe å skrive etter …(mumler)…Nei det..
OBSERVATØR: mm
PASIENT: så
OBSERVATØR: Men hvordan er det når du skal snakke med med barna dine og familie eller sånn…pleie du å..
PASIENT: Ja
OBSERVATØR: (fortsetter)..ringe. Ringe du til de?
PASIENT: Det (ler)..Dem er jo vokse dem alle sammen, det er ikke..
OBSERVATØR: Men du pleier ikke å ringe? Sånn ..
PASIENT: Hm?
OBSERVATØR: Du tar ikke telefonen og ringe til de? Pleier du det eller?
PASIENT: Nei…Nei, dem ringer dem.
OBSERVATØR: Det er de som ringer til deg?
PASIENT: Ja
OBSERVATØR: Ja, mm
OBSERVATØR: Har du telefon på rommet her eller, har du…bruke du telefon?
PASIENT: Akkurat nå bor jeg på trygdebolig .
OBSERVATØR: Ja?
PASIENT: (fortsetter) så jeg har ikke ..eh.. liksom hatt .. eh..noe på der, men nå har jeg skrevet det opp at jeg skal prøve å få det hvis jeg ikke blir borte når jeg..(ler)
OBSERVATØR: ja ja ja
PASIENT: Ja, når du blir over 90 år så er det ikke bare bare..
OBSERVATØR: Nei, det er ikke det. Det er det ikke.

2. del

OBSERVATØR: Hvordan synes du dette var?
PASIENT: Jo det var artig å prøve. (bemerker noe om at det er vanskelig å spille på en sånn)
OBSERVATØR: I spillet vi spilte på skjermen hørte du en stemme. Nå skal jeg sette på spillet igjen, og så må du fortelle meg hva som ble sagt.
PASIENT: (klarer å gjengi etter avspilling) "Velkommen" og "trykke på skjermen".
OBSERVATØR: Synes du stemmen i spillet var til hjelp?
PASIENT: Vet ikke.
OBSERVATØR: Kan du lese tekstene som kommer nå for meg (viser instruks 1 og 2 i instruksjonene på starten av spillet)?
PASIENT: (klarer å lese instruks 1 og 2 uten synlige problemer).

Bruker D

1. del

Hører du meg godt nå?
- Jeg hører jo hva du sier nå i hvertfall.

Så bra!
Jeg lurte bare på om du hadde noen spesielle interesser?
- Nei, ikke nå siden jeg ble gammal.

Ingenting?
- Nei, jeg vet ikke hva det skulle være for noe.

Når du sitter her eller er her på på [..dagsenternavn..], er det noen ting du liker å holde på med?
- Nei

Ingenting?
- Jeg husker ikke noe.

Ikke noe spesielt?
- Er jeg på [..dagsenternavn..] nå?

Ja!
- Det vet jeg ikke.

Skal vi se
Har du noen gang spilt sånn spørrespill?
- Nei

Aldri?
- Spørrespill?

Spørrespill!
- Nei, det tror jeg ikke.

Eller brettspill, eller puslespill eller..?
- Nei, jeg husker ikke det.

Nei vel.
TV da. Har du sett på TV eller liker du å se på TV?
- Jeg ser jo på TV når det er liksom. Det er ikke bestandig noe som er interessant, så ser jeg.

Pleier du å slå på TV'en selv?
- Ja, jeg klarer det.

Og radio da. Liker du å høre på radio?
- Ja, det er sånn opp og ned.

Pleier du å sette på radioen selv?
- Jeg husker ikke

Lese da. Liker du å lese?
- Jeg leste mye før når jeg var yngre, men nå som jeg har blitt gammel så er det ikke så interessant mer

Men hvis du skulle lese noe i dag, bruker du noe hjelpemiddel da eller?
- Jeg bruker briller da, gjør jeg ikke det da?

Ja
- Jeg tror jeg har briller i hvert fall

Mm
Men når du skal snakke med noen venner eller barnebarn eller familie, ringer du til dem da, eller er det de som ringer til deg?
- Det kan være begge deler det.

Ja vel?
- Jeg ringer dem og dem ringer meg.

Ja
Bruker du en sånn telefon du kan ta med deg rundtforbi da eller har du sånn en..?
- Det husker jeg ikke

Men hvis du skal ringe, vet du hvordan du ringer på telefonen? På de tallene? Gjør du det selv, eller er det noen som hjelper deg?
- Det husker jeg ikke

2. del

Synes du det var gøy å spille et sånn spill eller?
- Åssen spill?

Det vi spilte nå. Det du trykka på.
- Jeg vet ikke hva jeg trykka på jeg.

Nei
Synes du det var gøy å spille et sånn spill eller?
- Åssen spill?

Det vi spilte nå. Det du trykka på.
- Jeg vet ikke hva jeg trykka på jeg.

Nei

Observasjoner:
Ved avspilling instruksjoner gjengies følgende av brukeren:
- Velkommen til..” det var noe mer han sa.
- Ja - de skulle stille noen spørsmål og så skulle jeg trykke på skjermen.

Ved spørsmål om å lese teksten, gjengir brukeren følgende fra første spørsmål uten synlige problemer:
- Hodepine meslinger hoste magesår oppkast hva kan dispril hjelpe mot?

Bruker E

1. del

Observatør: Jeg hadde bare noen få spørsmål som jeg lurte på skjønner du. Og det var litt på om du har noe, kan svare meg litt på om du du har noe spesielle interesser, eller noe..
Pasient: Om jeg har. Om? Hva var det du sa?
Observatør: ...du synes er gøy å holde på med?
Interesser. Hva slags interesser har du? Har du noen spesielle interesser eller noe du synes er gøy å holde på med, eller?

Pasient: Nei jeg syns dagene går som jeg kan si normalt ikke noe hopping hverken her eller der?
Observatør: Men det er ikke noe spesielt du liker å holde på med?
Pasient: Hæ?
Observatør: Er det noe spesielt du liker å holde på med? Når du er her, eller?
Pasient: Å gura meg. Det den
Observatør: Noe spesielt?
Pasient: Jeg syns det er spesielt. Jeg syns alt er morro jeg.
Observatør: Alt er morro!
Pasient: Ja!
Observatør: Så bra då.
Pasient: Jeg syns jeg er akkurat..også prøve å se om du kan får klart å gjøra det og det og det og det og men den der der det må jeg prøve på sier jeg.
Observatør: Ja. Akkurat. Ja ja, Så du liker å prøve litt forskjellige ting?
Pasient: Ja, jeg er liksom så nysgjerrig etter noe nytt.
Observatør: Ja, jeg skjønner det
Pasient: (ler)
Observatør: Ja, men sånn eh..sånn spill og sånn med spørsmål og svar, liker du det?
Pasient: Ja, jeg er ikke - jeg er ikke flink i det. Jeg har ikke vært med på sånt. Så det det - det blir bare akkurat det jeg hører og ser akkurat i arbeidslivet.
Observatør: mm.. Ja.
Observatør: Er det noe - liker du å se på TV for eksempel?
Pasient: Når jeg ikke har noe annet å gjøre, så er det greit å se hva det er der.
Observatør: Ja.
Pasient: Og da ser jeg på det, og hvis jeg ikke ser på det, så slår jeg det av.
Observatør: Okey.
Pasient: Ja
Observatør: Pleier du og så slå av og på TV en selv, eller?
Pasient: Hæ?
Observatør: Slår du av og på TV'en selv?
Pasient: Ja
Observatør: Du gjør det helt alene?
Pasient: Ja det må jeg da gjøre, for jeg er som regel aleine så (ler)jeg må jo gjøre det.
Observatør: Ja, okey.
Observatør: Så lurte jeg på radio. Liker du å høre på radio?
Pasient: Ha? (usikker)
Observatør: Radio?
Pasient: Radio?
Observatør: Ja.
Pasient: Ja, det er lenge siden jeg har hørt.
Observatør: Er det lenge siden?
Pasient: Ja, det er jo utsatt - jeg vet ikke - er det noe radio nå?
Observatør: Ja ja.
Pasient: ja, nei..
Observatør: Men du pleier ikke sitte å høre på radio på rommet ditt?
Pasient: Det har jeg ikke hatt.
Observatør: Nei
Pasient: Når jeg går på rommet, så er det for å legge seg.

Observatør: Ja.
Pasient: (ler) .. så det blir ikke noe - og da skal jeg sove.
Observatør: Ja, jeg skjønner. Ja, det er vel det en gjør.
Observatør: Men liker du å lese da?
Pasient: Det gjør jeg. Så fremt jeg finner noe å lese, så syns jeg det er morro. Eller... tidsfordriv kan du kalle det.
Observatør: Ja, men du syns det er gøy?
Pasient: Ja ja, det blir jo det, samtidig med at du - får bort tida, som er kjedelig.
Observatør: Mm, ja, skjønner.
Pasient: Ja.
Observatør: Trenger du noe hjelpemiddel sånn for å lese, eller bruker du briller eller?
Pasient: Nei, jeg har briller... jeg har briller som jeg leser med.
Observatør: Okey.
Pasient: Ja, øya er ikke så stor som dem burde væra - dem begynner å bli skrøll..
Observatør: Ja, okey
Pasient: Skrall!
Observatør: Ja (ler litt..)
Observatør: Men når du skal snakke med ... med barnebarn, familie eller venner eller noen sånn - ringer du til de da, eller har du pleid å ringe?
Pasient: Vi er så spredt så, vi skulle tro at vi var på hver vår jordklode mange ganger.
Observatør: mm..
Pasient: det er så sjelden jeg får tak i hverandres så det... nei, det blir lite - veldig lite..
Observatør: du pleier ikke å ringe?
Pasient: hmm.?
Observatør: på telefon?
Observatør: Bruker du telefon?
Pasient: Nei, jeg bruker ikke.. har ikke telefon heller, så det - så er ikke vits jeg skaffe det en gang.
Observatør: mm...jeg skjønner.
Pasient: Nei, så det blir lite snakk.
Observatør: Okey
Pasient: da må du møtes, og det blir også lite -sjeldent. For alle har nok med sist.
Observatør: Ja, ikke sant?
Pasient: Ikke sant?
Observatør: Det er jo typisk, hæ?

Del 2

Observatør: Hvordan syns du det var å spille sånn?
Pasient: Det var helt i orden.
Observatør: Likte du det eller?
Pasient: Det var mye som ikke jeg klarte. (poengterer at det er nyttig å lære, men at hun selv ikke er så flink)
Observatør: Nå skal jeg ta og så spille en stemme, så må du se om du kan svare meg på hva du hører (spiller av første klipp av instruksjonene)? Er du klar? Nå kommer den.

Observatør: Hørte du hva de sa?
Pasient: Nei

Ved avspilling av ny instruksjon (denne gangen en annen instruks):
Observatør: Hørte du hva de sa?
Pasient: Jeg skulle svare ved å trykke på skjermen.

Pasienten leser greit opp fra både instruksene og alle tekstene på det første spørsmålene uten synlige problemer, når bedt om å lese dem.

Appendix 10 – Templates of the informed conscents

Avdeling for Teknologi

Tillatelse til innhenting av opplysninger i forbindelse med studentarbeid.

NAVN: ØYVIND ASKEDAL
KULL:MMT09

Studentarbeidets art: brukertesting og observasjonsstudie gjennom mobilspill.

ARBEIDSTITTEL/PROBLEMSTILLING: Nytteverdien ved bruk av assisterbar teknologi for å finne grad av selvstendig mobilspill blant eldre demente.

Metode for datainnsamling: observasjonsstudie, mobil logg og oppfølgende spørsmål mot bruker.

Arbeidstittel/problemstilling, metode og guide for innsamling av opplysninger (f.eks spørreskjema), er godkjent av veileder ved høgskolen.

Sted, dag: HiG, Mars 2011 Veileder: Simon McCallum (sign)

Ansvarlig faglig leder ved

.....

har lest vedlagte informasjon og gir herved videreutdanningsstudenten
ØYVIND ASKEDAL
tillatelse til å gjennomføre undersøkelse blant personale/brukere ved virksomheten, **dersom de selv har samtykket**.

Jeg er inneforstått med at det påhviler meg et etisk ansvar for at personer som blir bedt om samtykke er tilstrekkelig informert til frivillig å kunne si ja eller nei til å delta.

Sted, dato: _____

_____
_____
(Underskrift)

Høgskolen i Gjøvik

Samarbeidsprosjekt Omsorgsteknologi
Samtykke til deltakelse

Masterstudent i medieteknikk, Øyvind Askedal ved Høgskolen i Gjøvik jobber om dagen med en masteroppgave innenfor omsorgsteknologi.
I sin masteroppgave har han utviklet et mobilt spørrespill, spesielt beregnet for eldre mennesker, og med fokus på personer med demens.
Planen er at spillet skal kunne assistere den demente med tale under spillprosessen. Spillet vil underveis ta for seg bilder av gamle gjenstander, med tilhørende spørsmål og svaralternativ. I tillegg
vil det også ha kontrollspørsmål benyttet av leger, for å blant annet avdekke grad av demens.
Formålet med denne masteroppgaven er å belyse nytteverdien bruk av mobile spill for demente.
Vi ønsker å inkludere de som er brukere av ____[navn dagsenter]____ på ____[dato/-er]_____ i utprøving av spillet. Spillet vil bli prøvd ut mens brukerne er på dagsenteret. **Deltakelse I prosjektet er frivillig.**

Etter spillet er gjennomført, vil en anonym spørreundersøkelse bli foretatt med deltakeren, for å stadfeste observasjonene under selve spillet.
En dataserver vil kunne registrere den enkeltes bruk av spillet; vanskelighetsgrad, hurtighet, svarprosent, reaksjonshastighet og presisjon. Registreringen av dataene vil være anonym. De anonymiserte opplysningene vil brukes i masteroppgaven som en del av forskningen.

Nødvendig utstyr dekkes av prosjektet, og deltakelsen vil ikke koste deltakerne noe.
Underskrevet samtykkeerklæring vil bli oppbevart i brukers pasientjournal.

□ **Jeg samtykker i å delta i prosjektet**
□ **Jeg samtykker i å bli fotografert til bruk i masteroppgaven**
□ **Jeg samtykker i at uttalelser fra meg kan bli brukt i rapporten(anonymisert)**
□ **Jeg samtykker i å bli fotografert av media i forbindelse med prosjektet**
□ **Jeg samtykker i å bli intervjuet av media i forbindelse med prosjektet**

_____ _____
Dato og sted Underskrift
(bruker og/eller pårørende)

Appendix 11 – E-mail response personal contact

Date received: 25/02/2011

Hei

Vi har en samarbeidsavtale med et norsk firma som heter Bojo (bojo.no).
De leverer en talesyntese applikasjon for web som heter Readspeaker XT, som vi bruker på regjeringen.no.
Readspeaker blir utviklet av et firma som heter VoiceCorp AB.

Vi har 3 talesynteser: Kari (bokmål), Nora (Nynorsk) og Lucy (Engelsk).
De er alle utviklet av et firma som heter Acapela-group.

Når det gjelder krav og valg av løsning vet jeg ikke om jeg kan bidra med så mye nyttig info.
Som en offentlig bedrift hadde vi en anbudsrunde når vi anskaffet løsning for 4 år siden, og det ble bare levert 1 tilbud.
Det bør påpekes at vi snakker om 2 uavhengige applikasjoner i vår løsning.
For den webbaserte talesynteseapplikasjonen (Readspeaker) er det sikkert en del løsninger å velge mellom, men for den norske talesyntesen har jeg bare hørt om 1 konkurrerende løsning.
Det kan være at det har kommet flere de siste årene for jeg har ikke fulgt så nøye med, men jeg tror at man kan si at det finnes begrensede antall tilbydere av norske talesynteser. Det er dyrt å utvikle og vi er et begrenset marked.
Jeg tror Deltasenteret en gang prøvde å få i gang et prosjekt med å utvikle en gratis norsk talesyntese, men jeg har ikke hørt noe mer om det.

Hvis det er noe mer du lurer på, er det bare å spørre.

Rune Karlsrud
Rådgiver
Departementenes servicesenter
Informasjonsforvaltning
Web seksjon

Appendix 12 – E-mail response – personal contact

Received: 08/04/2011

Hei!
Vi opererer ikke med krav utenom at talen skal være klar og tydelig.

Med vennlig hilsen

_____

Norges Blindeforbund
Kari Anne Flaa
Konsulent Interessepolitikk

Fra: Øyvind Askedal
Sendt: 6. april 2011 20:19
Til: Kari Anne Flaa
Emne: Re: SV: Tekst-til-tale løsning

Hei,

Tusen takk for svar.
Opererer Blindeforbundet med noen krav eller retningslinjer til slike taleprodukter i forhold til ytelse overfor sine brukere? Det jeg tenker på er om dere har ønsket spesialtilpassede løsninger på disse hjelpemidlene fra den enkelte leverandør, eller kun gått for den standardløsning som de leverer til alle sine kunder.

På forhånd takk for alle svar :-)

Mvh
Øyvind Askedal
Masterstudent Høgskolen i Gjøvik / Medieteknikk

Appendix 13 – Research literature table

SØK NR	SØKEORD	ACM	PUBMED
#1	Mobile	36671	29889
#2	Game*	20385	18304
#3	Dement*	60	38186
#4	Reminiscence	157	302
#5	Quiz	1288	2454
#6	PDA	4439	2972
#7	Smartphone	844	49
#8	Audio	16972	4767
#9	Sound	20773	32707
#10	Independent*	62504	350482
#11	Interview	10869	77320
#12	Questions	62615	74055
#13	Assistive technology	1446	2432
#14	Android	808	522
#15	Apple	6027	4614
#16	iOS	693	254
#17	Text-to-Speech	469	28
#18	Speech synthesis	860	43
#19	Quality	106345	53324
#20	#1+#2+#6	6221	94
#21	#1+#2+#3	2	0
#22	#3+#16	4	62
#23	Alzheimer*	387	51851
#24	#1+#2+#10	93	0
#25	#3+#18+#12	2	66
#41	#10+#13+#38	30	2
#42	Wording	2377	591
#43	Sentence	28020	3777
#44	Easy wording	1194	15
#45	Sentence comprehension	2544	968
#46	Alzheimers desease	4	34625
#47	Sentence understanding	12004	1138
#48	Text comprehension	6295	526
#49	#42+#43	571	6

#50	#42+#3	10	3
#51	#43+#3	133	74
#52	#3+#45	60	34
#53	#3+#44	4	0
#54	#45+#46	49	16
#55	#3+#47	78	34
#56	#3+#48	51	3
#57	Cognitive impairment	2866	21850
#58	Norwegian	899	18646
#59	Norway	2935	39875
#60	#3+#18+#58	0	0
#61	#57+#18	246	19
#62	#57+#18+#58	2	0
#63	#38+#18	51	15
#64	#38+#18+#58	4	0
#65	#18+#58	35	1
#66	#18+#59	236	2
#67	#18+#59+#57	9	0
#68	Resistive	3202	2481
#69	Capacity	6	139072
#70	iPad	457	74
#71	Galaxy tab	77	0
#72	Touch screen	3013	433
#73	Tablet	4634	15718
#74	#68+#72	90	0
#75	#68+#73	51	2
#76	#3+#68	4	7
#77	#69+#71	0	10
#78	#69+#73	0	240
#79	#3+#69	0	705
#80	#3+#72	23	7
#81	#38+#72	56	9
#82	#3+#69+#72	0	0
#83	#68+#69+#72	0	0
#84	#3+#73	7	54
#85	#38+#73	0	45