Deafness and Dementia – a pilot study

Comorbidity in different listening- and speech-environment

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Abstract

Hearing impairment and dementia are both dominating diagnosis in the elderly population. After Uhlmann, Larson, Rees, Koepsell & Duckert (1989) suggested that there is a link between the two diagnosis. One fundamental factor for both diagnosis is that communication could be difficult and effortful (Tye-Murray, 2014). Poor communication skills could lead to social isolation and in worst case depression (Kiley, Anstey & Luszcz, 2013). Both communication and social isolation are risk factors in both diagnosis, and could be treated by social interactions (Bai, Yanh & Knapp, 2016; Dawes et al., 2015; Kuiper et al., 2015). With an expectance of increased number of seniors by 2040 (Brunborg, 2004), it is important to evaluate the current state of these individuals' conversational level as well as their audio environment.

Research question: How are older adults with hearing impairment and dementia communicating, and what does their listening and speech environment look like?

<u>Material and method</u>

To differentiate each diagnosis, it was chosen a non-experimental design with three groups of informants; elderly without hearing loss or dementia and elderly with both dementia and hearing loss. The participants consisted of eight individuals, whom five were living at home (Group one). Three of the participants were living at a nursing homes (Group two) who and had the combination of hearing loss and dementia. The Language Environmental Analysis (LENA) method used to record and measure the natural listening and speech environment during an ordinary day in both groups. Due to restrictions from the ethical committee it was only allowed to record for 4 hours during the day. Controls were also tested for hearing level and screened with the Minimal Mental State test (MMST). There is so far only one more known LENA-study in the literature that has investigated the communication patterns in elderly by using the LENA-method (li et al., 2014). The results from the present study was compared to some of the results from the American study by Li et al. (2014) with the purpose of exploring possible socio-cultural differences or similarities.

<u>Results</u>

The LENA results showed that the prevalence of Silence was the most common audio environmental factor during recordings, both in the control and the experimental group. When in comparison with another study recording elder adults with LENA, The Electronic

sound/TV level was statistically significantly lower in percentage in the Norwegian sample compared to results for typical functioning elderly in USA (Li et al. 2014). The control group had lower amount of Meaningful speech (speech on close distance) as well as a lower amount of exposure of speech in Distant. The exposure to speech, both Meaningful and in Distant, seemed to increase with age in both groups (1 and 2). In comparison to the study by Li et al. (2014), Total numbers of words exposure per hour were lower in the current Norwegian study.

Discussion

The listening environment in elderly both with a comorbid condition living in nursing homes and in controls with typical hearing and cognitive level both have similarities and differences. The main finding was that elderly with both hearing loss and dementia are exposed to more speech on close distance (Meaningful) and distance (Distant). The exposure to Electronic sound/TV was higher in the control group in comparison to the experimental group, but the overall percentage was significant lower than for elderly Americans (Li et al., 2014). This could be explained due to socio-cultural differences and other unknown factors.
The level of audio-verbal communication was low in the control group. One possible explanation for this is that the individuals were not being able to leave the house during the recording due to restrictions from the ethical committee. With a 12-hour recording from an ordinary day the results would have concluded in a different outcome. The audio-verbal communication in the Li et al. (2014) study showed a wider range of Meaningful speech in their recordings, than in the current study. However, the results seemed to be somewhat similar. If the current study would have been able to provide longer recording sessions, it is possible that the results would have been even more similar in tendency, except maybe for exposure too Electronic sounds/TV-time which seems to be a socio-cultural different variable.

In conclusion

The differences in environmental percentage could lower the validity of the LENA recorder as a measuring instrument. Thus LENA results would not be applicable to this group of individuals. However, taken the duration and the timing of the day when the recordings took place, the studies could perhaps be corrected and appearing more similar to each other. When comparing the communication variables, the different studies seem to coincide and strengthen the validity of this measurement instrument.

Acknowledgment

Writing this master's thesis would have been impossible without the help and support from so many different people.

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Sandefjord, 29. May 2017
Hilde Nøis

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1 Introduction to the study

1.1 New science and relevance

Wave of increased senior population have been reported, as there has been an increase in life expectancy in later years. The wave peak is expected in 2040 (Brunborg, 2004). Meanwhile, the Norwegian Hearing-impaired Federation (HLF) stated that by the year 2020, as many as 1 million people in Norway will have some sort of hearing impairment (Hørselshemmedes landsforbund, 2017, 20.04). Many of whom, will be affected by an age-related hearing loss, as it is the most common type of hearing impairment among older adults (Tye-Murray, 2014). The Nord-Trøndelag Health Study (HUNT) claimed that 60% of people aged 60-79 developed presbyacusis (Solheim, Shiryaeva, & Kvaerner, 2016). There are approximately 751 060 people in Norway aged 66+ (Statistisk sentralbyrå, 2016), and as a result an estimate of 450 000 people in Norway have an age-related hearing loss. The hearing loss can create some difficulties in communicating (Tye-Murray, 2014), and the most common facilitating method is hearing aid use. The growth in our population is occurring simultaniousley as the technological evolution is expanding (Stach, 2010). This creates a higher opportunity to develop satisfactory hearing aids for individuals with hearing impairment.

In addition to an increase in individuals with hearing loss, there would also be an increase in individuals with other communication difficulties, such as dementia (Nasjonalforeningen for folkehelsen, 2017, 10.04). The Norwegian National Association for Public Health report that there are currently 77 000 individuals with dementia in Norway (Nasjonalforeningen for folkehelsen, 2017, 06.03). Furthermore, they estimate that by the year 2040 the number will be doubled. In the year 2013 the telethon by the national tv channel was given to the National Association for Public Health, intended for research on dementia. The auction resulted in profit of nearly 230 million Norwegian kroner, and was scheduled to be distributed over a five-year period until 2018 (Nasjonalforeningen for folkehelsen, 2017, 16.05). In the wake of the increased attention, the Norwegian newspaper VG have published several reports on the subject. In fact, by May 2017 VG have released 6 publications on the subject this year (Jakobsen, 2017a; Hammerstrøm, 2017; Jakobsen, 2017b; Ighanian, 2017; Bergseng, 2017; Pettersen, 2017). This imply an increased attention on the topic, and therefore highly relevant for this thesis.

The quantitative assessment of communication and language is not a new thing. However, so far most studies have been conducted in dyads of younger cohorts with parents and children. The studies have not been conducted on older adults living at home in comparison to elderly with comorbide conditions. Hart & Risley (1995) conducted a ground-breaking longitudinal study on language and communication in early childhood, which consisted of one-hour audio recordings of communication between children and parents from 42 different homes. The participants in the study were recorded once a month for a three-year period. Later, Hart & Risley (1995) found that there was a direct correlation between the amount of words spoken by the parents and their children's IQ and language development. Another finding was that the child's later academic success also correlated with the number of words spoken by their parents in the study. Hart & Risleys' (1995) most remarkable finding was the '*30-million-word gap'*. When transcribing and coding 1 318 hour-long transcripts, they found that some children had heard oonly nine million words, whereas others were near 33 million in a three-year period (Hart & Risley, 1995). Another finding was that the IQ score of the child had a strong correlation to the word count. They also found that parens with low socioeconomic status talked less to their children, than parents with high educational level. Parents with high educational level also had more qualiy features in their language stiimulaton which benefitted their children, than parents with low educational level. However, the single most important variable of cognition and a child's later academic success was the word count of the parent.

In 2006, the LENA foundation conducted Phase one of "*The LENA Natural Language Study*", with 329 participants with 12 hour-long recordings (Gilkerson & Richards, 2009). The study consisted of recording sessions one day each month, for six months. For the second phase, 80 of the participants were chosen to continue in a longitudinal study from July 2006 consisting of monthly recordings. In December 2007, the recordings counted as many as 32 000 hours of data. The LENA study was compared with the Hart & Risley (1995) study conducted in 1995. In comparison, the LENA study had remarkably similar findings to the Hart & Risley (1995) study. Some of the coinciding results from the two studies were that parents estimated that they spoke more to their children than was recorded. Children of talkative parents were also talkative. The more TV time reported in a day correlated with lower language ability score. Most adult talk occured in mornings and late afternoon, compared to other times of the day (Gilkerson & Richards, 2009)

Seemingly, environmental aspects like quantity and quality in communication is important predictors for early language development. There are yet few studies that has investigated the importance of these factors for communication abilities in adulthood and in elderly with e.g. degenerative diceases like dementia or comorbide conditions like dementia and hearing loss.

1.2 Deafness and dementia

This current studys purpose of the current study was to explore the current handling method on the individuals with hearing impairment as well as dementia. As mentioned, this vulnerable group have a comorbidity that effects the communication in a cumulative manner. Taking into account the information in sub-chapter 1.1, the following research question are as follows:

- How are older adults with hearing impairment and dementia communicating, and what does their listening and speech environment look like, measured with the LENA-method?

- Can the LENA-method provide adequate assessment of the audio environment and verbal communication in elderly with dementia and hearing loss compared to a healthy control with normal hearing?

- Are there any socio-ucltural similarities and differences detected by LENA in audio environment and communication patterns between elderly in Norway and USA?

The first research question is a mapping of a current state in the society, at one point in time. The second research question is nessesary for the new technology to be approved and acknowledged as a measurement tool, to provide the field with further information and the third question concerns the first two and adds the impact of socio-cultural aspects.

This thesis is ment as a pilot study, as evaluating and implementing a new assessment tool in a vulnerable and sensitive clinical group turned out to be more demanding than initial thought, at least within a restricted time and study process.

1.3 Personal experience

The motivation to write this thesis was based on my personal experience as a daughter.
I am next of kin to my lovely dad who was very unfortunate to get the devastating diagnosis called Alzheimers 4 years ago. The choice of topic for the thesis is a reflection of me as a professional, a teacher of the deaf, and of me as a person. Therefore, my personal experience may in some way affect the viewing of this paper, and it could potentially be reflected in the results. As a researcher it was sometimes challenging to put aside the personal emotional baggage, and enter a state with an objective viewpoint. However, it is also important to emphasize that my high personal motivation could have been benefical when e. g. studying the literature to gain deeper knowledge of the field or while planning the study in a careful, ethical way. Additionally, the LENA-results are objective and honest on behalf of the vulnerable group represented in the study.

2 Theory and current literature review

2.1 Normal aging changes

Stach (2010) estimates that over 20% over the age of 65 have some degree of hearing impairment. Stach furthermore explain that the numbers increase with age; 90% of individuals at the age of 90 have some degree of hearing loss (Stach, 2010). Consequencely, he states that “normal aging process includes hearing loss” (Stach, 2010). Normal aging processes causes changes to the body, both physically and mentally. Dettmer, Pourmoghaddam, Lee, & Layne (2016, p. 1) states the following: “…there is a constant decline of sensory functioning and associated sensitivity to stimuli, which begins around the 4th to 5th decade of life with a more rapid decline during the 7th decade”. Moreover, Dettmer et al. (2016) indicate that sensory functioning failure in combination with motoric function and cognition cause dual-task processing challenges among elderly adults with less cognitive capabilities.

Aging causes degeneration in the motoric limb and grip strength (Heron & Chown, 1967; Anstey, Lord, & Williams, 1997). Wongrakpanich, Petchlorlian, & Rosezweig. (2016) highlights a less obvious dysfunction that comes with aging, the *olfaction* (sense of smell). A study conducted by Attems, Walker & Jellinger (2015) stated that 50% of individuals between the age of 65 and 80 are exposed to *olfaction* dysfunction, and the prevalence increased to 80% of those aged above 80 years. A study conducted by Humes (2015) showed that normal age-related changes in global sensory processing (audio, visual, olfaction, taste etc.) can result in a cognitive degeneration.

2.1.1 Hearing and cognition

Cognitive decline in normal aging is often linked with structural brain changes (Fjell, McEvoy, Holland, Dale & Walhovd, 2014. In their study, Fjell et al. (2014) revealed a tendency that atrophy in certain brain regions was higher among elderly adults than in middle-aged adults. These changes also occur in the central auditory nervous system (Stach, 2010). Degeneration in the auditory nerve, brainstem and cortex are all parts of an aging process, and is better know as a Sensorineural hearing loss (SNHL) (Stach, 2010). SNHL often decreases the ability for individuals to recognize speech (Tye-Murray, 2014).

Effectively, the hearing impairment in elderly contains both auditory processing disorder (APD) and the distortion of incoming sounds through the auditory periphery (Stach, 2010).

The signal-to-noise (SN) ratio also seems to be an indicator of cognitive aging. A study conducted by Pichora-Fuller, Schneider, Daneman (1995) used SN ratio to rate word recognition in younger (20-30-year-olds) and elderly adults (60-70-year-olds). The ability of word recognition was compromised in the older adults, when the multi-speaker crowd noise signal was amplified. The SN ratio needed to be substantially increased for the older adults to be able to compare the results of the younger adults in the study. Additionlly, it seemed that older adults managed better than the younger group when it came to testing contextual cues in high frequency noise conditions. These results suggest that older adults use their long-term memory when understanding speech in noise environments.

Studies have shown that brain development and functioning are affected by the exposure of stimuli, e.g. music-making can strengthen non-musical brain function such as speech in noise, attention and memory (Kraus & Chandrasekaran, 2010; Strait & Kraus, 2013). Furthermore, the years of musical training correlates with the ability to distinguish speech in noisy environment (Parbery-Clark, Skoe, Lam, & Kraus, 2009). These prvious studies show that there is a link between cognition and brain function related to listening experiences and stimuli through the auditory system, in combination with individual cognitive processing skills and a person´s knowledge level. In addition, the Hebbs law states that nerve cells that fire together, wire together (Hebb, 1949, p. 65). This suggest a certain “use it or lose it” concepts of the synapsis (where the information is transmitted into another nerve celle) in the brain, as the inactive synapsis are eliminated, and active synapses are strengthened.
As a result, an elderly brain could have strong and healthy synapses containing only what is necessary. However, this condition is depended of otherwise normal cognitive functionins.

2.1.2 Communication in elderly with typical aging

When mutally conversing there are some implicit rules to follow, such as tacitly agreeing to share one another’s interests as well as choosing subjects of conversation (Tye-Murray. 2014). Takeoka & Shimokima (2002) investigated conversational styles in older adults (80-year-olds), in comparison with conversational styles among younger adults (20-30-year-old).

In their study they revealed that conversation with elderly adults were slow-paced and exceeded the general impression that elderly adults understand things more slowly.
The researchers also noted that elderly adults used more *general-purpose* acknowledgments in conversations, such as “uh-huh” and “mmm”, but used less acknowledgements initiating conversation, such as “Oh?” etc.

Auditory processing disorder, as mentioned above in sub-chapter 2.1.1, is a consequence of the normal aging process. This factor in combination with distortion of sounds could affect the communication abilities negatively among elderly. When communication is difficult, some individuals tends to socially isolalate themselves (Mick, Kawachil & Lin, 2014), because communication becomes too effortful and tiresome (Tye-Murray, 2014). Other risk factors of social isolation among older adults could be: living alone, cognitive impairment, and poor social skills (Machielse, 2015). On a contradict, social support and helping behaviours from family have a positive effect on elderly adult’s life satisfaction (Bai, Yanh & Knapp, 2016).

2.2 Deafness and hard of hearing – Older adults

Hearing loss may inflict a person’s life in all life stages, and vary in form and degree of impairment. The topic of this paper is exclusively related to hearing impairment caused later in life, hence an age-related hearing loss. This type of hearing loss is often described as aquired sensorineural hearing loss (SNHL).

In a normal functioning ear, sound is received by the outer ear, and the sound wave vibrations are registrered through the tympanic membrane (Stach, 2010). The membrane sends the vibrations to the ossicular chain in the middle ear. The three small bones transfer vibration through the oval window and into the cochlea (Stach, 2010). The cochlea is a fluid filled complex organ with the shape of a snail shell. The shell consists of three individual tunnels, with thousands of small hair cells. The purpose of the hair cells is to transform the incoming signal from the fluid vibration into electrical signals, and forward it to the VIIIth brain nerve (Stach, 2010). The signal in the VIIIth nerve is then sent through the central nervous system, and through auditory radiations into the auditory cortex in the temporal lobe in the cranium (Stach, 2010). The cochlea can in some cases have difficulties to transmit the mechanical movement signals from the middle ear, into electrical signals through nerveending of hair cells, in to the VIIIth nerve. This type of failure conducts both a sensory and a natural hearing loss. Therefore, a SNHL is the result of sensitivity reduction, due to that the sensory or neural cells are absent or not well-functioning (Stach, 2010).

2.2.1 Presbyacusis

Presbyacusis is defined as an individual's decline in hearing level as a part of the aging process "...which cannot be attributed to other causative factors" (Stach, 2010, p. 171). This definition will not include factors like genetic predisposition, ototoxic drugs and so forth, as it is demanding to separate these individual factors (Gates & Mills, 2005). As mentioned in sub-chapter 1.1, there is an estimate of 450 000 people in Norway that have an age-related hearing loss.

Presbyacusis is related to ageing, as the auditory system naturally degenerates. Hair cell loss in the cochlea is one of the factors that leads to this type of sensorineural hearing loss (Stach, 2010). In an audiogram one can assume the individual has a sensorineural hearing loss if the air- and bone-conductied threashold graphs coincide with one another (Stach, 2010).

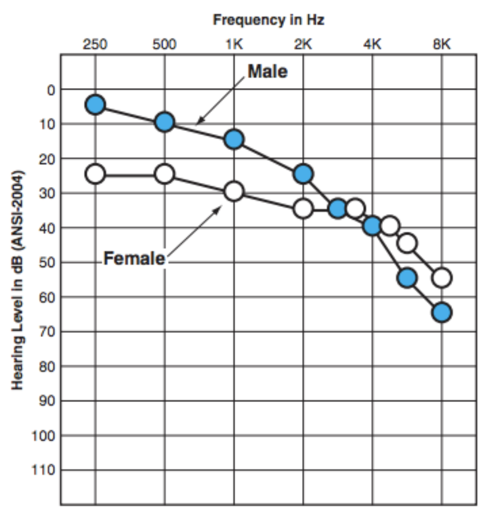

Figure 2.2.1.A: Presbyacusis in both genders shown in an audiogram (Stach, 2010, p. 174)

The shape of an age-related hearing loss presented in an audiogram is typically characteristic, bilateral, and does not differ much in appearance. In the audiogram displayed in Figure 2.2.1.A one can see that the highest frequencies are affected, from 4kHz and above. The hearing threshold also gradually decrease in the lower frequencies. When an individual has a hearing loss in the frequencies between 2-4 kHz it affects the "speech frequencies" as described in Stach (2010). These frequencies determine the speech threshold and the specific hearing sensibility with the most meaningfull feature information abouth consonant sounds in spoken language (Stach, 2010). Senior adults with presbyacusis might have difficulties understanding speech and additionally also have lowered hearing threshold. Figure 2.2.1.B gathered from Stach (2010) displays a speech audiometry example of the extent of speech recognition one can expect in individuals with presbyacusis.

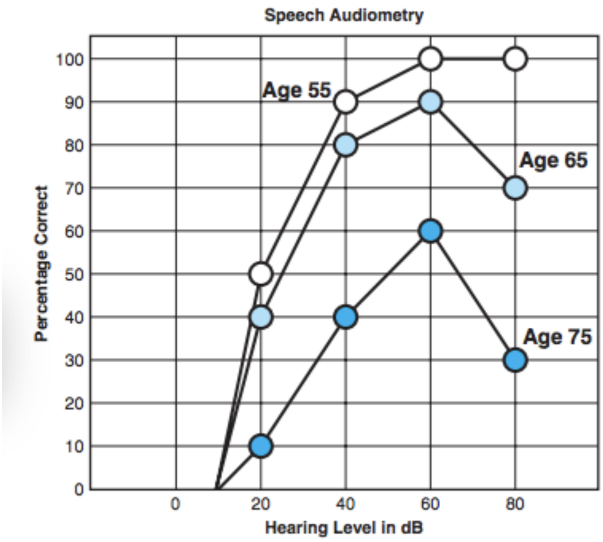

Figure 2.2.1.B: Showing distortion of speech at the age 55, 65 and 75 (Stach, 2010, p. 175).

At the age of 55 the corrected speech recognition percentage is at 100% when amplified at 60 dB. Meanwhile, at the age of 65 the percentage is 90% at 60 dB amplified. With increased decibel, the percentage of correct speech recognition will decrease due to a distortion of speech (Stach, 2010).

A study with over 50 000 participants from five different towns in northern Norway managed to create standardized hearing threshold levels for both male and females of different ages (Engdahl, Tambs, Borchgrevink & Hoffman, 2009). Participants in this study vary from 20 years and up to 89 years of age. The results showed an exceeding in hearing threshold level with age, and ithat it was gender specific. Male subjects, as illustrated in Figure 2.2.1.A, showed a substantially higher threshold level than for females. Therefore, the hearing level threshold should not only be scaled with age, but also with gender. This result reflects what Stach (2010) describes, which is that women tend to have flatter audiometric configurations than men.

(1) Hearing aids and communication

When a hearing disability affects the individuals' communication, even mildly, one logical first step would be to consider treatment by using hearing aids (HAs). By using HAs one can maximize the use of resudidual hearing (Stach 2010, p. 530). If the hearing loss progresses to become a severe or profound hearing loss, one can consider a cochlear implant (CI). Therefore, communicating with elderly adults could treveal and rack such progression. Stach (2010) states that most patients with SNHL may benefit from HAs amplification.

Individuals with hearing impairment often socialy isolate themselves due to the difficulties in communicationg (Tye-Murray, 2014). Use of HAs could help to prevent the isolation by making communication with others easier. Dawes et al. (2015) found that social isolation was associated with poor cognition and with poor hearing (Dawes et al., 2015, p. 6).
One explanation of the link between HAs and cognition could be that HAs may enhance the self-efficacy; The belief that one is capable of controling and executing a given task.
As hearing loss is associated with reduced self-efficacy, HAs could assist individuals by succeed the state of low self-confidence (Kramer, Kapteyn, Kuik & Deeg, 2002).

Stach (2010) supplements that elderly aduts could have difficulties in processing rapid speech. In the combination with functional leason in the nervous system, HAs can not benefit the individual optimaly alone, but one should therefore also consider other *hearing assistive technologies* (HAT). Such assistive technologies could be personal amplifiers, personal FM systems and telephone apmlifiers (Stach, 2010). Personal amplifiers could e.g. exclude unwanted background noise, as it has one directional microphone. However, it requires strict communication rules, since only one individual can talk at a time (Øverland, 2011)

(2) Hearing aids use and fitting of HAs in an elderly population

Individuals qualified for HAs can apply to the National insurance Authorityto receive funding in purchasing hearing aids (Folketrygdeloven, 2017). Additionally, paragraph §6-3 in the National Insurance Act, provides an amount in funding technical maintenance (Folketrygdeloven, 2017. However, these benefits only apply if the individual has a permanent hearing impairment effecting everyday life through illness, injury or other drawbacks (Folketrygdeloven, 2017).

Hearing aids mainly consist of three components: A microphone, an amplifier and a loudspeaker. Regardless of being placed either in the ear, in the ear canal, or behind the ear (BTE), all types of HAs consist of these components. An input signal can be sent through the first component, a microphone, which is either an 'omnidirectional microphone' (sensitive to sound from all directions) or a 'directional microphone' (focus on sound in front of the consumer/user). Some new HAs are fitted with both omnidirectional and directional microphones. Having both omnidirectional and directional microphones maximizes the benefit of the HAs in noisy environments (Stach, 2010). In most BTE HAs it is possible to switch and connect to other alternative input sources. One such source is the telecoil technology. The telecoil technology is inexpensive, only relying on a magnetic field of electric signals. However, use of telecoil also makes it a fragile technology as it risks interference with other electrical signals (Laukli, 2007). The second component, the amplifier, is the core of the HAs. Its purpose is to boost the electrical signal received from the input, and into the loudspeaker of the HAs. The amplifier can focus on boosting and limiting certain frequencies to give the consumer a custombuilt soundscape (Stach, 2010). However, this is more difficult in practice than described theoretically. A HA would often amplify background noise such as crakles with paper, reverbation and distant speech. Discussing the expectations of HA use could help the individual prepare for a more realistic understanding of HA use, and therefore passively influencing the use of HAs and maybe reduce the number of non-users og HAs (Tye-Murray, 2014).

Even though the HAs are fitted for a modern use, with the small size components and see-through tubes, some of them will still end up unused in a bedroom drawer. Solheim & Hickson (2017) reported that 15,5% of the participants aged 79 years never used their HAs, which also has been seen in previous studies (Solheim, Kværner & Falkenberg, 2011). Stach (2010) argue that poor physical ability in elderly, such as fine motor coordination, makes it difficult to properly maintain the HAs. Due to the small sizes, changing batteries could be especially challenging among the elderly population. Therefore, giving an orientation to the user about the HA and HA usage could make the user more aware about its use and maintenance. With adequate information, preferably both in writing and practice, it would benefit the usage and indirectly the hearing health of the individual and decrease the risk of returning the HAs to the audiologist (Tye-Murray, 2014).

Assessing the needs of elderly individuals with hearing impairment is necessary to exclude such factors mentioned above: What type of HAs is suitable to this specific population with hearing loss? How are the patients´ fine motor skills – could they manage to handle the devices on their own? Is the auditory processing disorder severe or more typical for their age? Eill the HAs increase the patient's quality of life? A study conducted by Mohlman (2009) showed no change in the individuals´ anxiety-mood after the introduction of HAs use. Therefore, when revising each elderly individual´needs, the audiologist should consider giving extended hearing rehabilitation beyond hearing amplification alone (Heine & Browning, 2002). This is perhaps the only way to reduce the number of users that refrain from wearing their HAs on a daily basis.

2.2.2 Listening- and speech-environment

Listening and partaking equally in the conversation is one of the implicit rules when communicating (Tye-Murray, 2014). However, this can be very challenging for individuals with a hearing impairment, and can lead to communication difficulties. As mentioned above in sub-chapter 2.1.1, the signal-to-noise ratio was significantly worse for elderly adults than for younger adults. With a low SN ratio and a high-frequency hearing loss, such as presbyacusis, listening and communicating in noisy environments full of reverberation could be intolerable.

To understand the concept of reverberation in listening environments, one has first to obtain an understanding of the acoustic energy of sounds. Sound is pressure waves made of densification and dilutions of molecules. Sound waves sent from an audio source defines the sound frequency', and is specified in Hertz (Hz). The Hz is calculated by the length of wave peaks in-between each sound wave (Laukli, 2007). Another characteristic feature of sound is its amplitude of sound pressure. Sound pressure is expressed in pascal, and later calculated into a more understandable sound pressure level of decibel (dB) (Laukli, 2007). The acoustics of normal amplified speech generates a sound pressure level at 50-60 dB with a distance of one meter. Normal frequency of speech signals by adults range between 100 Hz and up to 8000 Hz (Laukli, 2007). When a sound signal is sent, for instance speech, some of the sound signals reach a surface (walls, floor or ceiling) and as a result some of the energy is reflected. When the sound is reflected by the walls and is sent to different surfaces of the room it creates a reverberation (Laukli, 2007) This reverberation can create a difficult soundscape to the individuals in the speech-environment. The energy not reflected is either absorbed by the surface material or passes on to the next room (Laukli, 2007).

The vowels and consonants in spoken language are represented in the speech banana in Figure 2.2.2.A represented below. The purple field displays high frequency consonant sound such as for instance "*th*" and "*s*". High frequency sounds are relatively weak in acoustic energy, whilst low frequency vowel sounds are more powerful in energy (Laukli, 2007; Stach, 2010). Weak acoustic sounds are more easily masked and covered by noise of any kind. Therefore, "…the most important speech sounds are the least likely to be perceived" according to Stach (2010, p. 125).

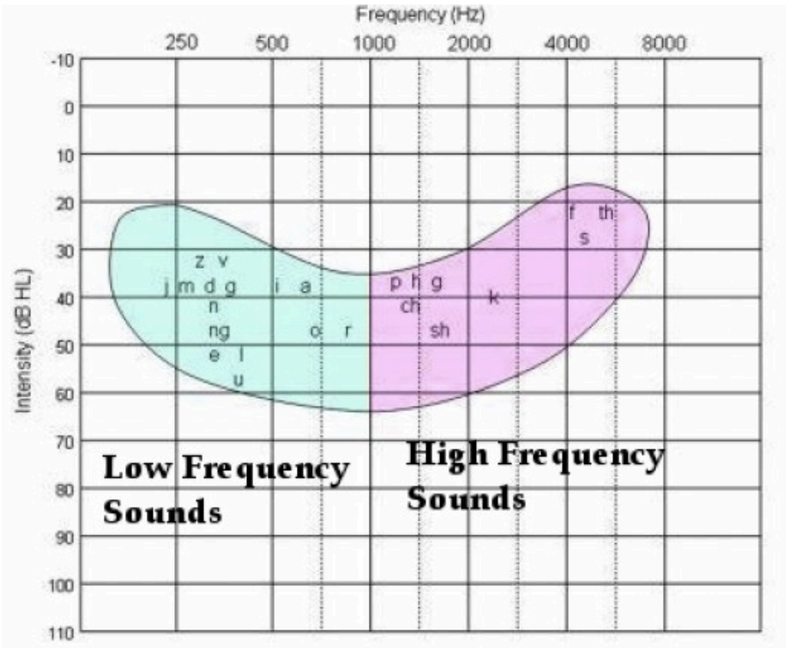

Figure 2.2.2.A: The speech banana showing the intensity (dB) and frequency (Hz) (An Audiogram, 2017).

The high frequency consonants are the most meaningful phonemes in spoken language (Stach, 2010). In addition, one can see that the weak high frequency sounds are more easily absorbed into walls and building structures, whilst the low frequency sounds creates reverberation (Laukli, 2007). Consequently, low-frequency reverberation represents more acoustic power on less meaningful sounds, making the soundscape difficult to interpret. Laukli (2007) also points out that further distance from the audio source will decrease the amplitude of the signal. When doubling the length from the audio source, the amplitude decreases by 3 dB (Stach, 2010).

Large rooms with hard surfaces will therefore increase the reverberation of low frequent vowels, and increasing the distance from the sound source will also decrease the amplification (Fogerty, Kewley-Port & Humes, 2012). Visual interpretation could make up for the bad SN ratio and provide the individuals with adequate speech understanding, as high frequency consonants are easier to lip-read (Stach, 2010). Lip-reading is a communication strategy in noisy environments (Tye-Murray, 2014). A visual stimulus is therefore an influencing factor in the speech and listening environment. Better visual conditions help the individual with lip-reading as well as other visible facial cues.

2.2.3 Double trouble – Hearing loss and vision loss

Vocial cues could help elderly individuals with hearing loss to gain better communication strategies. However, Wongrakpanich et al. (2016) provide grim figures by estimating that nine to 18% of elderly have visual impairments. As a contrast to presbyacusis, presbyopia is a "…universal age-related vision change" (Wongrakpanich, et al, 2016, p. 764), and occurs in 90 % of adults living in nursing homes (Elliott, McGawin & Owsley, 2013). In nursing homes as many as five to 21 % of patients have a defined combination of vision and hearing impairment (Brennan, Horowitz & Su, 2005; Brennan, Su & Horowitz, 2006; Smith, Bennet & Wilson, 2008). Øverland (2011) reported that one in ten residents in nursing homes have a combination of this typical dual impairment condition. Solheim et al. (2016, p. 482) reported this as 'double trouble'.

Stach (2010) clarify the importance of visual ability and communication, and that it could have an impact on hearing treatments, such as communication strategies. Stach furthermore states that visual acuity could "reduce the prognosis for successful hearing treatment" (Stach, 2012, p. 545). Individuals with visual impairments could use their hearing to recognize familiar voices, as well as individuals with hearing impairment could use their visual ability to lip-read and mimic. 'Double trouble' reduces the opportunity to take advantage of any residual vision and/or residual hearing as a communication strategy (Øverland, 2011).

The consequences of this dual sensory impairment have shown to impact on individuals' functional abilities, including social functioning (Wallhagen, Strawbridge, Shema, Kurata & Kaplan, 2001). These claims confirm that Solheim et al. (2016) enlightens a significant link between sensory loss and need of assistance in daily activities. As a consequence of the double trouble, needing assistance with daily activities could lead to the development of depressive symptoms in individuals, and decrease the sense of sense of achivement. Depressive symptoms could furthermore be related to a worsened cognitive function, and therefore projects a cumulative effect (Kiley, Anstey & Luszcz, 2013).

2.3 Dementia and Alzheimer

> *Sykdommen Alzheimer er skummel, og uforutsigbar. Den lever i vårt indre, vi vet den er der for å lage problemer. Kanskje det er på tide å endre strategi, å møte Alzheimer offensivt og kjempe tilbake. Kanskje kan Alzheimer bli en venn? En som vi konfronterer aktivt når han gjør seg vrang. Vi må lære oss å kjenne sykdommen for å kunne slå tilbake.* (Nasjonalforeningen for folkehelsen, 2017, 28.05)

Written by Knut Erik Olsen (Nasjonalforeningen for folkehelsen, 2017, 28.05). These strong words from an individual with Alzheimer challenges the way we might see the diagnosis, and encourages to treat it differently. It is important to understand the diagnosis, in order to fight back.

2.3.1 Diagnostic Dementia– Similarities and differences

All though dementia is a collective term, the differential diagnosis within the term does variate in practice. Which area of the brain that is affected by dementia determines how the disease will unfold. The most common form of dementia is Alzheimer's disease, which affects the area in the brain called hippocampus. Hippocampus processes information from the short-term memory to the long-term memory and spatial memory, enabling orientation in time and place (Nasjonalforeningen for folkehelsen, 2017).

Among the early signs of dementia like memory loss and disorientation, the language difficulties are one of the main topics in this thesis. People with dementia will in some cases struggle with finding the right words in the right moment, and sometimes use words that makes no sense in the context of the conversation (Nasjonalforeningen for folkehelsen, 2017). Loss of initiative is also one of the early signs of dementia (Nasjonalforeningen for folkehelsen, 2017). Distancing from hobbies and social activities is not unusual behaviour for older adults. However, for some people with dementia they will distance themselves in a more severe degree from daily activities and socialization (Nasjonalforeningen for folkehelsen, 2017). Some studies have concluded that lack of social interactions is a risk factor for incident dementia (Kuiper et al, 2015).

Previous research studies have linked hearing impairment to dementia, seemingly based singularly on the Alzheimer's diagnosis, as it is the largest group of dementia. Sixty percent of people with dementia are diagnosed with Alzheimer's disease (Nasjonalforeningen for folkehelsen, 2017). Uhlmann, Larson, Rees, Koepsell & Duckert (1989) claimed that the auditory neuropathology of Alzheimer's disease was adequately described, and therefore was the single diagnosis of dementia they included in their study. Therefore, the Alzheimer's disease is an attractive diagnosis to study in this paper as it has a well-documented auditory neuropathology and is comparable with other studies (Uhlmann, et al. 1989).

2.3.2 Laws and regulations – Dementia

When treating individuals with dementia in nursing homes, some additional rights and regulations apply. In the Norwegian law Helse- og omsorgstjenesteloven the main purpose is to ensure quality in health care services, such as equitable assistance when needed. §3-3 states that municipals should promote health and seek to prevent illness (Helse- og omsorgstjenesteloven, 2011). Additionally, the paragraph specifies that this includes facilitating the patients' own home with necessary equipment. Municipals should function as informative, guiding and advisory institutions when providing health services according to §3-3. Individuals diagnosed with an advanced stage of dementia have the right to be admitted to a nursing home as this right applies to individuals with a long-term illness with no chance of recovering (Helse- og omsorgstjenesteloven, 2011).

Although individuals with dementia need socialization, as mentioned in sub-category 2.3.1, they also simultaneously have to be protected from exposure of too much visual and vocal stimuli in the same time (Nasjonalforeningen for folkehelsen 2017, 21.04). Therefore §4-7 in Forskrift for sykehjem m.v. (2013) helps to ensure that municipalities establish protected units for individuals with dementia, and that these units should only host between 4-12 residents. The regulation aims to protect the patients from excessive stimuli as well as facilitating socialisation within the unit. Patients residing in the unit have the right to access benefits and activities on the same level as any other resident outside the protected unit. Paragraph § 4-7 therefore helps to create a social environment for Norwegian individual's with dementia without the exposure of excessive vocal and visual stimuli (Forskrift for sykehjem m.v., 2013).

To help establish each patients' needs, one can acquire an Individual Plan (IP) for the patient. Paragraph §7-1 in Helse- og omsorgstjenesteloven (2011) states that the municipality can develop an IP to better help each patient attain satisfactory services on an individual level. The paragraph is intended for persons with excessive long-term needs from several health service providers. Developing an IP may in some ways give structure in the ways of handling and receiving health care services. The plan is developed in line with the individuals needs, which constantly changes (Wallander, 2017).

When developing an IP, it is created based on the goals and wishes of the service recipients'/ patients. Meetings are coordinated by the health service providers involved in the development of the Individual plan. However, in some cases, the patient is excluded from these meetings, due to stress and the overwhelming amount of information. In cases where patients are excluded from the meeting, the power of attorney can be administered to one or several individuals to represent the patient (Vergemålsloven, 2013). Power of Attorney can be pre-defined such as his or her authorisation is valid once the patient no longer is able to take care of own interests. This authorisation gives the attorney authority to act in all legal or financial aspects that have been pre-defined (Vergemålsloven, 2013). When needed, patients with lack of capability to take care of their own interests, can have a custodian appointed. With legal basis in Vergemålsloven (2013) §20 a custodian can make economic decisions as well as all legal aspects.

2.3.3 The link between dementia and hearing loss

The first study to suggest a hypothesis between dementia and hearing loss was presented by Uhlmann et al. (1989). They found that the degree of hearing loss significantly correlated with the severity of cognitive dysfunction, which has been confirmed in latter findings by Lin et al. (2012). These findings by Uhlmann et al. (1989) suggested that participants with a hearing loss of 0.52 dB/year was linked to a later development of dementia. An annual hearing loss of 0.27dB however, was normative of individuals without dementia. Uhlmann et al. (1989) furthermore stated the following: "...we do not wish to imply that it (hearing impairment) might ´cause´ Alzheimer's disease in a pathophysiological sense; rather, hearing impairment would probably expose or exacerbate the symptoms of dementia" (Uhlmann et al, 1989, p. 1918). The link found between the two diagnoses was later proposed by Lin et al. (2013). Lin et al. (2013) found that individuals with hearing impairment have an increased risk of cognitive impairment, but the links pathway between them are still unclear. Gurgel, Schwartz, Foster & Tschanz (2014) suggested that hearing impairment is a marker for cognitive dysfunction in elderly adults. Whether or not hearing loss is a cause, a possible marker, or an aggravating factor to the atypical cognitive decline, has not yet been concluded in the literature. This form of *comorbidity* will be investigated more fully in sub-chapter 2.4. Panza, Solfrizzi & Logroscino (2015) listed nine different longitudinal population-based studies whom all have investigated the link between peripheral hearing impairment (inner ear nerve endings and the VIII nerve) and cognitive decline. Some studies claimed that hearing impairment independently were associated with cognitive decline, whilst one study found no association with decline in cognitive domain. However, this study had a two-year follow-up, whilst other studies had up to 17-year follow-ups, which could have effect the results.

2.3.4 Comorbidity

Comorbidity has numerous definitions due to discrepancies between authors. Degenhardt, Hall & Lynskey (2003) defined it as "the co-occurrence of two or more mental health problems", although the definition could be more complex. In this study comorbidity included other physical occurrence of disorders, such as hearing loss and degenerating of brain matter, like dementia. These two disorders are not limited to mental health, but also a disorder of physical state.

The type of relationship within the comorbidity will indicate what structure each disorder causes. Expert opinions seem to be divided when it comes to the association between Alzheimer's disease and deafness and the comorbidity pathway. A study conducted by Schäfer et al. (2010) showed a causal and random comorbidity where the same risk factors were in association with both disorders by chance. Another study concludes that there is a greater risk of developing Alzheimer's disease for patients who already have a severe hearing loss (Lin, et al. 2012). With more severe hearing loss comes greater risks of developing Alzheimer's disease (Lin, et al., 2012). This suggests a prognostic comorbidity according to (Jakoljevie, & Ostojie, 2013).

Several variables also seem to frequently co-occur between the two diagnoses. Uhlmann et al. (1989) exemplifies that hearing loss reduces the environmental stimuli and decreases orientation, which is an early sign of dementia. Individuals with hearing impairment could often become socially isolated (Tyre-Murray, 2014), which furthermore could lead to depression (Dawes et al., 2015). Uhlmann et al. (1989) also linked hearing loss to depression, which has a significant effect on the cognitive functioning. A study conducted by Frtize et al. (2016) showed similar results, stated that depression had a significant effect on dementia diagnoses. They further stated that the risk of developing dementia increased by 36 % when the individual was diagnosed with a depression. In addition, the study showed that both variables (hearing impairment and depression) was significantly associated with a faster transition to dementia.

Auditory sensory deprivation has also been connected to cognitive deterioration, since poor auditory input from a hearing impairment could lead to atrophy (Valentjin et al., 2005). A study conducted by Dawes et al. (2015) found that poor hearing was significantly associated with social isolation. Additionally, other research also concluded that social isolation was associated with incident dementia (Kuiper et al., 2015). Dawes et al. (2015) further suggested that an un treated hearing loss could lead to auditory deprivation. Consequently, the untreated hearing loss could result in an increased cognitive decline over time.

The diagnosis could also affect each other in destructive ways. When testing cognitive functioning, verbal tests are often used, such as the MMST and modified versions of MMST (Lin et al., 2013). Because hearing impairment could affect the speech perception, it could result in false diagnosis, or an underestimation of cognitive functioning (Uhlmann et al., 1989). Although, this could lead to false diagnosis in some dementia diagnoses. Alzheimers disease, Levy-body dementia and Frontal lobe dementia have very specific diagnostic criteria and is less likely to be diagnosed incorrectly (Lin et al., 2013). A decrease in cognitive reasoning, such as short-term memory, is also affected as the auditory perception requires a greater proportion of the individuals’ cognitive abilities (Gurgel et al., 2014).

2.3.5 Dementia and Hearing aids

Uhlmann et al. (1989) implied that if hearing loss is a risk factor for dementia, HAs could not prevent cognitive degeneration. However, Uhlmann et al. (1989) believed that HAs could reduce the symptoms. It is still discussed by researchers whether HA could slow down the degeneration, or even reverse the cognitive atrophy. Mulrow et al. (1990) measured an improvement in cognitive functioning in some individuals with dementia who used HAs. Secondly, Choi, Shim, Lee, Yoon & Joo (2011) measured a significant improvement in the short-term memory in individuals with dementia after HAs usage. The latest study by Wong, Ye, Chan & Tong (2014) stated there were still a significant decline in cognition of individuals with dementia, although speech and sound sensitivity was improved by HAs.
In the study by Kalluri & Humes (2012) it was reported that a short-term use of HAs could improve immediate cognitive functioning. Nonetheless, there was limited evidence of a long term-usage, which coincides with the study from Wong et al. (2014).

Stach (2010, p. 545) list factors that could affect the usage of HAs and other hearing management programs for elderly individuals with hearing loss. Such factors are: the mental status, psychological well-being, social environment, attitude and motivation. In addition to these factors, the timing of a hearing impairment could be an additional challenge for people with dementia. Being diagnosed with dementia prior to a hearing impairment could make it especially challenging for individuals to adjust to the new sound scape provided by use of HAs (Øverland, 2011). However, if the individual was diagnosed with a hearing impairment prior to a dementia diagnosis, the sound scape would be similar, and use of HAs should continue. Therefore, HAs should be adjusted as soon as a hearing loss is revealed, since it could be difficult to adjust at a later time. Øverland (2011) suggests another alternative for those who were diagnosed with dementia prior to a hearing loss. A voice amplifier could be an adequate alternative for individuals within in this scenario. A personal voice amplifier could exclude unwanted noise and shield the individual from excessive stimuli (Øverland, 2011).

2.3.6 Communication and dementia

As there is currently no way of treating dementia, the society and researchers have directed their focus also on increasing the quality of life of those individuals affected. Partaking in the communities and social activities is suggested as therapy methods for individuals with dementia. However, communication could be more difficult as individuals could struggle with word perception, and difficulties with expressing themselves (Nasjonalforeningen for folkehelsen, 21.04). The Norwegian National Institute for Health and Clinical Excellence (NICE) in corporation with Social Care Institute for Excellence (SCIE) have published guidelines with recommendations to appropriate treatments to secure the quality of healthcare (National Collaborating centre for Mental Health, 2007). The purpose of these guidelines is to provide care practitioners and service commissioners with evidence-based good-practice of individuals with dementia. The guidelines states that individuals with dementia should have their voices heard in the planning, reviews, regulations, and development of services they are part of and involved in (National Collaborating centre for Mental Health, 2007).
These guidelines seem to align with the concept of empowerment, which enables individuals to take control and influence on their own life, health and wellbeing.

The communication between a care-giver and patient could be both calming and aggravating. The NICE-SCIE guideline 8.6.3.1. states that poor communication between patients with dementia and staff members are one of the risk factors to a violent and aggressive patient behaviour (National Collaborating Centre for Mental Health, 2007). Secondly, the guidelines on communication emphasizes the importance of empowerment by promoting independency among individuals with dementia. Additionally, guideline 7.2.2. states that communication strategies could improve personal skills and reduce the need for dependency care (National Collaborating Centre for Mental Health, 2007).

The 7.2.2. guidelines further explain what “good communication” means (National Collaborating Centre for Mental Health, 2007). They state that being aware of non-verbal cues in combination with knowledge regarding sensory abilities and socio-cultural differences, makes good communication between the patient and staff. By testing different responses and adapting to different tones and rates of speech, one can make the communication with the patient easier (National Collaborating Centre for Mental Health, 2007). Good communication situations and verbal assistance could help patients with dementia performing a task, rather than the care giver "takes over" and preforms in their place.

Communicating with written words or pictures is also possible ways of maintaining good communication. The guidelines conclude with:

> The importance of and use of communication skills for working with people with dementia and their carers; particular attention should be paid to pacing of communication, non-verbal communication and the use of language that is non-discriminatory, positive, and tailored to an individual's ability (National Collaborating Centre for Mental Health, 2007, 9.7.1.2.)

A way of communicating with text and picture could be through memory books, which includes images and statements from the individuals' earlier life experiences. Furthermore, memory books could be used to recall memories, and to initiate higher quality in the communication with the patient. Such non-verbal communication techniques seem to improve communication between the care giver and care receiver (Allan, 2001 in National Collaborating Centre for Mental Health, 2007, 9.4.3.). The guidelines furthermore state that if the individual with dementia have specific problems with communicating, a speech and language therapist could assist with appropriate strategies for training and guiding of caregivers.

2.4 Nursing homes and communities

2.4.1 Laws and definitions

Municipalities are required by law to give inhabitants essential health care services (Helse- og omsorgstjenesteloven, 2011). Essential health care services include; medical services, RGP scheme, social-, psycho-social and medical rehabilitation. As a result of this regulation, municipalities are also responsible for institutions, including both nursing homes and shared housing accommodations (Helse- og omsorgstjenesteloven, 2011).

A patient or a user, who has been diagnosed with dementia after a proper professional interdisciplinary investigation, have the right to demand residence in a nursing home or similar housing, adjusted for services round-the-clock (Pasient- og brukerrttighetsloven, 2001). In order to distinguish the differences between being a *patient* or a *user*, one must evaluate which assistance measures the care recipient requires. A *patient* is defined as someone who addresses health care services with a request for medical care. A *patient* can also in individual cases be offered health care services when applicable. These health care services include preventative, diagnostic, therapeutic, preserving and/or rehabilitating services by healthcare professionals. On the other hand, the definition of a *user* relates to a person receiving treatment included in the health care services that are not diagnostic, rehabilitating etc. as previously mentioned.

In this thesis the term patient will include both aspects of care-receiver.

2.4.2 Regulations and expectations

Social needs, such as social contact, activities and sense of unity, is documented in the regulations for quality in nursing and care services §3 (Kvalitetsforskrift for pleie- og omsorgstjenestene, 2017, 16.01). This regulation implies that the social aspects of patients' needs have to be adequately attended to. The main purpose of the Norwegian law *´pasient- og brukerrettighetsloven´* is as follows: "Lovens bestemmelser skal bidra til å fremme tillitsforholdet mellom pasient og bruker og helse- og omsorgstjenesten, fremme sosial trygghet og ivareta respekten for den enkelte pasients og brukers liv, integritet og menneskeverd" (Pasient- og brukerrettighetsloven, 2001, §1-1). This Law relates to patients- and users' rights and protects their interests. It furthermore includes advocating social well-being, maintaining respect for individual patients and users, as well as their integrity and dignity.

Although regulations state that social well-being is incorporated in legislations, studies show that this is not necessarily something that is practised in all aspects within the health care system. There are several studies supporting this claim. Perhaps more importantly, Solheim, et al. (2016) has published a study with the suitable title "Lack of ear care knowledge in nursing homes". In this study, over one hundred and ninety employees from different nursing homes across Norway were handed questionnaires, partaking in a descriptive study.
The study investigated the amount of knowledge and competence associated with hearing impairment as well as HAs, among health care workers. One of their most crucial results

showed that when hearing aids were not used, it was due to the residents not mastering HA use. This was applicable for over 50 % of the respondents in the questionnaire. Furthermore, the study showed that over 80 % of the respondents needed more information on maintenance of HA equipment (Solheim et al., 2016).

2.5 Traditional methods for measuring communication

2.5.1 Interview

Interviewing is one of the most common methods within qualitative research (Brinkmann & Tanggaard, 2012). Interviews help the researcher acquire knowledge about the participants' own experiences and practises. Sigstad (2014) supports this argument by pointing out that the interview method has a high focus on empowerment. With a higher focus on empowerment, an opportunity to "express their experience" (Sigstad, 2014, p. 189) is created for the participants. Additionally, Sigstad (2014) explains that this form of self-reporting is crucial for their self-determination. Other master theses have used interviews as a method for measuring communication (e. i. Kvesetmoen, 2016; Føleide, 2015). Common for these types of methods, is the use of technical instruments such as an audio recorder. The analysis of data provided through a recorder is often transcribed, and also often put in context by field notes. A qualitative method of this kind would often be time consuming. As quoted by Grues law, "Transkripsjon tar alltid mer tid enn du tror – også når du tar høyde for Grues lov", transcription will always be more time consuming and demanding than one would think.
As a consequence, quantitative data would be close to impossible, or at least very time consuming to gather with these technical instruments and a limited time frame. One of the master theses mentioned, also interviewed staff to help describe communication techniques with patients (Føleide, 2015). Secondary information provided from these interviews needs to be considered carefully when interpreting the results, as staff only can assume what makes good communication practises for their patients. Secondary information may lack several important traits and queues concerning the individuals' actual communication situation.

2.5.2 Questionnaire

Questionnaires can contain both complex and simple questions. They could be automated as web-based questionnaires, or sent by email. Either way, de Vaus (2014) points out that questionnaire design needs to take into account how the analysis of data is accomplished.

When responding to such questionnaires, participants can be tempted to answer in a way that emphasize their own capability or talent regarding the topic of question. As a consequence, de Vaus (2014) stated that socially desirable traits are over-reported, while less desirable social traits are under-reported. This could be difficult to make up for in the results, unless you take precautions to these potential misleading results. However, a questionnaire and data log study from 2013 showed that self-reported communication in mobile-phone use seemed to correlate with results obtained from telephone operators (Boase & Ling, 2013).
Even though, this study did have a slight over-reporting in the results, this was only significant for male participants (Boase & Ling, 2013). This study suggested that mobile-phone communication could be measured through questionnaires, and that predetermined responses cause less over-reporting than other methods using open ended responses.

2.5.3 Observation

By obtaining data through observing instead of an indirect approach through others points of view, one can avoid the potentially misleading "secondary information" results discussed in sub-chapter 2.7.1.

"Observasjon er systematisk innsamling av informasjon om den fysiske og sosiale verden slik den viser seg for oss direkte via våre sanser, i stede for indirekte gjennom beretninger fra andre." (Vedler, 2000, p. 9).

Vedler (2000) furthermore explains that measuring communication by observations could provide a wider perspective of children's free speech and the individuals language style.
On the other hand, being present in an observation field study could somewhat disrupt the natural settings, and only provide an indication of the behaviour in question in a more natural setting. To avoid this potential threat, new technology can help to provide assistance to a delicate situation through the use of video-observation. A few master theses using video-observations to measure communication situations seem to benefit from it, as one could revisit and clarify important parts of the recordings (Mortvedt, 2015). Moreover, the researcher could leave and re-enter whenever sensitive and important topics or activities took place. However, it is challenging to capture the more ecological everyday communication situations in life with a video-camera. In addition, the transcriptions and analysis from an all-day video-recording would be very time-consuming.

2.6 LENA – introduction of a new assessment tool

2.6.1 Introduction to the LENA foundation

The LENA method was originally primarily developed for use in paediatric populations but has the potential of being used also in adult populations (Li et al., 2014). LENA foundation is a charity based organisation located in the USA. The LENA product was inspired by the Hart & Risley study (1995). “Drs. Hart and Risley identified talk environments in the first 24-36 months of life as the single most important determinant of language ability, IQ, and school success” (LENA, 2017, 03.02). LENAs goal is to increase language development and to advance the cognitive, social, and emotional health of children. LENAs mission is also to close the word-gap, as described in Hart & Risley (1995) study in sub-chapter 2.1.2.

2.6.2 Digital language processor

The LENA digital language processor, or DLP, is a body-worn gadget the same size as a pager. The DLP is shown in Figure 2.6.2.A. The DLP records environmental sounds, such as TV and electronic sound, noise- and silence exposure. The DLP is calculated with advanced algorithms to analyse the communication recorded. The DLP also records conversational utterance such as adult word count, talking in distant (over 6 feet from the recorder) conversational turns (adult to child alternations) and child vocalization frequency (including words, babbles and prespeech sounds). Even with advanced algorithms in the DLP, there is an estimated error rate of 2 % in adult word count in comparison to transcription by humans. LENA foundation argues that the errors in word count are inconsequential as the relative values and tendency in the recordings are more important than absolute (correct) values (Gilkerson & Richards, 2009).

Figure 2.6.2.A: LENA digital language processor (Ford, Baer, Xu, Yapanel & Gray, 2008).

After recording, a LENA computer software turns the encrypted recording into readable/understandable data. The results from the software help provide parents and teachers with numbers to measure aspects of language development, e.g. interactions and conversation turns when in dialogue with children (LENA, 2017, 03.02) The foundation furthermore points out that LENA only is a screening measuring tool, and that ultimately parents have the real power of communication input. LENA results just guide the parents how to communicate more and in a more interactive way. The software available at www.lena.org nowadays also includes an online-version where the parents and teachers can upload recording information and have the data analysed by the LENA foundation. By uploading individual data recordings, it is possible to receive specific guidance by speech and hearing professionals on how to address e.g. speech and language delays and hearing loss (LENA, 2017, 04.02)

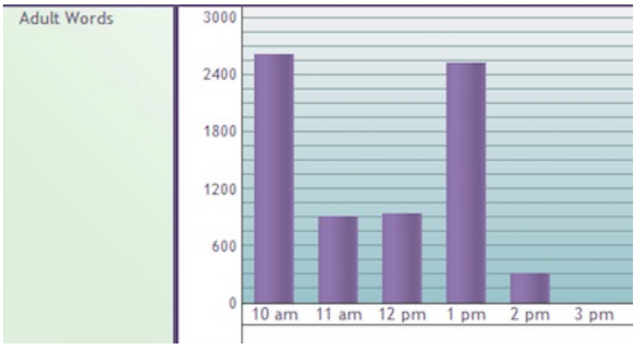

Figure 2.6.2.B: Bars represent amount of adult words spoken from 10 am to 2 pm – from current study

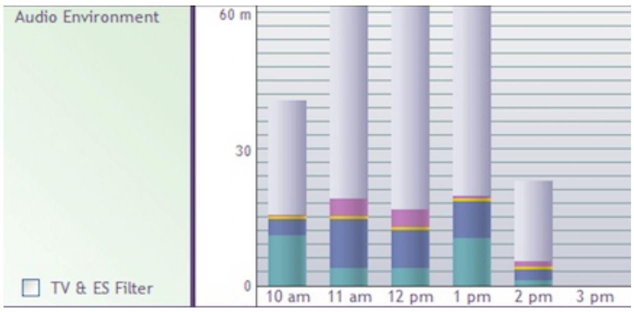

Figure 2.6.2.C: Bars represent clustered environmental sounds in minutes' hourly from 10 am to 2 pm – from current study. Grey represent Silence, pink =Noise, yellow= Electronic/TV sounds, dark blue = Distant (speech on distance) and light blue = Meaningful (speech on close distance)

The screenshots presented above shows both number of adult words spoken each hour, and the number of minutes' environmental sound exposure for each hour recorded. The complex mathematic algorithm explained in sub-chapter 1.1 are displayed in easy and understandable graphs within the LENA analysis software. If needed, the software allows the users to analyse the intervals more clearly, by displaying a five-minute composite view as displayed in Figure 2.6.2.D.

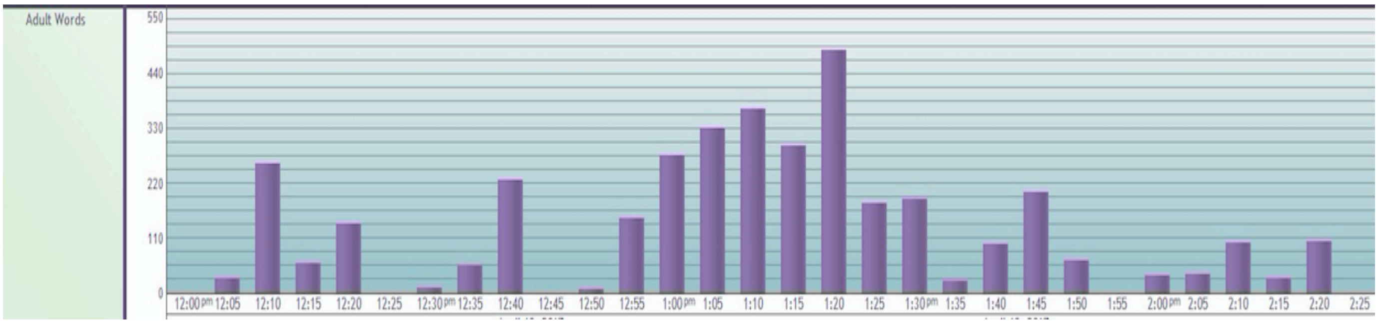

Figure 2.6.2.D: Five-minute composite view of adult words recorded between *noon* and 2.45 pm.

2.6.3 Current use and research

The LENA program is widely used in communicative research in the pre-lingual phase. The method is used on both children with typical language development (Caskey, Stephens, Tucker & Vohr, 2014), as well as children with hearing impairments (Ambrose, VanDam & Moeller, 2014) or for instance, autism spectrum disorder (Warren, et al., 2010).

However, the method has barely been used on adults, except for in a study conducted by Li et al. (2014). The study's purpose was to quantify the audio environment of elderly adults. Their participants were mainly women (89,2%) and their mean age was 75,9 years old. All participants were African American, and most of them lived alone (91,9%). There were 24 participants with adequate recordings, and 20 of them were retired (83,3 %). Three of the participants in this stuy group had college education, whilst 21 had *´some college´* or less. They found out that the LENA DLP could be successfully used as a quantifier of auditory and language environment for older adults. However, they stated that the recordings were limited to a single day of recordings, and that repeated measuring could provide a more reliable result. The study by Li et al. (2014) will suffice as a comparison to this master thesis, as it is the only one performed on elderly that is published so far in the scientific literature.

2.6.4 Expectations to the new assessment tool

The LENA DLP differentiate from traditional ways of recording communication. Interviews are often demanding to transcribe, and more adequately used in qualitative studies, rather than quantitative. For instance, transcribing 12 hour long recordings from 24 different homes would seem impossible for a master thesis scope. Whilst, with the LENA tool, analysing the recordings will only take about two hours per DLP and requires no manual attention to the data analysing process.

Questionnaires could provide over-reporting results in smaller segments as shown in sub chapter 2.5.2. Additionally, it would be difficult for participants to correctly estimate the amount of words spoken in a 12 hour-long period. Although LENA have minor miscalculations, as mentioned in sub-chapter 1.1, the results could more accurately and easily be reported for the participants than it would be in questionnaires. Furthermore, the LENA DLP records both language and the environmental sounds, which provides the research with additional information which is otherwise difficult to measure in studies of communication.

Observational research method provides both environmental context and language data, but it could be difficult to observe communication for 12 hours. The long duration of a video-recording could lead to same difficulties as an interview session, with endless hours of transcription. With a DLP the researcher would not have to be present for the recording, and furthermore the measurement would be objective with an ecological approach. By using a LENA recorder, one could with ease measure a whole day of natural communication situations, and acquire larger quantities of information than any of the measurement methods previously mentioned.

3 Methodology

3.1 Quantitative research

Considering that qualitative research studies specific cases, quantitative research is set to study samples that represents the population (Gall, Gall & Borg, 2007). The present thesis required a quantitative approach for providing a broader perspective and more logical assumptions from five LENA recordings (in total 32 hours) representing the ecologically-based listening and speech environment of eight elderly individuals (Kalleberg, 1998). The method will describe and conclude with logical deduction without participant´s experiences being taken to account. This study has merely measured numbers of different parameters of the LENA-recordings and compared the results from normal hearing controls and three participants with dementia and hearing loss. Quantitative research uses statistical methods to analyse data, and generalise these data with statistical inference procedures (Gall, Gall & Borg, 2007).

Even though quantitative and qualitative research methods are fundamentally dissimilar, this study needed to consider both methods to gain a greater understanding of the context within the small sample. Both have weaknesses; a quantitative method is created based on predetermined questions and topics made by the researcher, and the qualitative research is subject to interpretation difficulties (Charmaz, 2014). However, this paper has concluded with an objective report, which is dissimilar to qualitative interoperated reports. Therefore, as Kalleberg (1998) would describe it, this study has been dominated in a quantitative matter and the study design is defined as a pilot-study due to the limited number of participants.

Gall, Gall & Borg (2007) raises an interesting question when using both quantitative and qualitative research methods in the same thesis paper: do these two methods complement each other? They additionally name methods including both qualitative and quantitative research methods as: Mixed-methods research. The method combines different techniques, approaches and concepts in the same research paper. It also seems that quantitative studies may be a benefit for qualitative studies in the future, which also qualifies as a mixed-method research. To combine both quantitative and qualitative methods in this current study, it can discover additional theories related to the findings that are important for future studies.

A mixed method research approach could be highly useful for the topic of this thesis. Therefore, the topic of this master thesis should serve to encourage further research in a qualitative matter.

3.2 Design

The intention of this explorative study was to observe the current state of the participants without interfering and interacting with the participants. The study concludes in a *descriptive* matter, also known as a *passive-observation* (Lund, 2015). Therefore, the research question of this study was designed as a descriptive research, and the intention was to find out "*What* is going on?" (de Vaus, 2001, p. 1). The theme of this study has little previous research, making it both an interesting and potentially ground-breaking study. However, there are many explanatory research questions to this interesting theme. Explanatory research aims to identify the clear reasons *why* separate phenomena occurs. Unfortunately, we cannot yet discuss the "*why*", when we do not know the "*what*". Therefore, this descriptive thesis research will help provide the future explanatory research questions with background material.

This study was based on Keven's definition of "non-experimental" design (Lund, 2015).
It was not the intention of this thesis to force an effect with intervention and manipulation of variables; instead, it aimed to explore things "as is". It was beyond the scope of this non-experimental design to find causality or a cause-effect in the experiment, as it would not study possible influences of the results. Because of the non-experimental design, the study cannot be able to explain certain conclusions about causality, but simply oppose alternative explanations of the data analysis. With the limitations imposed, inclusion of a control group was be necessary to achieve validity within the study. A control group requires homogeneity, and matching the groups with an equal number of participants is advised.

The decision to use the research design mentioned above was furthermore based on the fact that there are no studies suggesting that the results will vary over time. This descriptive non-experimental design intended to investigate the given phenomenon at one given point in time, and not in a general approach (Gall, Gall & Borg, 2007).

3.3 Participants

3.3.1 All good things come in three

This study wanted to describe a theorem in a larger population. To manage this, a small group (*sample*) was needed to accurately represent a defined larger group (*population*) (Gall, Gall & Borg, 2007; de Vaus, 2001). The population in this thesis intended to be patients in nursing homes in the Oslo-area with a combination of diagnosed dementia and presbyacusis and controls without SNHL and/or dementia. The small group, or sample, are the participants of this thesis. The sample frame of this thesis consisted of residents living in nursing home establishments that has a functional contact e-mail on their website. The sample-frame also included individuals in nursing homes with a well-established connection to a "HLF *likepersonskoordinator*" (a person with hearing loss who guide or support /mentor equal persons with hearing impairment) (Hørselshemmedes Landsforbund, 2017, 06.03).
This sampling-frame could potentially be unfair as nursing homes with web pages could presumably have different qualities than nursing homes who do not. They could furthermore be biased, as a connection to a *HLF likepersonskoordinator* requires attention and dedication to hearing impairment in patients. Such a potentially biased sample needs to be accounted for in the statistical analysis, better known as 'weighing'.

Design control measures was set in this explorative thesis to include matching homogeneous groups. The intention was that the groups consisted of 15 individuals, divided into three separate groups:

1. Control group
2. Individuals with dementia and hearing impairment
3. Individuals with dementia

The benefits of using three separate groups was to distinguish the two factors: dementia and hearing impairment. As mentioned in chapter 2, there are several co-existing factors that could affect the results of each individual. With a separate group for the individuals with dementia one could more clearly distinguish the two diagnosis to see whether there are any differences in the results. This is an effective way to remove dementia as a variable in the results. However, due to lack of participants from the third group, this study only consists of a control group (Group one) and a group consisting of individuals with dementia and hearing impairment (Group two).

3.3.2 Recruitment

When recruiting patients in nursing homes, a dementia team was contacted by phone to gain input on how to best proceed with the recruitment process. The team advised that contact via the department managers in each specific nursing homes, with set criteria patients, would be the best way forward. By searching for the keyword 'dementia' on several municipality websites, it was possible to gather necessary contact information. Following the research, an informative e-mail was forwarded to several nursing home department managers in the Oslo-region, which were easily accessible by either car, train or by tram/subway.
In fact, all of the recruitment in the mentioned groups were intentionally limited to the Oslo-region. The geographical limitation was set due to practical purposes, such as accessibility and economical expenses. However, these limitations would later be extended to less accessible and more remote nursing homes, due to the lack of feedback and responses.

The social media platform 'Facebook' was used in this study to acquire subjects to the control group. Through sharing a 'Facebook-post', four control-group participants were acquired for this study. One of the control-group participants replied to an informal e-mail sent to several popular voluntary groups and organisations among older adults.
Another participant got in contact after one of his/her friends participation in this study.
This "selection" of participants is highly biased as the recruitment was distributed to and via voluntary individuals with adept technology knowledge. Therefore, individuals not participating in voluntary work and those with no access to the social media platform 'Facebook' had no opportunity to partake in this study.

3.3.3 Criteria and limitations to Dementia

As stated in sub-chapter 2.3.1 the different dementia diagnosis unfolds variously. The most common diagnosis is Alzheimer. Alzheimer's disease is also adequately auditory tested and researched, and is as a result therefore frequently used in articles addressing the connection/link/relationship between dementia and hearing impairment. Alzheimer's disease was then first set as a specific criterion to the second and third group. These two groups were set for individuals with diagnosed dementia. In the latter stages of the study it would prove challenging to set 'Alzheimer' as a specific criterion for the first and second group.

The responses from the nursing homes stated that they did not have patients that would fit the criteria listed in the email. As a result, 'Alzheimer' as a criterion in the second group was expanded to include all types of dementia within the first two sample groups.

Diagnostics of the control group in this thesis was limited to one standardized test, the so-called "Minimal Mental State Test" (Aldring og helse, 2017, 13.02). This standardised test has been revised to Norwegian, and is commonly used in several nursing homes across Norway to reveal cognitive failure. The test is not solely approved as a test to diagnose dementia, but is commonly used to reveal less comprehensive cognitive failure, such as the ability to drive. MMST is easily conducted by test leaders and require no extensive health care skills, as the material and test manuals are available online. Example of the test sheet are added as Appendix 8. Even though this test is not used to diagnose dementia, it was safe to use MMST to measure the cognitive ability of the control group in this thesis. There was a potential possibility that the participants were familiar with the test and its contents. In cases where the participants were familiar with the content of the test, results could prove void and inadmissible. However, on the other hand, patients that have a cognitive failure would not have been able to pass this test, even though they had certain knowledge of the test and its contents. Furthermore, the answers in the MMST test differ from each test, as the date, season and locations are not the same (Aldring og helse, 2017, 13.03; Appendix 8). With a cognitive disability one would additionally struggle to memorise the test and its contents.

3.3.4 Criteria and limitations to Hearing threshold

Patients living in nursing homes with a hearing impairment were needed for the second group of this study. Numerous nursing homes were approached and contacted to see whether they had patients with HAs. Looking for patients with HAs would ensure that they indeed had been diagnosed with a hearing impairment. Patients with HAs or using other technical equipment were therefore a set criterion for this group. Additionally, the nursing homes were informed that the study was looking for patients diagnosed with presbyacusis, which is an age-related hearing loss. Although hearing impairment is common among elderly, several nursing homes claimed that they had no patients fitting the criteria.

The control group of this study was tested with audiometry to match the set criteria.

The hearing threshold level from the Nord-trønderlag hearing loss study (Engdahl et al., 2009) was used as a criterion of exclusion in the control group of this thesis. To determine whether the participant was in the normal range of hearing threshold, they were compared to Engdahl et al. (2009) normative hearing threshold of the adult population. The present study confirmed that there was a difference in gender outcome when it came to hearing threshold (2009, p. 222). Therefore, the study allowed some test subjects in the control group with a hearing loss equal to 40 dB in the middle frequencies, and down to 74 dB HL in the highest frequencies of 8 kHz (this is the limitation to male subjects under 89 years of age).
The participants were measured to the nearest age-limitation in the study mentioned above (Engdahl, et al., 2009). Any subjects with an extended hearing loss have been excluded from the study and advised to refer to a General Practitioner (GP) or a specialist for further examination/testing. This was the case of one subject.

3.3.5 Presentation of participants

The participants consisted of eight individuals divided in two groups: Group 1, the control group, and Group 2, individuals with dementia and hearing impairments. The individuals were coded with Fp + number, see Table 3.3.5.

The participants consisted of only two males, and with risk of identification, the gender is not specified in the table below. The educational level varies from 0-7 years in collage, and most of the participant's professions were either teachers, or other caring professions. The activities through the recordings were quite similar, due to the restriction of locations by the ethical committee. Playing music, listening to audio book, and working on the computer were some of the reports from the control group. The experimental group (Group two) had no specific activities, other than eating lunch, staying in bed, and having a visitor.

The background variables in Group 1 was obtained by asking the participants questions related to home-environment and education. In Group 2 the background variables were mainly obtained by looking at "*information cards*" describing each patient. The information on the cards contained a brief summary of the patients epicrisis, including the dementia diagnosis and the routines surrounding the use of hearing aids. The card furthermore contained information about the social aspects of the patients. Any additional information, such as educational background, was provided by the nursing home staff.

	Total N=8	*Group 1 N=5*	*Group 2 N=3*
Mean age, SD, (range)	77 SD:*10* (65-89)	70 SD:*7* (65-82)	87 SD:*3* (84-89)
Females, nbr (%)	6	3	3
Children, nbr (%)	1,63(1-2)		
1	3 (37,5%)	1	2
2	5 (62,5%)	4	1
Edu level: (range, years)	(0-7 +y)		
< Secondary school (%)	3 (37,5%)	-	3
Bachelor (%)	3 (37,5%)	3	-
>Bachelor (%)	2 (25%)	2	-
Alone in recording (%)	2 (25%)	2	-
Living alone (%)	6 (75%)	3	3
Adjusted vision (%)	6 (75%)	5	1

Table 3.3.5: Background characteristics of Group 1 (controls) and Group 2 (patients in nursing homes).

3.4 Data collection and analysis

3.4.1 Norwegian social science service

When a study contains personal information (personal information/data), you are required to notify the Norwegian social science service (NSD) about the collection of data.
The NSD is owned by the Ministry of Education and Research. Its purpose is to protect personal data and improve the practices of data collection as well as assisting in issues related to methodology and ethics.

Since this study both included medical and health aspects, the Regional Committee for Medical and Health Research Ethics (REC) was contacted by phone. The committee meets on a monthly basis and is regionally based. If applying for approval in January, the REC committee would discuss the application in February, and finally either approve or

disapprove the application in March. With such a time frame, the preparation and development of a master thesis would be restricted to half a semester.
As a result of this, it would be too demanding for the student to finalize the project in time. Furthermore, the research question of this study would have to exclude individuals with Alzheimer's disease, which ultimately would change the desired outcome of this study. However, the response from REC was positive. Considering that the study would not apply anything new to the field of health and research, there was no need for approval from the REC secretariat.

Appendix 1 refers to the application to NSD, dated 21. of December 2016. However, a reply from NSD was subsequently received on the 31. of January with some concerns regarding the LENA recordings. The main concern was related to third party individuals and their lack of consent to the study. Since potential third party individuals could be present or appear during the recordings, thus also be subject to the recordings, the concern related to a lack of consent. To solve this issue of matter, consent from nursing home staff and the family members of the patients was obtained. Additionally, the researcher was obligated to be available to the informants during the whole recording sessions. For instance, if one of the informants wished to quit the study, a researcher had to be present in order to switch off the device and stop the recordings. The availability of the researcher would furthermore make it easier to answer any potential questions arising during the recording session. The researcher was available during the recording session in all groups.

Having a researcher available and accessible during the recordings lead to unexpected complications. One of the complications related to the control group, who, as a result of the NSD conditions, had to stay indoors during the entire recording session. This was done to prevent recording exposure to any potential third parties without any approved consent.
As an attempt to solve this difficulty, each recording only attained four hours of recorded material instead of the desired 12 hours. This decision was also made for practical reasons in terms of restlessness and the sanitary needs of the researcher being present during the entire recording sessions. Limiting the recordings down from 12 to four hours could unfortunately altered the results that this study was hoping to receive, due to the daily diversity in activities mentioned in sub-chapter 1.1. Nevertheless, these noted guideline from the NSD could not be ignored, and therefore the study could continue without the wanted length nor amount of recording sessions.

The NSD advised that five different consent sheets were needed in order to suite the different roles in the participation of this study, such as: Employees in nursing homes (Appendix 2), patients who were informants (Appendix 3), patients who were not an informant (Appendix 4), the control group (Appendix 5), as well as visitors (Appendix 6). The sheets included standardised text about the intention of the study, among different descriptions of the tasks performed by each recipient. The intentions of these papers were to fully inform the recipients about the study. The consent form also included information about the right to withdraw from the study, that the study was voluntary, and that the researcher would be accessible during recordings (Appendix 7).

3.4.2 Audiometric technique and testing process

The control group were tested with MADSEN Xeta 1067, produced by GN Otometrics A/S. The audiometer was calibrated prior to the testing. Pure tone frequencies included 250 Hz to 8 kHz, with a hearing level range from -10 to 120 dB. For practical reasons, participants were tested in their own homes, in close proximity to the researcher. The participants were instructed to press the button in front of them immediately when they detected a "beeping-sound" in their headphones. The participants were furthermore instructed to sit with their backs towards the audiometer, and only one meter in front of the researcher. This instruction was made to ensure that they would not be influenced from the visual movements by the researcher. Although the instructions above were made to avoid incorrect readings, the environment under which the tests were carried out was however not optimal. For instance, one of the participants had a dog and a cat in the same room during the test. These types of background noises affect the audiometric environment and the participants' attention during the test. Furthermore, several participants lived in close vicinity to roads with a lot of traffic. Low-frequent noises from cars also affected the audiometric environment, which would otherwise not be present at a professional ear, nose, and throat (ENT) clinic. Even though, with some disturbing background noises, five of the six participants scored adequately on the audiometric test and were therefore qualified to participate in this study.

The control group (Group 1) was tested with airconducted audiometric procedure.
The audiometric procedure (technique) used in this study is called Hughston-Westlake up five down ten (Hall & Mueller, 1997).

The following technique was used on these frequencies: 1 kHz, 3 kHz, 4 kHz, 6 kHz, 8 kHz, 250 Hz and 500 Hz. The right ear was tested first, followed by the left ear. The sequences started at the amplitude of 40 dB. During the test, the researcher sent a frequency of 1000 Hz from an audiometric apparatus to the connected headphones used by the participants of the test. If the participant perceived the frequency, they were instructed to press a button, which would then signal the researcher, indicating that the frequency had been perceived.
If the participant responded to the signal, the amplitude would then be decreased by 10 dB until the tone no longer would be recognizable. If the participant did not respond to the signal, the amplitude would increase with 5 dB until the subject responded. When the participant had registered the same amplitude twice from low to high amplitude, the results would be added to the hearing threshold of the participant in an audiogram. The examination would then continue to test the participants hearing threshold within the different frequencies mentioned above. Completing the test in all separate frequencies would create a result in an audiogram. An audiogram is a diagram showing the hearing threshold of the participants in the test.

One participant had a hearing loss greater than typical degeneration, and was as a result disqualified and recommended consultation at a GP or ENT-clinic. The participant who was disqualified from the test was aware of the hearing loss, but did not know the extent of the loss prior to the test. Other participants in this current study had an adequate hearing threshold.

3.4.3 Minimal mental state test

In order to test the cognitive skills of the control group, a standardised test called 'Minimal mental state test' (MMST) was conducted (Aldring og helse, 2017, 03.03). The manual of the test has been revised to Norwegian, which was the native language of participants in the control group. Bearing in mind that the test has been revised, potential cultural and linguistic barriers were eliminated. Thus, the results would also prove more realistic and less prone to misconceptions and misunderstandings.

The required test material for the MMST, including manuals and score sheets, were available online. The score sheets are added in the Appendix 8. Before visiting the test participants, the website containing the MMST score sheets were made available for offline use on a laptop.

This ensured that it was possible to conduct proper calculation of the MMST results and thus also the participants' eligibility to participate further in the test. Meeting prepared with the required test material available was necessary in cases where there was no available Internet connection. Additionally, having all material available prior to the test was important in making the test process professional and seamless in its progress.

It was necessary for the researcher to use a laptop when visiting the participants in order to calculate the MMST-results correctly prior to the recordings. Other accessories, such as blank paper, pen and test graphics sheets were also required to conduct the MMST properly.
Before starting the test, each participant was questioned whether they had experienced any decline in memory over the past years. One of the participants claimed a decline in memory, whereas a few others declared they struggled remembering and recognising names.
During this part of the test it was necessary to clarify that cognitive decline is a common part with ageing, and that it not necessarily had anything to do with dementia. Throughout the test, the participants sat on the opposite side of the table, facing the researcher.
The participant had no clear vision of the MMST- sheets. Additionally, they did not receive any non-verbal hints or queues during the test, nor when they failed to answer correctly.

A corresponding test result was that most of the participants struggled on the same task in the test, namely the mental arithmetic task (Appendix 8). At first, they had to provide the answer to 80 subtracted by seven. Having answered correctly (i.e. 73), they were asked to subtract another seven from their first answer. In this example, 66 would be the correct response.
The mental arithmetic task in the MMST was finished when the participant correctly solved five separate subtractions. However, if the participants failed to answer one of the subtractions correctly, but successfully subtracted seven from the incorrect answer, the answer was still correct. If any of the participants failed to solve the subtraction question, they completed distraction task where they had to count backwards from 100. The distraction task did not award any points in the test, and its intention was to examine the participants' long-term memory.

The results from the mental arithmetic task showed that four out of the six participants answered incorrectly on the second subtraction, which was 73 subtracted by seven.

However, one out of the four participants, who failed on the second subtraction, corrected his/her wrong answer and continued the test correctly. At the third subtraction task (i.e. 66 subtracted by 7), the remaining three out of six participants answered incorrectly. Nevertheless, since all participants successfully managed to subtract seven from the incorrect number, all registered answers were correct.

All participants in Group 1 scored adequately on this minimal mental state test.

3.4.4 LENA

As mentioned in Sub-chapter 2.7, the LENA Digital Language Processor (DLP) is a small wearable gadget. The DLP consists of two buttons (On/Off and Record), a display and an integrated microphone A white sachet accompanying the Lena DLP made it easier and more convenient for the participants to wear the DLP throughout the test period.

The nurses assisted the patients in the nursing homes with turning on the equipment and starting the recording session. Furthermore, the nurses helped the patients correctly apply the DLP in the white sachet on the chest. The nurses in the nursing homes were instructed to assist their patients in the specific order mentioned above. Furthermore, the nurses had to make sure that the patients did not remove or fiddled/tampered with the DLP during the recording session. The white sachet was useful to avoid tampering with the DLP recorder during the test as the recorder was less accessible and visible to the participant.

After four hours of recording, the nurses were instructed to remove the pouch from the patient chest, and stop the recording. When the recording was done, they handed over the DLP to the researcher to ensure the 4 hours of recording was registered. The DLP was then turned off, and transferred to the computer laboratory at the University of Oslo.
The transferred data was automatically deleted immediately from the DLP, and the process of analysing could begin.

Additionally, when recording, the nurses was asked about the patient's daily activities.
This makes the analysing much easier, as it puts the data in context of noises and events that occurred during the recording. The researcher was available to contact through the whole

recording. The researcher was designated a space to be available for the nursing home staff, as well as to collect consent of those who choose to participate.

Informants in the control group was handed the DLP ready to record from the researcher, and instructed to attach it to the patients' shirt. They were also instructed to not fiddle with the pouch. If they needed to take a shower, they were informed that they should leave the DLP on the shirt until they changed into a new one. While recording the researcher was also available to the control group participants for the 4 hours of data collection. The researcher was either placed outside of the house in a car, or outside of the apartment on a chair.
This was to inform anyone who were exposed to the study, and to collect their consent if they choose to participate. If the visitors did not want to join in, the researcher should inform the participant, and pause the recording.

The placement of the researcher was not optimal. There were several occasions when the informant contacted the researcher while recording. One of the informants asked the researcher a couple of times if they needed slippers, blankets or sandwiches, and several others offered coffee. The further the researcher was placed from the informants' door, the fewer dialogs were made. This found could be corrected for, if the NSD had allowed the recorder to be turned on without the present of the researcher. The interference with the researcher needs to be adjusted for in the analyse of results.

3.4.5 Pilot study

When access to the field was granted through NSD, a pilot study was conducted. The pilot study was conducted for a woman with a known hearing loss and without any reduced cognitive abilities identified. This woman was a family friend of the researcher conducting the pilot study. She was assigned as a pilot due to lack of available informants within the set criteria that were both available and willing to assist in the thesis. By using a person with a hearing loss in the pilot, it was possible to avoid using any potential participants intended for the main study of this thesis. Moreover, this also meant that the desire to perform a pilot study was met. Although Gall, Gall & Borg (2007) recommend 2-3 pilot-participants, this study only included one. The pilot was tested with both audiometric assessment as well as the cognitive test Minimal Mental State test (Aldring og helse, 2017, 13.02).

The audiometric assessment was comparable with previous audiometric results, which assured that the researcher was using correct test procedures. This finding further solidified that the audiometric assessment procedure completed in the pilot study also was applicable in the control group of the main study. The MMST and the audiometric assessment tests used are standardized instruments within each field of study. The researcher had previous knowledge on how to perform these assessments. It was therefore no need to further test the instruments. The MMST was performed, and no cognitive decline was revealed. After the assessments were completed, the pilot was equipped with the LENA DLP for about one hour in her own home environment. The researcher was waiting outside while the recording was taking place. The DLP data was then transferred into a computer at the University of Oslo Laboratory. The data was successfully uploaded, and an experienced user gave a tutorial of the LENA software program.

The pilot was later asked to comment on the assessments and the recording. She reported that the tests were easy to perform, and that the researcher was adequate in the performance. She furthermore mentioned that the DLP was not on her mind at all when doing everyday chores and activities, and that she even forgot it was there.

3.4.6 SPSS

To analyse the results, Statistical Package for the Social Sciences Version 24 (SPSS) was used. It is the most commonly used software for statistical analysis in educational research (Gall, Gall & Borg, 2007). Because of its wide range of users, one can be certain that the program does not fail in errors, or discover bugs. The researcher of this thesis attended a three-days course in SPSS prior to the study, which helped in developing the data entry.

3.5 Validity and reliability

3.5.1 Internal validity

Lund points out that: “Det finnes ikke noe endelig bevis for kausalitet i en ikke-eksperimentell undersøkelse, men man kan styrke tilliten til en årsakstolkning gjennom å vise at mulige alternative tolkninger er lite sannsynlige “(Lund, 2015, p. 271). Therefore, the non-experimental design in this study was not going to analyse causal relations, since it would be impossible to come to a concrete conclusion in the results. To strengthen the internal validity, one should instead propose an alternative interpretation of the results, and argue that certain

alternatives are impossible. This will increase the cause credibility of one interpretation, and weaken the other cause (Lund, 2014). This is particularly applicable for social researches, such as this thesis study, which is mentioned by de Vaus (2001, p. 28): “It is impossible to eliminate all ambiguities in social research but we can certainly reduce them”.
Lund (2015) illustrated in a list the different threats to the internal validity of researches. The potential threats applicable to this thesis paper has been accounted for in the section below.

The first potential threat related to an issue with *directions*. In this study, how do we know that the diagnosis affected the way people communicated, and not the other way around? To answer this potential threat, Lund (2015) states that an effect cannot appear before the cause. As explained in sub-chapter 2.8.3 A, dementia and hearing impairment may lead to poor communicative skills, but not the other way around. Therefore, to answer this threat, it was important that the theory in this thesis highlighted the comorbidity and pathway of dementia and hearing impairment.

The second potential threat is the *history* threat. This threat is comprised of the potential experiences the objects/informants had experienced prior to the data collection and its effects to the results. In the study by Hart & Risley (1995), they concluded that different socioeconomic environments affect the extent of language and communicative skills.
For instance, one could suspect that one nursing home in near proximity of a university could attain more highly educated individuals, than more remote nursing homes. Although this may be a real threat to this study, the socioeconomic differences in the Oslo-region appears to be minor.

Instruments was also a potential threat to the internal validity. This potential threat could be highly relevant to this thesis study. The LENA program is constructed to measure the language development in children and not in adults, and is therefore a valid threat to the instruments in this thesis. To solve the potential *instrument* threat, one could compare the results in this thesis to the known studies on children. By doing so, the results from environmental noise and silence could tell us if the data-analysis is somewhat similar in both studies and one could prevent measuring errors. The results in this current study were therefore compared with an American study conducted by Li et al. (2014). If the results coincided and were in accordance with one another, the instrumental validity would be increased.

The threat of *selection* was also applicable to this thesis, hence the non-random group selection. The groups were intentionally dissimilar in order to gain results from this specific group of individuals. However, due to the lack of participants, the experimental groups only consisted of one group. This causes the threat to be highly valid, and one should carefully when applying the results to individuals with dementia in general.

Drop-outs also threatens the internal validity, and it seems to be a valid threat to this thesis as well. The small number of participants could critically harm the results if they had been lowered. On the other hand, this thesis evolved into being a pilot study and therefore the requirement of informants could be decreased.

Lastly, the validity threat *atypical behaviour in the control group* was also potentially applicable for the participants in this thesis study. The participants in the control group have been precisely informed what exactly is being measured, as well as why they are measured. Therefore, one could argue whether or not this group was atypical, given that they were well aware of what was being measured. However, one could also argue that the results showing a high percentage of silence show that the participants did not attempt to influence the study. Trusting that the participants partaking in the study were honest and truthful in their behaviour, e.g. when mentioning they did not notice wearing the DLP, was also essential.

3.5.2 External validity

The external validity in this master thesis was considered to be poorly. The sample of participants have been selected with strict set criteria and in an expedient manner (Befring, 2007). Furthermore, the sample was not representative due to its low volume of participants, and therefore this thesis could not compare the results to the rest of the population. This study was meant to be a pilot study with good internal validity, and the results was not generalised due to the low external validity (de Vaus, 2001).

3.5.3 Reliability

Due to the choice of instruments in this thesis, reliability would depend on measurements showing the same tendencies in other recording sessions completed by the same participant. The purpose of this thesis is to provide an assessment to this new measurement tool as well as its uses. However, de Vaus (2001) specify certain unreliable sources, such as how an interviewer could affect the results for each session. In this thesis, the researcher is not even present as mentioned in sub-chapter 2.5. Therefore, this thesis has a stronger reliability when it comes to researcher potentially influencing the outcome of the results. The objective and ecological way of measuring makes the results more reliable. On another note, the measurement could differ from day to day due to the short period of recording time.
With longer recordings, and with increased participants, the reliability of the measurement would also increase. With increased reliability, comes increased credibility.

3.6 Ethical consideration

Ethics related to research should be carefully considered when planning, conducting and analysing the results. Gall, Gall & Borg (2007) states that the ethical view should be considered before, while and after conducting an experiment or research of some kind.
The Ethical concerns could affect participants. By taking concerns in to account, one could protect the participants from damaging results, and honour their participation by keeping them anonymous (Gall, Gall, & Borg, 2007).

"De nasjonale forskningsetiske komité for samfunnsvitenenskap og humaniora" (NESH) is a national comity in Norway who constructs ethical guidelines for research within social science, humanities, law and theology. Their introduction states that: "Retningslinjene er rådgivende og veiledende, og de skal bidra til å utvikle forskningsetisk skjønn og refleksjon, avklare etiske dilemma og fremme god vitenskapelig praksis" (De nasjonale forskningsetiske komiteene, 2017. 10.01). NESH present advisory guidelines. These guidelines encourage ethical discretion in research as well as revealing and clarifying any potential ethical dilemmas encountered. Furthermore, one can say that NESH promotes an ethical approach to scientific practices. This quantitative thesis is, among other quantitative studies, called a positivistic epistemology, and as a result demands an impersonal and objective relationship between the researcher and participants. Gall, Gall & Borg (2007) states that positivistic epistemology studies have apparent and obvious ethical dilemmas in the design stage.

They furthermore point out that these dilemmas easily can be facilitated and corrected as they occur during the early planning stages of the study.

“Deception is the act of creating a false impression in the minds of research participants through such procedures as withholding information, establishing false intimacy, telling lies, or using accomplices” (Gall, Gall, Borg, 2007, p. 71). In this study, such inquiries could relate to concealment of information about the DLP as well as the withholding of information about what is recorded. When informing the participants about the study, and what is being recorded by the DLP, one should do so with caution. It is un-ethical to withhold information, but when informing a patient with dementia, one has to be brief and concise to avoid unnecessary strain and confusion. For the single purpose of communicating with patients with dementia, it was necessary to obtain information about how to best communicate their rights regarding the recording process. Therefore, the researcher contacted Liv Thalén, PhD-Student and speech-language pathologist at the Department of Clinical Science, Intervention and Technology (CLINTEC), Karolinska Institutet, who studies the independency of people with dementia, to obtain advice on best practices on how to communicate with patients with dementia. Information about these best practices can be found in subchapter 2.6.3.
By obtaining best practices, this research paper acknowledges and respect individuals’ dignity. This important aspect assures individuals inviolability.

In an attempt to respect the privacy as mentioned in NESH (De nasjonale forskningsetiske komiteene, 2017, 10.01.), all informants were coded in order to secure their anonymity.
The encoding key with their results were locked securely at the University of Oslo laboratory with limited access. The personal information was anonymised, however as the participants consisted of a highly marginalised group of patients, some potentially revealing information has been withheld in the results. Withholding information from the results protects the participants from being identified, and also protects the identity of the nursing homes included in the study. It furthermore protects the nursing homes that decided not to participate in this study. These actions are aligned with the NESH guideline six (privacy) and 21 (Consideration for vulnerable groups), as well as guideline 19 (Respect of private interests) (De nasjonale forskningsetiske komiteene, 2017, 10,01).

Because the thesis included personal information, consent to participate was obtained (Appendix 7). Furthermore, this type of respect for personal information is grounded in the Norwegian Personal Data Act, and requires the study to register to the data protection office (Norsk Senter for Forskningsdata). Consent from the participants was obtained through a consent form by written signature. Additionally, if the individual was not able to make decisions singlehandedly, nor had physical abilities to sign the consent form, consent was obtained from next of kin.

Furthermore, the consent form clearly stated that partaking in the study was voluntary and that the participation could be cancelled at any given time without further reasoning needed. The consent form also stated that the participants were free to contact the project supervisor or the researcher with any relating questions during the data collection process. These actions can help promote the aim to achieve a freely, informed and expressive consent. The personal information regarding health related issues were deleted when no longer needed, as recommended by the Health Research Act (Helseforskningsloven, 2008)

NESH furthermore expands these guidelines mentioned above to include any individual that is subject to the research during the data collection process (De nasjonale forskningsetiske komiteene, 2017, 10.01). Therefore, obtaining consent from all potentially exposed individuals during the data collection period was necessary. These individuals typically include professionals, nurses, doctors, cohabitants and relatives.

Moreover, obtaining consent also applied to any third party individuals, who for various reasons were present during the data collection process. These third party individuals could in this case be for instance an electrician, door-to-door sales person or even friends visiting. This is in accordance with the NSD guidelines.

3.7 Statistical analysis

This master thesis concluded in a descriptive matter, and the results is only applicable to the sample. The results were presented in tables and graphs to present central tendency, correlations and an overview of the collected data. A non-parametric test was chosen as the sample was small and not able to predict the distribution in a wider population.
The non-parametric tests have a higher risk of making a Type II error, due to the low effectiveness and as they do not exploit all the information available.

The Mann-Whitney U test (two independent samples) is used instead of a T-test of independent samples. Since most of the variables are on an interval scale, Pearson's R was used to figure out the correlation between the variables. The correlation coefficient is always a value between 1 and -1. A negative value (less than 0) indicates that the variables correlate as one variable increases and the other one decreases. A positive correlation (above 0), indicates that both values increases simultaneously. However, if the value is 0, there is no correlation between the variable values. De Vaus (2001) lists the different strength levels for coefficients, and the results are affected by these values.

4 Presentation of findings

4.1 Group 1 and 2

As mentioned in sub-chapter 3.3.5, this thesis only contained two groups; namely, the control group (Group 1) and the experimental group consisting of hearing-impaired individuals diagnosed with dementia (Group 2). A survey on the participants´ background information was used to compare the results from the two individual groups and some results from the only known LENA-study in an adult cohort was included for initial comparisons, partly for validation reasons (Li et al., 2014).

The mean age of the control group in this study was approximately 70 years, with a standard deviation (SD) of 6,9. The mean age of the second group, the experimental group, was 87 years with a SD of 2,6. The analysis also showed that the spread measured by standard deviations was greater in the control group than in the experimental group. Therefore, one must carefully compare these groups, as the differences in mean age can make the two groups of samples dissimilar. By doing a non-parametric test, the result also specified that this median difference was statistically significant between the two groups ($z = -2.249$, $p=.036$). This can be said about the findings as the *p-value* was lower than the significance level of .05. By doing a bivariate correlation test on the two Groups (1+2) it was shown that age had a very strong positive correlation coefficient value of .847. This result also had a significance score as strictly as the .01 level ($p=.008$ two-tailed).

Through the use of the Mann-Whitney U test, several other background variables were also tested: “number of children”, “living alone” and “alone while recording”. Neither of the variables tested were 2 SD units away from the median, as the z-scores were between -1.1 and -1.2. These scores were not significant with a p score > .05 which means that the results could be fairly random. However, one background variable had a z-score over -2.4, which states that the results were over 2 SD away from the median and that the sample was skewed. This variable was *education*, and the results had a statistical significance below .05. The test came out with a two-tailed significance of $p=.036$, and therefore the result was not random. Since the *p-value* was greater than the .05 value, we can with roughly 97% probability claim that the variable *education* was significantly different between the two samples.

The number of male participants in this thesis was 25% of N. As there was a combination of few male participants and an overall low count of individuals qualified for this study, no statistical tests on gender differences was completed.

4.1.1 Comparison of audio environment (LENA) between groups (1 vs 2)

To compare the audio environment results between the two groups, the variables *Silence*, *Noise*, *Distant Speech* and *Electronic Sound* (TV, radio) was compared in percentage.
The graph in Figure 4.1.1.A shows that Group 2 had less exposure of Electronic/TV sounds, as well as Noise exposure. The experimental group also had less percentage of Silence in their everyday audio environment than Group 1.

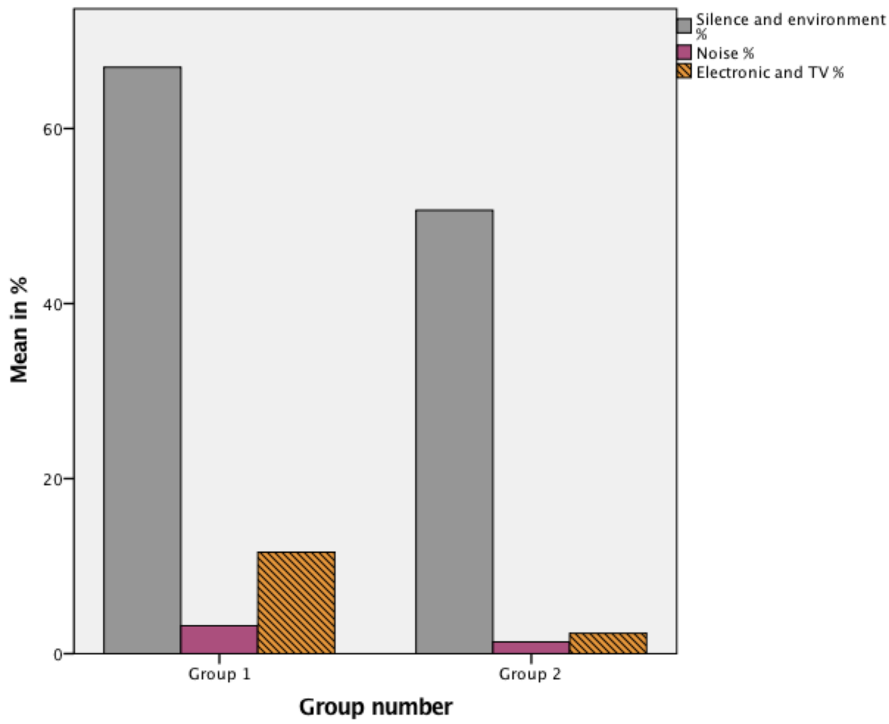

Figure 4.1.1.A: Audio environmental parameters (percentage) in Group 1 vs Group 2.

The difference between Noise-exposure were barely noticeable (3,20 % vs 1,33 %), whilst Electronic/ TV had larger differences (11,60 % vs 2,33 %). In Group 1 there was a very strong correlation between the variable Silence and the variable Electronic/ TV ($r=-.870$, $p=.05$). Silence was 67 % in Group 1, and 50 % in Group 2, with a z score of -.750, and a *p value* at .571. There was a difference, but the difference could be random or due to measuring errors.

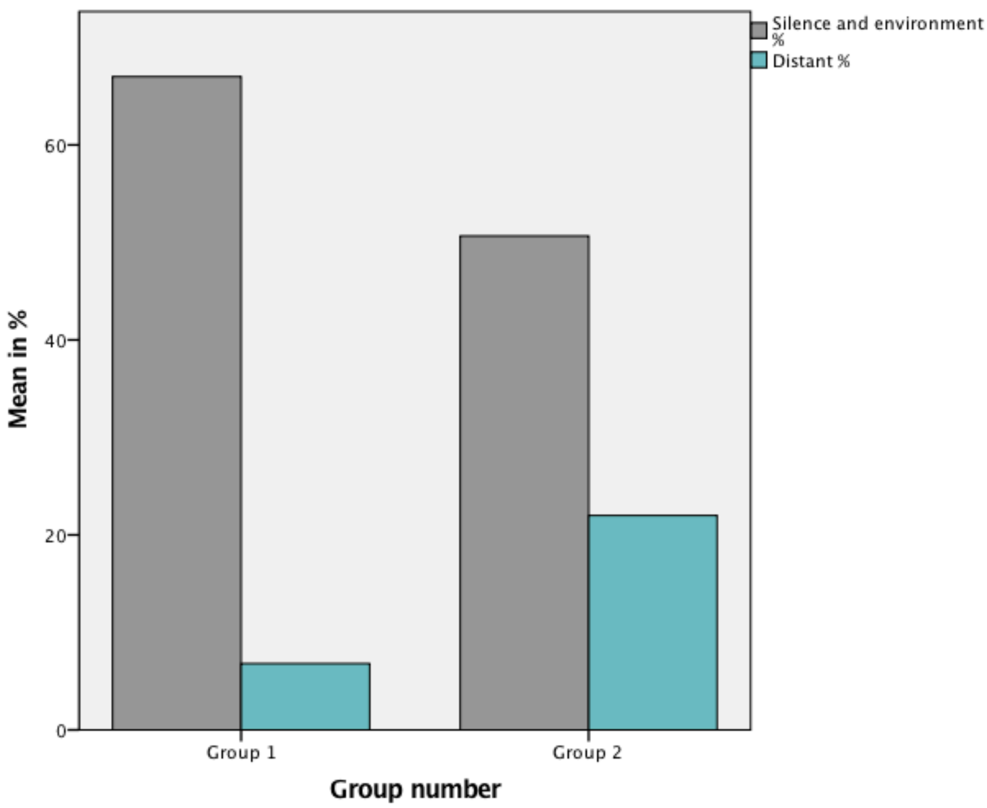

Figure 4.1.1.B: Environmental sounds presented in percentage divided between the two groups (1 vs 2).

With less Electronic/TV sound exposure and Silence, comes greater value of another environmental sound variable, mainly hearing speech in Distant. Therefore, Distant could be, as mentioned in sub-chapter 3.4.5., both an environmental sound as well as a communicative category. When doing a correlation test between the Distant percentage and the Silence category, one can find a very strong negatively correlation ($r = -.769$) between the two categories. The results were also significant at the p=.05 level (p=.026). This result tells us that when there was less Silence, there was more talk at Distant in the recordings.

The Figure 4.1.1.B illustrates that the Silence in percentage was higher in the control group (Group 1) (67%), whilst the speech at Distant percentage was higher in the experimental group (Group 2) (22%). The category Distant percentage in Group one was nearly 2 SD below the median for both groups ($z = -1.650$, p=.143). In the experimental group (Group 2), it was furthermore also a near perfect negative correlation between age and Silence in percentage. However, the finding was not within the .05 significance level (r=-.989, p=0.97), and there is a risk that the results were based on random measurement error. Therefore, one should be careful when reviewing these numbers.

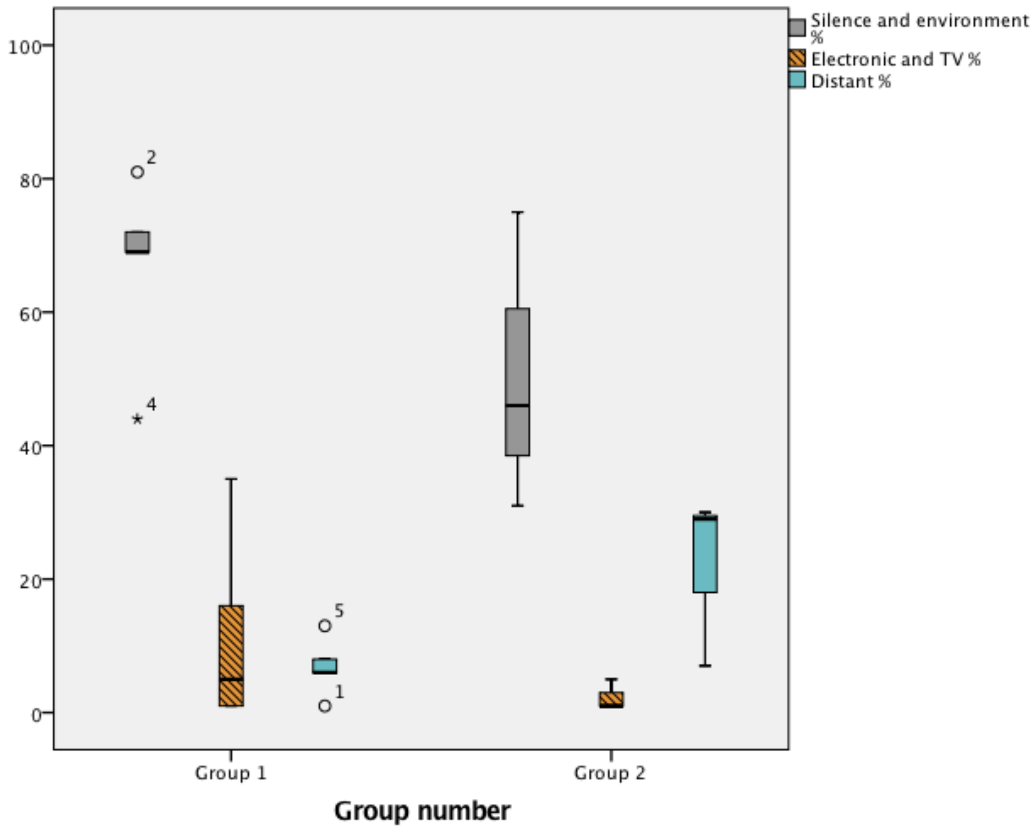

Figure 4.1.1.C: Percentage of Silence, Electronic/TV and Distant in Groups (1 and 2).

In Figure 4.1.1.C., the boxes present a greater spread in Silence in Group 2, in comparison to Group 1. The Electronic/TV variable was close to zero percent in Group 2 (2,33%), while there was a large spread among Group 1 with a low median (11,6%). Neither of the results were statistically significant within the .05 value, which therefore states that there were no statistical significant differences between the variables in the two groups.

The Distant variable was also included in the boxplot in Figure 4.1.1.C. In Group 2, there was a greater spread in speech at Distant, but with a central tendency closer to the highest value than to the 25th percentile. The shape of the Distant variable in the boxplot also projected a negative skew.

4.1.2 Comparison of communication (LENA) between Groups (1 vs 2)

In the comparison of the communication markers between the two groups (1 vs 2), the variables were as follows: Distant, Meaningful speech and Total score of words per hour. The median exposure between both Groups (1 vs 2) of Meaningful speech was 16 percent (SD= 9,5) whilst exposure of speech at Distant was 12,5 percent (SD = 10,9). Group 1 had a mean exposure of 1517 words per hours, whilst Group 2 had a mean of 3074. The difference between the two groups were 1557, making the Word count per hour twice as high in Group 2 than in Group 1.

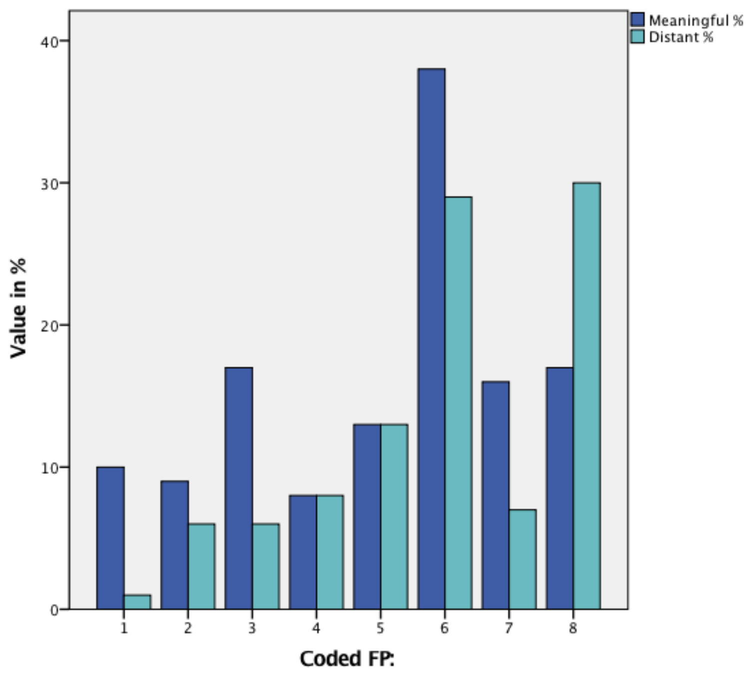

Figure 4.1.2.A: Percentage of Meaningful and Distant (%) on an individual level for participants (Fp1-8) in Group 1 and 2.

When comparing Meaningful speech with hearing speech in Distant (in percentage), one can clearly see a trend within the sample in Figure 4.1.2.A. Participants Fp6, Fp7 and Fp8 were participants from Group 2. In the first Group (1) the median of Distant speech was 6,8 %, with a SD of 4,3. In Group 2, the mean of Distant speech was 22 % (SD=13), almost 10 % higher than mean percentage for both groups. The median in the Meaningful speech variable for Group 1 was 11,4 % while in Group 2 the value was 23 %. The results of a Mann-Whitney U test showed a z score of -1.800, almost two SD from the median, but with a significance of p=.071. The groups were unequal in this variable, and with more participants the results would most likely be significant. The Distant speech was -1,650 SD from the median, but with a significance of p=.143, and therefore not statistically significant.

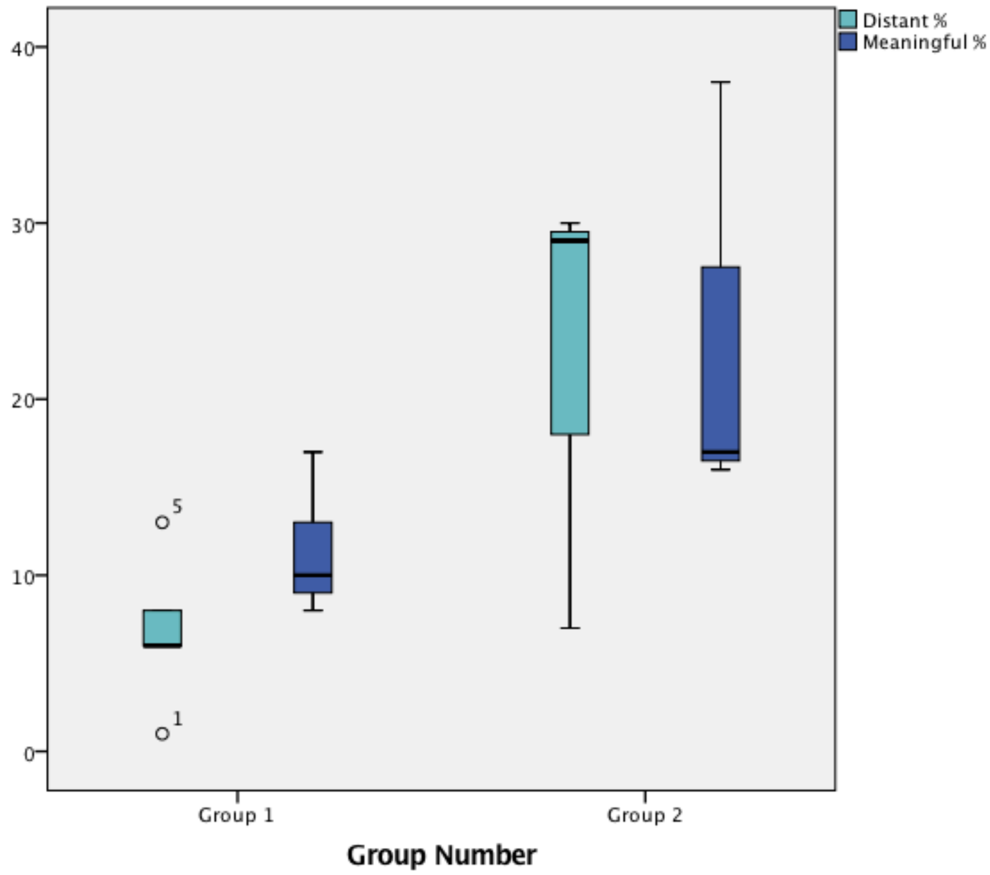

Figure 4.1.2.B: Meaningful and Distant (percentage) between the two groups (1 vs 2).

In Figure 4.1.2.B the participants were sorted into dedicated groups (1 and 2). The results in Group 2 consisted of a wider spread in both variables than in Group 1. When doing a correlation test between the variables Distant and Meaningful, there was a very strong positive correlation between the two variables, and the correlation was significant at the .05 level (r=.709, p=.049).

The Figure 4.1.2.B showed that median within the Distant variable was closer to the highest level recorded in Group 2, and the median within Meaningful were at the lowest level recorded. Moreover, as shown in the Figure 41.2.A, the participant with the highest amount of Meaningful speech, were also the one with highest amount of hearing speech in Distant. The participants within Group 2 had the highest amount of Distant in percentage, and a much lower percentage of Meaningful speech. Based on this single finding, it was decided that more qualitative findings within the LENA analysis program was needed on the single subject Fp6.

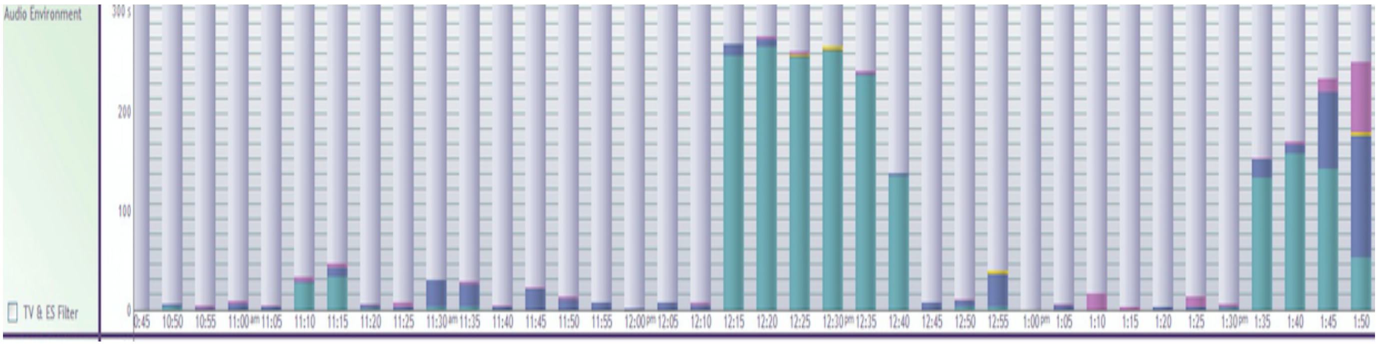

Figure 4.1.2.C: Shows a 5-minute composite view of the Audio environment between 10:45 and 13:50 in a recording from Fp6 (Group 2).

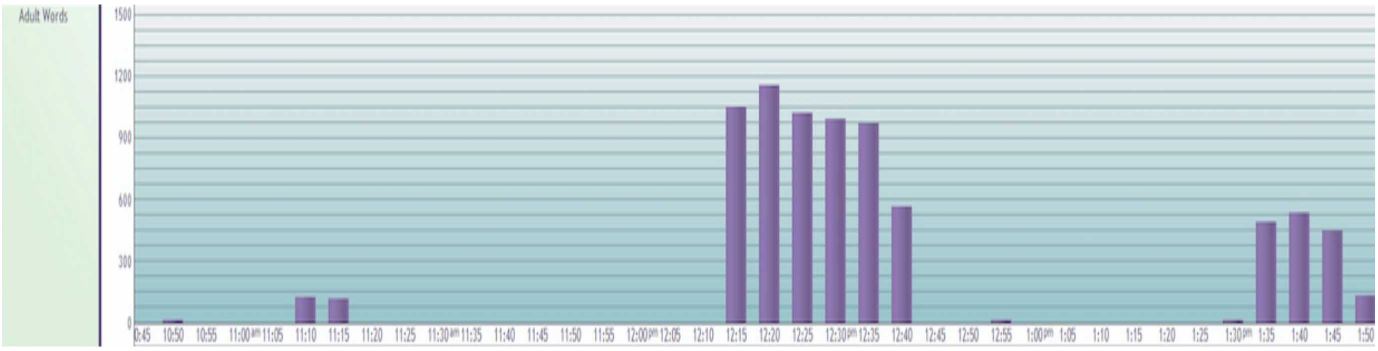

Figure 4.1.2.D: Shows a 5-minute composite view of the Adult words spoken between 10:45 and 13:50 in a recording from Fp6 (Group 2).

Figure 4.1.2.C show bars coloured green as Distant speech, whilst the blue stacked bar shows Meaningful speech. In this Figure, one can assume that at 12:15 someone started talking with the individual, and stayed with them for about 30 minutes. When asking the nurses about the participant's day, they said that a staff member visited around 12 am, which coincides with the 5-minute composite view in Figure 4.1.2.C. There was also a small word-count spike around 13:35 when looking at Figure 4.1.2.D. The same spike is displayed in the audio environment composite, but this time the pink bar describing the Noise exposure was also prominent. Besides the spikes mentioned, the audio environment seemed to be quiet.

In Group 1, there was a nearly perfect positive significant correlation between Meaningful speech and Total word count per hour (r=.942, p=.017). In Group 2 the correlation was also nearly perfect, but not significant (r=-.987, p=.102). It is possible that with a larger group, the correlation would have been statistically significant.

4.2 Group 1 and 2 vs the American study

4.2.1 Background information

In this thesis each LENA DLP recording lasted for approximately four hours, due to the privacy conditions mentioned in sub-chapter 3.4.1. Figure 4.2.1.A below illustrates on what time-frame the recordings were made on individual basis. The earliest recording started at 10:00 am, and the latest recording ended at approximately 16:30.

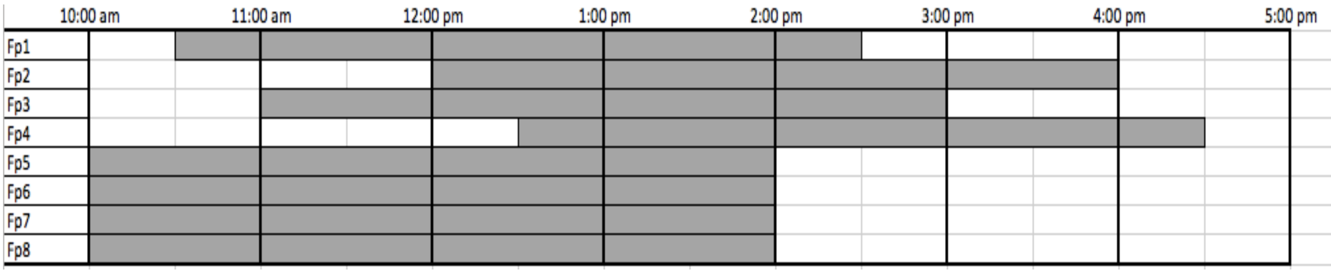

Figure 4.2.1 A: Display of recording time from 10 am to 5 pm, with coded participants (1-8) in each row.

On the other hand, Figure 4.2.1.B shows us the time-frame of the recordings made in the Li et al. (2014) study. As illustrated below, the earliest recording started at 6:00 am, and the last recording ended at 12 am. One of the participant criteria in the Li et al. (2014) study was that they had to be recorded for at least 10 hours or longer. Their recording time frame represents 18 hours of the given day, whilst this thesis recordings only contained six and a half hours.

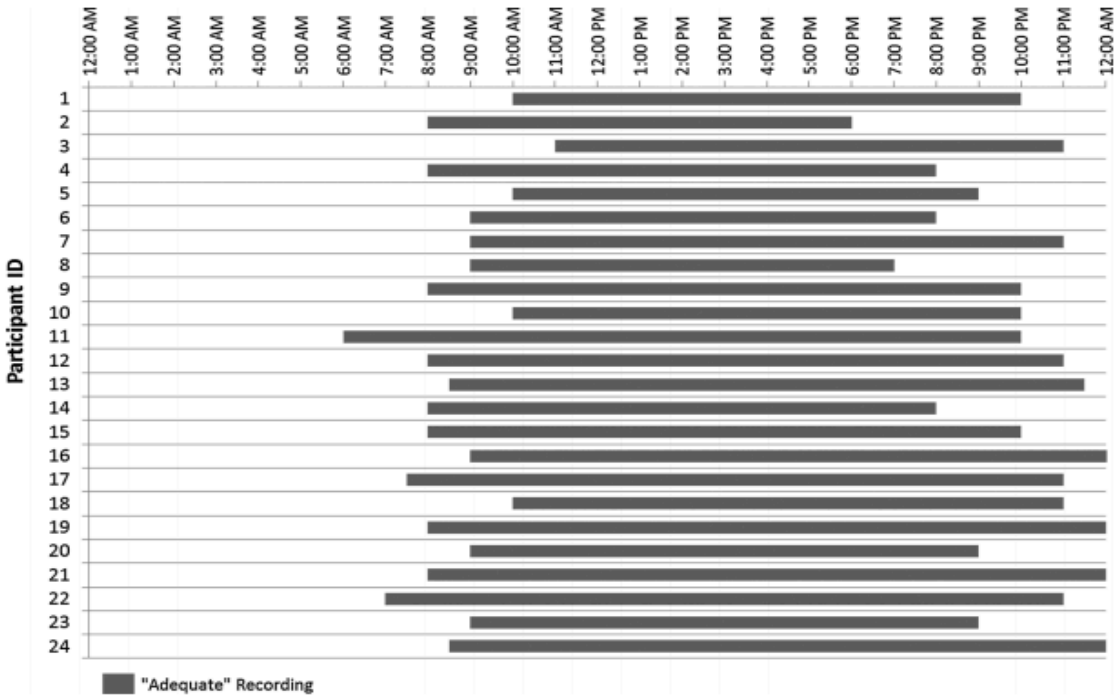

Figure 4.2.1 B: Display of recording time in Li et al. study (2014) on individual level

The mean duration of the Li et al. (2014) study was 13 hours and 13 minutes, whilst the current study's mean duration was four hours. The results from the current study was therefore divided into words per hour, to provide a clearer and more intelligible result to the study and easier to compare to the American study.

The mean age in the American study was 76 years, whilst the mean age in the current study was 77 (group 1 and group 2 combined). The Li et al. (2014) study listed the educational level of the participants as well as the participant's race. In the current study, only the variable *education* was of interest. Their study had categorized e.g. "*some college*" and "*college*" in their results. However, the current study measured amount of education completed in years after completed high school. To compare the two studies adequately, the category "*some college*" in the American study was set as equivalent to three years completed in college in the current study (three years is common for a bachelor's degree in Norway). The category "*college*" in the American study was set to include four years or more of completed school in the current study. The other categories (< *12th grade* and *high school graduate)* from the American study were grouped together and compared with participants in the current study who had zero years in college.

In Li et al. (2014) the number of participants categorized with < *12th grade* and *high school graduate* education included 41,6 percent of the respondents. In the current study, the percent of respondents in this similar group was set to 37,5 %. The American study had 45,8 % respondents with *some college,* whilst this current study had 37,5 %. The category *college* consisted of 12,5 % of the participants in the Li et al. (2014) study, and 25% of the participants in the current study.

4.2.2 Comparison of audio environment (LENA) between studies

The study conducted by Li et al. (2014) did not contain the variable “Noise”. Therefore, the *Noise exposure* variable was eliminated in this part of the results.

	This pilot study	Li et al.
N	8	24
Distant %, (range)	12,5% (1%-30%)	22,4% (3%-51%)
Silence % (range)	60 % (31%-81%)	26,8% (9%-65%)
TV % (range)	8% (1%-35%)	26,7% (4%-58%)

Table 4.2.2.A: Table displaying N of both groups. Distant speech, Silence and TV exposure is displayed in percentage.

Within the Li et al. (2014) study, Table 4.2.2.A shows that hearing speech in Distant was 10 % higher in median, and wider in range than the findings in the current study. Hearing speech in Distant had a negative z value, with nearly one SD from mean, and a high *p value*, which makes the result not statistically significant (z=-778, *p*=667). The variable Silence was over two times greater in the current study than in the American study. The current study was one and a half SD from median (z=-1,556). However, the results for the variable Silence were not statistically significant within the .05 criteria (*p*=.222).

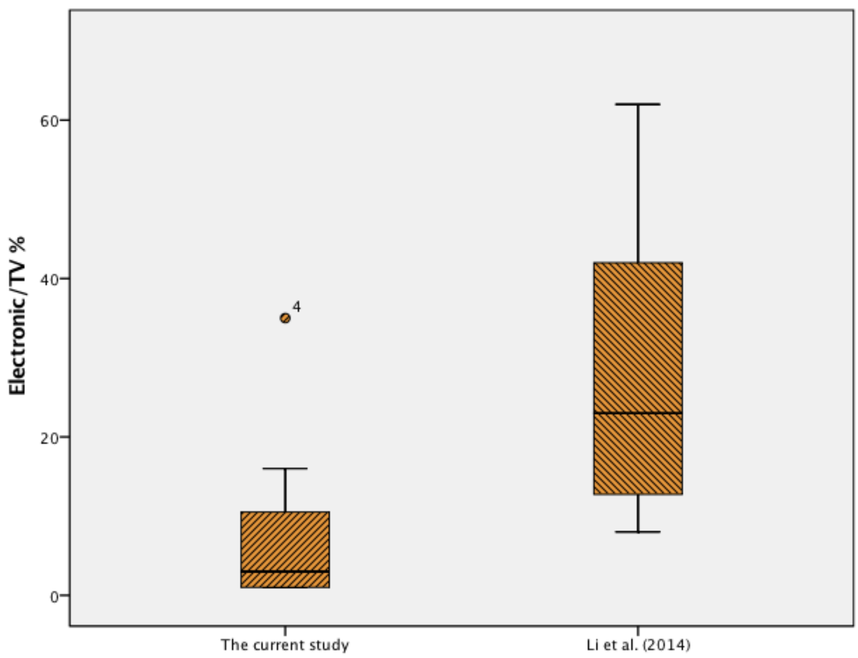

Figure 4.2.2.A: Electronic sound/TV (in percentage) between the two studies (The current study vs. Li et al. (2014).

The Electronic sound/TV exposure median was nearly 19 % higher in the Li et al. (2014) study. When doing a Mann-Whitney U test, the variable had three SD from median (z=-3,190). The difference in the variable was statistically significant between the two studies, within the .05 value (p=.001).

Figure 4.2.2.A explains that the central tendency in Li et al. (2014) was closer to the 25th percentile, and it also shows a larger spread in percentage within the category. In the current study, central tendency was closer to the lowest percentage data in the study. The Figure 4.2.2.A also shows an Electronic/TV exposure recorded (Fp 4) at 35%, which was higher than one would expect for this group, hence an outlier. Both studies had a positive skew in the Electronic/TV exposure variable.

4.2.3 Comparison of communication (LENA) between studies

	This pilot study	Li et al.
N	8	24
Distant %, (range)	12,5% (1%-30%)	22,4% (3%-51%)
Meaningful % (range)	16% (8%-38%)	19% (3%-48%)
Total word count (range)	2101 (425-4465)	2508 (387-5893)

Table 4.2.3.A: Table displaying N of both groups. Distant and Meaningful speech is presented in percentage. Total word count is presented per hour.

In the current study, the Total word count mean results are divided into a 4-hour long recording. In the Li et al. (2014) study however, the Total word count mean was divided into a 12-hour long recording. This resulted in the variable Total word count per hour.
The mean exposure of Total word count per hour in the current study was 2101 words with a range of 425- 4465 (SD = 1195). The American study had a mean of 2508 words per hour, but the SD were not accounted for. Therefore, the Total word count in the current study was 401 words less per hour than in the Li et al. (2014) study. There was a larger spread in word count in the American study. Talking in Distant was nearly twice the percentage (12,5% vs. 22,4%) in the Li et al. (2014) study than in the current study.

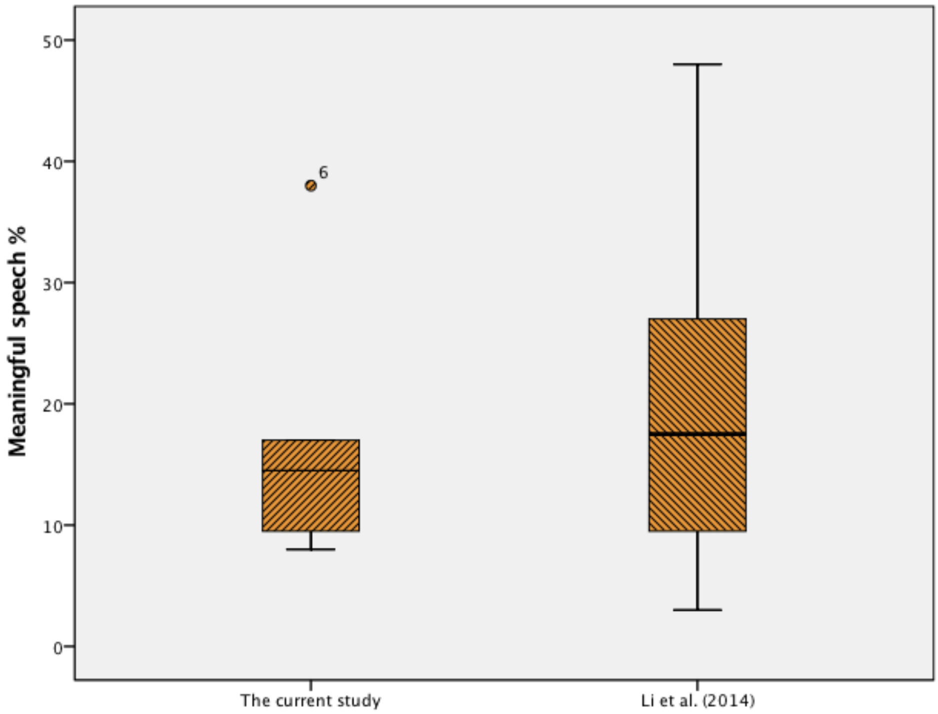

Figure 4.2.3.A: Meaningful speech (in percentage) between the two studies (The current study vs Li et al. 2014)

Meaningful speech was one SD from median, when doing a Mann-Whitney U test (*z*=-,939). However, the results were not statistically significant within the .05 value (*p*=,357). Figure 4.2.3A showed a larger spread in the American study. The central tendency in the Li et al. (2014) study was closer to the 25th percentile, and was somewhat a positive skew. The current study had the central tendency closer to the 75th percentile, and was somewhat a negative skew.

4.2.4 Summary

The results have been processed and calculated with SPSS, version 24. At first, only the data from the current study was included in the data sheet. The data from the Li et al. (2014) study was later added and included in the same data sheet. The two groups from the current study matched in both age and number of children of participants. The variable education was however dissimilar in the two groups in the current study. The participants in the Li et al. (2014) study also matched in age with the participants in the current study. However, the recordings were several hours longer in the Li et al. (2014) study than in the current study. The environmental sound was quite similar for both groups (1 vs. 2) in the current study. However, percentage of Distant speech was higher in the experimental group (Group 2). In the Li et al. (2014) study, the Electronic sound/TV percentage was significantly higher than in the current study (Group 1 + 2). In communication, the main finding was that participants in Group 2 of the current study had a higher amount of Meaningful speech in percentage. Furthermore, Group 2 had a higher Total count of words per hour, but also had the highest amount of Distant speech percentage. The Li et al. (2014) study had a higher word count per hour than the current study, but the American study also had a higher percentage of Distant speech. The demographic variables (gender, , children, living alone and vision) results were statistically tested, but neither had any significant correlation with the LENA analysis results in this sample (Group 1 and 2).

5 Discussion

The purpose of this study was to investigate the audio-verbal communication situation of individuals with hearing impairment and dementia compared to age-matched controls without hearing loss and dementia. The most important findings from the current study was related to audio environemental factors related to possible communicative behaviour. Another outcome was that the LENA technology can be used in a Norwegian context, and might be helpful in exploring communication interactions in everyday situations of elderly, including individuals with a comorbid condition. Additionally, it seemed that there were socio-cultural differences related to audio environment, that can be revealed by using the LENA technology. However, further studies are needed to confirm the preliminary results from this pilot study.

5.1 Audio environment in relation to verbal communication

The audio environmental differences between groups (1 vs 2) waa measured with LENA and was represented with some similarities between the groups (1 vs 2). However, Group 1 with typical functioning had more *Silence* during the recordings than Group 2, and Group 2 had more exposure to speech in Distant. The audio environment was dominated by Silence and by speech in Distant in Group 2. As hearing of speech in Distance is measured by the DLP to be speeeh further away than 6 feet from the individual, it is an indication that the audio environment could be exposed to reverberation (Laukli, 2007). Some HAs will amplify background noise, and thus make the sound scape difficult to understand, especially if one has a cognitive deficit (Stach, 2010). Such exposure also seems to be stressful, and could in worst case make the elderly users of HAs refrain from wearing the devices (Solheim et al. 2011). Consequently, this will also lead to a national financial issue, as HAs are founded by the National Insurance Act (Folketrygdeloven, 2017).

Silence was dominant in the control group (Group 1). There were up to 81% Silence in one of the recordings. This environmental setting will not affect a healthy brain, but for individuals with dementia, hearing impairment and/or cognitive decline, this can be crucial to the degeneration of brain matter (Valentjin et al., 2005; Dawes et al., 2015). The lack of verbal and meaningful communication can be disadvantageous for an elderly brain that's already struggling with decay. If not dealt with, the lack of communication can in some cases lead to social isolation and depression. Social isolation could lead to a worsening in the brain cognition. Depression is a condition that is common among elderly with dementia (Uhlmann et al., 1989). Experts in the research field of dementia and hearing loss are uncertain whether or not HA usage is effective in treating the brain degeneration and anxiety in elderly with dementia (Mohlmann, 2009). However, the experts suggest that individuals with this comorbid condition should be treated and stimulated with increased social activities with caregivers, and that this kind of actions possibly could slow down the degeneration process (Bai, Yanh & Knapp, 2016).

5.2 Norwegian pilot-study of elderly with and without comorbid condition vs American outcome of age-matched adults

The audio environmental differences in results from the current study compared with the American study conducted by Li et al. (2014) showed a lower percentage of Silence in their recordings. However, they had an increasingly higher percentage of *Electronic sounds/TV exposure* than the participants in the current study. When trying to find an explanation to this difference, a correlation test was executed which showed a strong correlation but not within the .05 value (r=,483, *p*=188). The *age* or any other demographic information was not statistical significant different between the groups (Group 1+2 vs Li et al., 2014).
The American study also included the background information *race,* which was not included in the current study. The American study was solely consisted of individuals with African American background which low educational level, whilst the current study consisted of Caucasian individuals with a Norwegian mother tongue (Group 1+2). Therefore, this environmental difference could perhaps be explained by different socio-culture or socioeconomic background variables.

Another cause for this finding (Electronic sound/TV differences) could be that the recordings from the current study were compromised and only contained four hours per recording.
The American study included roughly 12 hours per recording. The time of day was limited in the current study since the individuals only were available during day time. Thus, it is possible that the trends could have changed if the recordings had taken place during all-day recording, including the afternoons or evenings. The Li et al. (2014) study did not provide

any information regarding the Electronic sound/TV trends, nor commenting on the amount, indicating that the amount of TV exposure of their participants might reflect the average/normal exposure in the general American population. These trends could have been presented in a 5-minute composite view as displayed in sub-chapter 2.6.2. The LENA natural language study (2007) found that American children were exposed to more TV during evenings than during daytime. This suggests that with longer recordings in the Norwegian study, the Electronic/TV percentage could have had an increased median percentage. However, the American Li et al. (2014) study displayed a figure which showed that five individuals had over six hours of Electronic/TV exposure during the recording. Therefore, the individuals must have been exposed to Electronic sound/TV for a greater period of time than just during the afternoon. Hence, the indication that socio-cultural differences could be a plausible cause to the environmental differences are supported by these results.

The audio-verbal communication outcome in the current study compared to the results of Li et al. (2014) study, showed a lower percentage in all of the three following variables; Meaningful, Distant and Total word count per hour. The Total word count difference between the two studies were 401 words per hour. The variable “Meaningful” had a larger spread in the Li et al. (2014) study, and a higher percentage (shown in Figure 4.2.3.A) than in the current study. However, the shapes of the boxplot inform about the skewness and the central tendency appears somewhat similar, when looking at the outlier. This finding suggests that with a larger sample in a similar future study, the Norwegian results could potentially be more similar and comparable to the Li et al. (2014) study. The Hart & Risley longitudinal study (1995) and the LENA natural language study (Gilkerson & Richards, 2007) had similar findings in children. Gilkerson & Richards (2007) found that there was a higher talkative peak in the evenings than during the daytime, which coincided with the Hart & Risley (1995) findings. These findings furthermore suggest that recordings in the current study with a different timeframe perhaps could have increased the Meaningful speech percentage in the results of the current study.

5.3 Comorbidity and verbal communication in nursing homes

The verbal communication differences in the current study showed a higher percentage of Distant, Meaningful speech and numbers of Total word count in the experimental group (Group 2) compared to controls (Group 1). The exposure of Meaningful speech seemed to increase with age, which is a preventative factor against cognitive decline (Bai, Yanh & Knapp, 2016) The nursing homes partaking in this study seemed to be eager and involved in the study as they had freely volunteered and shown an own desire to participate. The nursing home had a connection to a *HLF likepersonskoordinator,* which further suggest an extensive attention and dedication to patients with hearing impairment. One can only speculate whether the nursing homes that chose not to participate were not as motivated. Perhaps they had less smaller focus on individuals with both hearing impairment and dementia. Additionally, the nursing homes that chose not to participate were perhaps furthermore not in a position or able to pay attention to this specific comorbidity. This could indicate that these nursing homes might not follow the strategies put forward by NICE-SCIE (National Collaborating centre for Mental Health, 2007) regarding promotion of communication between individuals living in nursing homes and professionals. Hence, as the partaking nursing homes seemed very compelled to participate, the results do not represent the wider population of Norwegian nursing homes. The participating nursing homes might have different fields of priority than the wider population of nursing homes, since they decided to participate. The study by Solheim et al. (2016) showed that some staff members in nursing homes had difficulties in handling the HA equipment. The HAs provides great advantages when communicating and socializing (Tye-Murray, 2014). This leads to an interesting question: How can one follow the customs of socialization when elderly with hearing loss and dementia patients struggle to perceive what is communicated and the health care staff lack knowledge regarding e.g. HA maintenance? The individuals living in nursing homes partaking in this current study seemingly had adequate information regarding HA equipment. The information cards of the participants which were described in greater detail in sub-chapter 3.3.5 contained information regarding battery and other maintenance routines. This supports the statement that the nursing homes participating in this study perhaps had a greater understanding than other nursing homes, on the complexity of comorbidity and communication discussed in this thesis.

The individual with the highest amount of Meaningful speech, measured with LENA (Fp6), who both had dementia and hearing loss, was also one of the participants with the highest amount of exposure of speech at Distance. By looking at a 5-minute view in the LENA analysis program, it was easy to see that when the variable Meaningful had a higher percentage, the Distant word count also increased. One could suggest these results were based on a measuring error. However, as shown in sub-chapter 2.6.2, this type of error was accounted for when developing the LENA analysis program. The finding could thus not be measuring error. This result might be related to unknown reasons, like e.g. the individual´s abilities to communicate through listening and/or speech deficits in speech and language that are related to dementia. Standing further away from the individual with a hearing loss in combination with exposure of rapid speech are some known difficulties in individuals with hearing loss (Stach, 2010). However, one can also fear that the reported Meaningful speech in the analysis could have been a combination of talk in Distant, and talk *over the participant's head.* This potential combination of speech exposure would be strikingly in contrast with a Meaningful and rewarding conversation as recommended by the NICE-SCIE guidelines (National Collaborating centre for Mental Health, 2007). By using good communication strategies, one could empower the patient to a preform and succeed in reachable tasks resulting in sense of achievement in the individual with a comorbid condition. Additionally, the overall sound scape seemed to be quiet and with a low amount of Meaningful speech if one disregards the 'spikes' shown in the LENA Analysis program. Spikes are explained in greater detail in sub-chapter 4.1.2

The high amount of Meaningful speech and speech in Distant from Fp 6 in Figure 4.1.2.A represents data from the whole recording. In this figure, it would seem that Fp6 had a high percentage of Meaningful speech and Distant talking throughout the day. However, by looking at the 5-minute composite views (Figure 4.1.2.C and 4.1.2.D) of Fp6, it is clear that Meaningful speech and speech at Distant only appears in few, short 'spikes' throughout the day. This illustrates the advantages of using the LENA program, not only to measure the total numbers of words during a day, but also that it gives in-depth understanding and detailed composite views of the individual's communication habits during a whole day. By looking at the total percentage figure, the recording results from Fp 6 present a seemingly rich sound scape. Nevertheless, if one looks at the LENA analysis 5-minute composite view of the Fp 6 results, one can see the greater tendencies such as for instance 'spikes' etc.

Consequentially, one should be careful when viewing the total percentage figure, as they in some cases can appear misleading. With a high amount of spoken words in a short period of time one worsens the issue regarding rapid speech (Stach, 2010). Individual's benefits from a large amount of words is therefore somewhat questionable, as the word count may be large, but the word perception, and understanding of word could be low. The example from the Fp 6 results indicates that there is a need of a combination of quantity and qualitative LENA-study with focus on examining communication strategies. This is necessary to evaluate the quality of the conversations properly in dyads of caregivers and elderly with comorbid conditions. Nursing homes are obligated to advocate for the individuals' social well-being, as well as protect their interest and maintaining the respect for both integrity and dignity. Perhaps Fp 6 was in need of less social stimuli in that specific day, due to illness or other unknown reasons. Individuals with dementia have the right to reside in protected units without any excessive stimuli (Forskrift for sykehjem m.v., 2013).

Nonetheless, without the necessary qualitative data, these assumptions are only hypothetical and must therefore be examined in a future study.

In the control group (Group 1) the results showed signs of a low percentage of Meaningful speech. This could be explained by that some of the participants were alone during the recording. Although, when examining each recording, some participants who were not alone during the recordings still had a low percentage of audio verbal communication, both in Distant and Meaningful speech (hearing speech at long and short distances). As mentioned, this result would not effect a healthy brain, but could be destructive to a brain with cognitive decline. Therefore, individuals with a comorbidity condition of dementia and hearing impairment could benefit more from the nursing homes' communicative sound scape, when compared with the sound scape of the control group.

5.4 Unpredictable challenges to perform the study

In the current study, it was important to emphasis the challenges related to the demanding job of implementing and gaining approval of the measurement tool LENA. The first obstacle in the current study was obtaining approval from NSD. Their first initial response came one month after having registered the project on their websites (21st December to 31st January). NSDs' main uncertainty was related to the privacy policy. Since the LENA device was new to the NSD, they needed proven research and information from the LENA foundation in the USA about the functions of the DLP. The process of assuring the NSD that the LENA tools complied with the Norwegian privacy policy was an arduous and a time-demanding task.
The master thesis was approved on the 3rd of March, as shown in Appendix 1. In addition to the approval, NSD also commented on the methods and information security related to the use of LENA tools, which has been listed in Appendix 1. One of the statements from NSD regarding the information security was as follows:" Det er i utgangspunktet svært vanskelig å lytte til lydfilene, men det finnes en teoretisk mulighet for dette." (Appendix 1). This statement was one of the biggest threats related to the use of the measuring tool LENA in the current study. It proved difficult to reply to NSDs concerns regarding the privacy policy threat as they claimed that it was possible to listen to the audio file. Assuring the NSD that this was not the case was difficult as there were few valid informational articles contradicting their claims. Due to the difficulties obtaining adequate information regarding this threat, the LENA tool was restricted both in length of the recordings and in the placement of the participants. An additional requirement from NSD was that the researcher had to obtain consent from staff and other visitors in Group 1 and 2 of the current study. Furthermore, the participants in the control group could not leave the house during the recording sessions. Whilst recording, a researcher had to be available in case the participant had to turn off the DLP for any unknown and necessary reason. Having the researcher available outside the participants' residence made it easier for the participants to contact the researcher if anything out of the ordinary would occur. However, this resulted in a substantial threat to the recordings, as the participants had a lower threshold to contact the researcher. The recording situation could therefore appear staged, and could consequently lead to the potential disadvantages related to "observational" research methods with atypical behaviour.

The placement of the researcher also had an effect on the recordings, as participants living at own homes came in contact with the researcher on several occasions. However, the low percentage of talk in the results tells us that this contact had no effect on the results, rather the opposite: The individuals living at home had even less words spoken during the recorded period. This could additionally be a result of the restriction to not leave the house during the recording session.

Another topic that deserves discussion, was the lack of nursing home participants in the current study. The increased focus by the media on dementia was expected to increase the interest in the topic and thus also the interest to participate in the study. However, this was not the case. Nevertheless, the recruitment process of the control group was fruitful, and it was easy to obtain participants for such an important cause. The feedback from the control group participants was that everyone felt they knew someone with either of the two diagnosis, and therefore they wanted to contribute to the cause. Another general consensus was that they believed this thesis subject was highly relevant in todays' society. On the other hand, in the nursing homes it was proven to be more difficult to obtain participants for the study. Several statements by the potential nursing homes were communicated containing agreements that they would respond and follow up on the communication if they found the subject interesting. Moreover, several nursing homes also stated that they had no such patients in their nursing homes, even though the numbers of statistics indicate otherwise (Solheim et al, 2016; Statistisk sentralbyrå, 2016.

The LENA Foundation's goal is to increase language development and to advance the cognitive, social, and emotional health of children. In the current study, it was implied that the LENA measurement could be applicable to a larger field of studies than intended e.g. in elderly adults. This thesis is presumably the second study in the literature that has evaluated adult participants with the LENA technology. This was also the first study containing a sample with a comorbid condition of dementia and hearing impairment, which makes the study ground-breaking. When comparing results from the current Norwegian study to the American study of typically functioning elderly people, there were some findings that were different. For instance, in perecntage of different audio environment parameters, such as level of Electronic sound/TV exposure. These dissimilarities are probably explained by socio-cultural differences, and/or the diverse length and time of the recordings. The results of the current study in comparison to the Li et al. (2014) study have proven that LENA could be used not only in adults but also in vulnerable groups like individuals with hearing loss and dementia. The goal of the LENA Foundation to advance the cognitive, social and emotional health of children can expand and likewise be applicable to an older population, with and without cognitive decline, and thereby influence in a lifespan perspective and promote these groups specific needs of improved quality of life.

When comparing the results in the current study with the Li et al. (2014) study, the participants from both Groups (1+2) in the current study were combined into one group. The participants from Group 2 were not comparable with the participants in the Li et al. (2014) study, since the participants (Group 2) had both a hearing impairment and a dementia diagnose. Combining the two different Groups (1+2) in the current study and further compare these with a control group from a different study, could lead to methodological problems. The participants from the current study were matched with the only published scientific literature containing older adults. Use of this method could potentially provide misleading results as the groups were different to begin with. One group were "clinical" whilst the other consisted of individuals with typical ageing. However, the combination of the Groups (1+2) was necessary to provide results from a larger sample. Furthermore, by comparing the Groups from the current study and the Li et al. (2014) study, one could see that there could be socio-cultural differences between the two samples unrelated to clinical background.

6 Limitations and future perspective

This thesis was limited was mainly due to external factors. First up, NSD had strict rules when it comes to implementing new recording devices. The process took a lot longer than expected, and the data collection could not start until the approval was received, which was in March. In addition, the recordings duration was limited from the intended length, as the researcher had to be present at each recording session. This led to another disadvantage, the locations of participants needed to be in ´traveling distance´ as well as only one recording could be active as once. This led to a limitation of participants in, and as this is a quantitative study, moreover resulted in a lower external validity. As shown in chapter 5, the duration of the recording sessions could also affect the results, and therefore compromise this thesis intentions and research question. The current study therefore was decided to be executed as a pilot study. In future perspective, one should contact the NSD at an earlier stage of the process. One should also argue that the recordings could take place without a researcher present to improve the reliability of the results.

Additionally, there were several individuals whom wanted to join in as control group, whilst few nursing homes had the capacity, as discussed in chapter 5. Is LENA difficult to understand, or is it frightening? The interest in this current study were generally low among nursing homes. A few nursing homes reported that they already were participating in another study, which could affect the results. LENA was a new tool no-one had heard of, and it could have made the study less interesting than other ongoing studies. Moreover, a nursing home responded that they had no patients with the set criteria, and a large amount of nursing homes did not respond to the initial e-mail. In future studies, one should start by contacting the *HLF Likepersonskoordinator*, as this was the single most successful way to recruit participating nursing homes.

This subjects deserve a qualitative study to assess the quality of the conversations between patient and professionals. It also deserves a larger quantitative study to assess the larger tendency. One should publish this paper findings, and market this new assessment tool for a whole new field of study on older adults.

7 Conclusion

The study has revealed that the listening environment in both nursing homes and in the control group had a low percentage of Noise exposure, which decreased the annoying reverberation. It also seemed that the individuals with no hearing impairment nor dementia diagnosis had a lot more silence in percentage in the time period of 10 am to 5pm.
The exposure of Electronic sound/TV was higher for the individuals living at home in comparison to the individuals residing in nursing homes. The percentage of Electronic sound/TV exposure was even higher in the American Li et al. (2014) study. This could be due to socio-cultural or socioeconomic differences between the studies.

The communication in the control group was low, and this could be because the individuals were not able to leave the house during the recording. It could furthermore be that the 'time of the day' the recordings took place had an effect on the results. With a 12-hour recording the results could perhaps have concluded in a different outcome. The variable Meaningful speech in the experimental group also coincided with talking in Distant. However, one participant's Meaningful speech exposure was compressed into *spikes* in the recordings. This could suggest that the individuals' environmental sound mostly was exposed to Silence, with some fragmented exceptions of communicative conversations. The communication in the Li et al. (2014) study showed a wider range of Meaningful speech in their recordings. However, the results seemed to be somewhat similar in shape when taking the outlier in this current study into account. This suggests that with longer recordings, or with a larger sample, the results could prove to be comparable.

The differences in environmental percentage could lower the validity of the LENA recorder as a measuring instrument. Thus, the LENA results would not be applicable to this group of individuals. However, taking into account the duration and the timing of the day when the recordings took place, the studies could perhaps be corrected and appearing more similar to each other.

When comparing the communication variables, the two different studies seem to coincide and strengthen the validity of this measurement instrument.

8 Reflections and recommendations

The process of writing this master thesis has been both stressful and demanding, yet also very interesting and inspiring. As a first-time researcher it was exciting to enter the field of science by conducting a non-experimental quantitative study.

The participating nursing homes in this current study were possibly some of a few institutions who had adequate routines regarding HA use and maintenance if elderly with a comorbid condition. The individuals with HAs were thereby presumably very fortunate to be residing in these specific nursing homes. The percentage of Meaningful speech, measured with the LENA technology, was higher for participants living in the nursing homes than for controls, who were living in their own homes. The sound scape for individuals with a hearing impairment and dementia could therefore be better in nursing homes than in their own personal residencies. As a general outcome, it should be more desirable for the ageing population with comorbid conditions to reside in nursing homes, rather than staying in at home as long as possible. However, one should keep in mind that the limited recordings in this study will not be representative for the whole population. There is a need of conducting a larger cohort study with longer all-day LENA recordings, preferable with two control groups; one with dementia only and one with typical cognitive condition and normal hearing. Furthermore, the preliminary results from this pilot study indicate a need to also explore more qualitative aspects like the use of communicative strategies of caregivers, both in nursery homes and in personal residencies.

The NICE-SCIE guidelines states that good communication strategies could prevent aggravated behaviour in the individuals with dementia. The guidelines furthermore encourage to promote self-efficiency among patients with dementia, empowering the individuals to trust in themselves that they are capable of executing a given task. Communication strategies have also proven to be useful for individuals with a hearing impairment. An example of this could be that communication strategies could be used to prevent social isolation, which again can lead to cognitive decline. These guidelines of good practices assist and guides nursing home staff to better communicate with individuals diagnosed with dementia. The question is if caregivers are educated and guided by professionals like speech language pathologist or teacher of the deaf in how to interpret and implement the guidelines from theory to practice.

Based on the findings in the results and the provided theory (Solheim et al., 2011), I firmly believe that more nursing homes should enhance their competence concerning the comorbidity of dementia and hearing impairment. The NICE-SCIE guidelines is a very good starting point on developing good practices in nursing homes, now and in the future, and in the whole country.

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Appendix 1

Ulrika Löfkvist
Institutt for spesialpedagogikk Universitetet i Oslo
Postboks 1140 Blindern
0318 OSLO

Vår dato: 03.03.2017 Vår ref: 51757 / 3 / HIT Deres dato: Deres ref:

TILBAKEMELDING PÅ MELDING OM BEHANDLING AV PERSONOPPLYSNINGER

Vi viser til melding om behandling av personopplysninger, mottatt 21.12.2016. All nødvendig informasjon om prosjektet forelå i sin helhet 02.03.2017. Meldingen gjelder prosjektet:

51757	*Presbyacusis i samspill med Alzheimer hos personer på sykehjem – En kartlegging av gruppens lyssnings- och talspråksmiljø i sammenligning med åldersmatchade grupper som inte har presbyacusis respektive vare sig har presbyacusis eller Alzheimer*
Behandlingsansvarlig	*Universitetet i Oslo, ved institusjonens øverste leder*
Daglig ansvarlig	*Ulrika Löfkvist*
Student	*Hilde Nøis*

Personvernombudet har vurdert prosjektet, og finner at behandlingen av personopplysninger vil være regulert av § 7-27 i personopplysningsforskriften. Personvernombudet tilrår at prosjektet gjennomføres.

Personvernombudets tilråding forutsetter at prosjektet gjennomføres i tråd med opplysningene gitt i meldeskjemaet, korrespondanse med ombudet, ombudets kommentarer samt personopplysningsloven og helseregisterloven med forskrifter. Behandlingen av personopplysninger kan settes i gang.

Det gjøres oppmerksom på at det skal gis ny melding dersom behandlingen endres i forhold til de opplysninger som ligger til grunn for personvernombudets vurdering. Endringsmeldinger gis via et eget skjema, http://www.nsd.uib.no/personvern/meldeplikt/skjema.html. Det skal også gis melding etter tre år dersom prosjektet fortsatt pågår. Meldinger skal skje skriftlig til ombudet.

Personvernombudet har lagt ut opplysninger om prosjektet i en offentlig database, http://pvo.nsd.no/prosjekt.

Personvernombudet vil ved prosjektets avslutning, 01.09.2017, rette en henvendelse angående status for behandlingen av personopplysninger.

Vennlig hilsen

Katrine Utaaker Segadal

Hildur Thorarensen

Dokumentet er elektronisk produsert og godkjent ved NSDs rutiner for elektronisk godkjenning.

NSD – Norsk senter for forskningsdata AS Harald Hårfagres gate 29 Tel: +47-55 58 21 17 nsd@nsd.no Org.nr. 985 321 884
NSD – Norwegian Centre for Research Data NO-5007 Bergen, NORWAY Faks: +47-55 58 96 50 www.nsd.no

Personvernombudet for forskning

Prosjektvurdering - Kommentar

Prosjektnr: 51757

FORMÅL

Forskningsprosjektet vil undersøke lytte- og tale-språkmiljøet hos eldre personer med påvist Alzheimer demens i samspill med aldersbetinget hørselshemming som bor på sykehjem, i sammenligning hos en aldersmatchende gruppe som kun har påvist Alzheimer demens, og mot en gruppe som hverken har Alzheimer demens eller aldersbetinget hørselshemming. Formålet med prosjektet er å gi en oversikt over lytte- og tale-språkmiljøet hos de ulike gruppene, og undersøke om enkelte faktorer kan påvirke eventuell kommunikasjon og sosial omgang.

ANDRE GODKJENNINGER

Vi legger til grunn at gjennomføringen av prosjektet avklares med institusjonen den skal gjennomføres ved.

DATAMATERIALETS INNHOLD

Det behandles sensitive personopplysninger om helseforhold.

INFORMASJON OG SAMTYKKE

Det gis skriftlig informasjon og innhentes skriftlig samtykke for deltakelse i prosjektet. Personvernombudet finner informasjonsskriv mottatt 02.03.2017 godt utformet.

Enkelte av deltakerne vil kunne ha noe redusert samtykkekompetanse. Personvernombudet finner at opplysninger innhentet fra personer uten full samtykkekompetanse, kan behandles med hjemmel i personopplysningsloven § 8 d) og § 9 h).

Det anses ikke som potensielt belastende for vedkommende å delta i prosjektet. Det opplyses at vedkommende vil bli gitt tilpasset informasjon, samt at hjelpeverge/nærmeste pårørende informeres om prosjektet, og eventuelt gir en uttalelse om hvorvidt opplysninger om vedkommende kan anvendes i studien.

Det vurderes at den valgte fremgangsmåten for inklusjon av personer uten full samtykkekompetanse, bidrar i betydelig grad til å redusere personvernulempen ved deltakelse. Det vurderes videre at opplysningene vil kunne komme gruppen som helhet til gode. På bakgrunn av dette finner personvernombudet at samfunnsinteressen i at behandlingen finner sted, overstiger ulempen den medfører for den enkelte registrerte.

METODE

Data innhentes gjennom lydopptak ved bruk av programmet LENA. Det vil bli gjort lydopptak ved en institusjon og i en hjemmesituasjon. Ved lydopptak på institusjon forutsettes det at alle beboere, ansatte og eventuelle besøkende til avdelingen gir et informert samtykke til gjennomføringen, ellers kan datainnsamlingen ikke gjennomføres, eventuelt må opptakeren slås av mens besøkende som ikke vil delta er til stede. Forsker vil være til stede utenfor avdelingen for å avklare dette med dem det måtte gjelde.

Ved opptak i hjemmesituasjon forutsetter dette også at alle involverte samtykker til å delta. Lydopptaker vil bli slått av dersom det kommer besøkende, eller hvis personen går ut. Forsker vil være til stede for å hjelpe med dette.

INFORMASJONSSIKKERHET
Målemetoden (LENA) innebærer å objektivt kvantifisere antall ord en person hører i løpet av en dag, samt hvor mange ytringer personen selv uttrykker. Man kan også trekke frem informasjon om lyttemiljø og kommunikasjonsmønstre mellom informanten og dem man har samtale med. Innspilleren kan registrerer lytte- og tale-miljø og kommunikasjon i 12-16 timer. Et dataprogram regner ut antall ord som blir ytret, både av personer rundt, og forsøkspersonen selv. Den registrerer også lyttemiljøet forøvrig som for eksempel elektronisk lyd (tv, radio). Hver avspilling blir bli kodet og slettet etter endt innsamling. Det er i utgangspunktet svært vanskelig å lytte til lydfilene, men det finnes en teoretisk mulighet for dette. Innspillingene som vil bli kodet og behandlet på Universitetet i Oslo sin forskningslab. Programleverandøren vil ikke på noe tidspunkt ha tilgang til lydfilene.

Under innspillingen vil forsker være til stede utenfor hhv. avdelingen og hjemmet. Dette er for å forsikre at alle som blir registrert av innspilleren har gitt sitt samtykke, som ved uventet besøk ol., eller hvis det skulle bli nødvendig å avbryte innsamling av data.

Personvernombudet legger til grunn at forsker etterfølger Universitetet i Oslo sine interne rutiner for datasikkerhet.

PROSJEKTSLUTT OG ANONYMISERING
Forventet prosjektslutt er 01.09.2017. Ifølge prosjektmeldingen skal innsamlede opplysninger da anonymiseres. Anonymisering innebærer å bearbeide datamaterialet slik at ingen enkeltpersoner kan gjenkjennes. Det gjøres ved å:
- slette direkte personopplysninger (som navn/koblingsnøkkel)
- slette/omskrive indirekte personopplysninger (identifiserende sammenstilling av bakgrunnsopplysninger som f.eks. bosted/arbeidssted, alder og kjønn)
- slette digitale lydopptak

Appendix 2

Informasjonsskriv til frivillige deltakere i forskningsprosjekt

Du er herved invitert til å delta på et forskningsprosjekt tilknyttet Universitetet i Oslo. Forskningsprosjektet vil undersøke lytte- og tale-språkmiljøet hos eldre personer med påvist demens i samspill med aldersbetinget hørselshemming som bor på sykehjem, i sammenligning hos en aldersmatchende gruppe som kun har påvist demens, og mot en gruppe som hverken har påvist demens eller et aldersbetinget hørselshemming. Formålet med prosjektet er å gi en oversikt over lytte- og tale-språkmiljøet hos de ulike gruppene, og undersøke om enkelte faktorer kan påvirke eventuell kommunikasjon og sosial omgang.

Det er for tiden et aktuelt tema å kartlegge kommunikasjon og sosialisering hos eldre med både demens, og eldre med et aldersbetinget hørselstap. Det er dog ikke mange studier som inkluderer begge disse gruppenes kommunikasjon- og sosialiserings-vansker. I denne pilotstudien er det ønskelig å se komorbiditeten av diagnosene, og om kommunikasjonen vil variere hos de ulike gruppene, i sammenligning med aldersmatchende gruppe uten påvist demens eller aldersbetinget hørselshemming.

Informasjonen til studien vil bli innhentet via en rekorder produsert av Lena Foundation (LENA) (www.lenafoundation.org), og metoden er en av de første av sitt slag. Målemetoden innebærer å objektivt kvantifisere antall ord en person hører i løpet av en hel dag, samt hvor mange ytringer personen selv uttrykker. Man kan også trekke frem informasjon om lyttemiljø og kommunikasjonsmønstre mellom informanten og dem man har samtale med.

Du kommer til å bli bedt om å gjøre en LENA-innspilling på pasienter som omfatter en hel dag med innspilleren slått på. LENA-innspilleren er et lite apparat på størrelse med en mobiltelefon, som er plassert i et beskyttelsesetui man kan feste på brystet. Innspilleren kan registrerer lytte- og tale-miljø og kommunikasjon i 12-16 timer. Et avansert dataprogram regner ut antall ord som blir ytret, både av personer rundt, og forsøkspersonen selv. Den vil også registrere lyttemiljøet forøvrig som for eksempel elektronisk lyd (tv, radio). Ingen lydfiler vil bli lagret og avlyttes, og hver avspilling blir kodet og slettet etter endt innsamling.

Ingen uautoriserte personer vil ha tilgang til innspillingene som vil bli kodet og behandlet på Universitetet i Oslo sin forskningslab.

Under innspillingen vil forsker være tilstede utenfor avdelingen deres. Dette er for å forsikre at alle som blir registrert av innspilleren har gitt sitt samtykke, som ved uventet besøk ol. Forsker skal også være til stede om du ønsker å avbryte innsamlingen av data. Forsker vil gi dere instruksjoner i forkant, og besvare spørsmål dere måtte ha.

Resultatet i denne pilotstudien inngår i masteravhandling ved UiO og vil muligens bli publisert i vitenskapelige artikler. Prosjektet avsluttes 1. Juni 2017. Den vil være helt anonymisert slik at deltakeres identitet ikke blir publisert. Deltakerne av studien har rett til å trekke seg når som helst under forskningsprosjektets løp, men data som allerede er overført og innsamlet vil ikke bli trukket fra resultatene.

Har du/dere spørsmål til forskningsprosjektet kan dere kontakte følgende:

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Appendix 3

Informasjonsskriv til frivillige deltakere i forskningsprosjekt

Du er herved invitert til å delta på et forskningsprosjekt tilknyttet Universitetet i Oslo. Forskningsprosjektet vil undersøke lytte- og tale-språkmiljøet hos eldre personer med påvist demens i samspill med aldersbetinget hørselshemming som bor på sykehjem, i sammenligning hos en aldersmatchende gruppe som kun har påvist demens, og mot en gruppe som hverken har demens eller aldersbetinget hørselshemming. Formålet med prosjektet er å gi en oversikt over lytte- og tale-språkmiljøet hos de ulike gruppene, og undersøke om enkelte faktorer kan påvirke eventuell kommunikasjon og sosial omgang.

Det er for tiden et aktuelt tema å kartlegge kommunikasjon og sosialisering hos eldre med både Alzheimer demens, og eldre med et aldersbetinget hørselstap. Det er dog ikke mange studier som inkluderer begge disse gruppenes kommunikasjon- og sosialiserings-vansker. I denne pilotstudien er det ønskelig å se komorbiditeten av diagnosene, og om kommunikasjonen vil variere hos de ulike gruppene, i sammenligning med aldersmatchende gruppe uten påvist demens eller aldersbetinget hørselshemming.

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Du kommer til å bli bedt om å gjøre en LENA-innspilling som omfatter en hel dag med innspilleren slått på. LENA-innspilleren er et lite apparat på størrelse med en mobiltelefon, som er plassert i et beskyttelsesetui man kan feste på brystet. Innspilleren kan registrerer lytte- og tale-miljø og kommunikasjon i 12-16 timer. Et avansert dataprogram regner ut antall ord som blir ytret, både av personer rundt, og forsøkspersonen selv. Den vil også registrere lyttemiljøet forøvrig som for eksempel elektronisk lyd (tv, radio). Ingen lydfiler vil bli lagret og avlyttes, og hver avspilling blir bli kodet og slettet etter endt innsamling. Ingen uautoriserte personer vil ha tilgang til innspillingene som vil bli kodet og behandlet på Universitetet i Oslo sin forskningslab.

Under innspillingen vil forsker være tilstede utenfor avdelingen deres. Dette er for å forsikre at alle som blir registrert av innspilleren har gitt sitt samtykke, som ved uventet besøk ol. Forsker skal også være til stede om du ønsker å avbryte innsamlingen av data.

Resultatet i denne pilotstudien inngår i masteravhandling ved UiO og vil muligens bli publisert i vitenskapelige artikler. Prosjektet avsluttes 1. Juni 2017. Den vil være helt anonymisert slik at deltakeres identitet ikke blir publisert. Deltakerne av studien har rett til å trekke seg når som helst under forskningsprosjektets løp, men data som allerede er overført og innsamlet vil ikke bli trukket fra resultatene.

Har du/dere spørsmål til forskningsprosjektet kan dere kontakte følgende:

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Appendix 4

Informasjonsskriv til frivillige deltakere i forskningsprosjekt

Du er herved invitert til å delta på et forskningsprosjekt tilknyttet Universitetet i Oslo. Forskningsprosjektet vil undersøke lytte- og tale-språkmiljøet hos eldre personer med påvist Alzheimer demens i samspill med aldersbetinget hørselshemming som bor på sykehjem, i sammenligning hos en aldersmatchende gruppe som kun har påvist Alzheimer demens, og mot en gruppe som hverken har Alzheimer demens eller aldersbetinget hørselshemming. Formålet med prosjektet er å gi en oversikt over lytte- og tale-språkmiljøet hos de ulike gruppene, og undersøke om enkelte faktorer kan påvirke eventuell kommunikasjon og sosial omgang.

Det er for tiden et aktuelt tema å kartlegge kommunikasjon og sosialisering hos eldre med både Alzheimer demens, og eldre med et aldersbetinget hørselstap. Det er dog ikke mange studier som inkluderer begge disse gruppenes kommunikasjon- og sosialiserings-vansker. I denne pilotstudien er det ønskelig å se komorbiditeten av diagnosene, og om kommunikasjonen vil variere hos de ulike gruppene, i sammenligning med aldersmatchende gruppe uten påvist Alzheimer demens eller aldersbetinget hørselshemming.

Informasjonen til studien vil bli innhentet via en rekorder produsert av Lena Foundation (LENA) (www.lenafoundation.org), og metoden er en av de første av sitt slag. Målemetoden innebærer å objektivt kvantifisere antall ord en person hører i løpet av en hel dag, samt hvor mange ytringer personen selv uttrykker. Man kan også trekke frem informasjon om lyttemiljø og kommunikasjonsmønstre mellom informanten og dem man har samtale med.

Det kommer til å bli gjort en LENA-innspilling på pasienter i din avdeling som omfatter en hel dag med innspilleren slått på. LENA-innspilleren er et lite apparat på størrelse med en mobiltelefon, som er plassert i et beskyttelsesetui man kan feste på brystet. Innspilleren kan registrerer lytte- og tale-miljø og kommunikasjon i 12-16 timer. Et avansert dataprogram regner ut antall ord som blir ytret, både av personer rundt, og forsøkspersonen selv. Den vil også registrere lyttemiljøet forøvrig som for eksempel elektronisk lyd (tv, radio). Ingen lydfiler vil bli lagret og avlyttes, og hver avspilling blir bli kodet og slettet etter endt innsamling. Ingen uautoriserte personer vil ha tilgang til innspillingene som vil bli kodet og behandlet på Universitetet i Oslo sin forskningslab.

Under innspillingen vil forsker være tilstede utenfor avdelingen din. Dette er for å forsikre at alle som blir registrert av innspilleren har gitt sitt samtykke, som ved uventet besøk ol. Forsker skal også være til stede om du ønsker å avbryte innsamlingen av data.

Resultatet i denne pilotstudien inngår i masteravhandling ved UiO og vil muligens bli publisert i vitenskapelige artikler. Prosjektet avsluttes 1. Juni 2017. Den vil være helt anonymisert slik at deltakeres identitet ikke blir publisert. Deltakerne av studien har rett til å trekke seg når som helst under forskningsprosjektets løp, men data som allerede er overført og innsamlet vil ikke bli trukket fra resultatene.

Har du/dere spørsmål til forskningsprosjektet kan dere kontakte følgende:

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Appendix 5

Informasjonsskriv til frivillige deltakere i forskningsprosjekt

Du er herved invitert til å delta på et forskningsprosjekt tilknyttet Universitetet i Oslo. Forskningsprosjektet vil undersøke lytte- og tale-språkmiljøet hos eldre personer med påvist Alzheimer demens i samspill med aldersbetinget hørselshemming som bor på sykehjem, i sammenligning hos en aldersmatchende gruppe som kun har påvist Alzheimer demens, og mot en gruppe som hverken har Alzheimer demens eller aldersbetinget hørselshemming. Formålet med prosjektet er å gi en oversikt over lytte- og tale-språkmiljøet hos de ulike gruppene, og undersøke om enkelte faktorer kan påvirke eventuell kommunikasjon og sosial omgang.

Det er for tiden et aktuelt tema å kartlegge kommunikasjon og sosialisering hos eldre med Alzheimer demens, og eldre med et aldersbetinget hørselstap. Det er likevel ikke mange studier som inkluderer begge disse gruppenes kommunikasjon- og sosialiserings-vansker. I denne pilotstudien er det ønskelig å se komorbiditeten av diagnosene, og om kommunikasjonen vil variere hos de ulike gruppene, i sammenligning med aldersmatchende gruppe uten påvist Alzheimer demens eller aldersbetinget hørselshemming.

Informasjonen til studien vil bli innhentet via en rekorder produsert av Lena Foundation (LENA) (www.lenafoundation.org), og metoden er en av de første av sitt slag. Målemetoden innebærer å objektivt kvantifisere antall ord en person hører i løpet av en avspilling, samt hvor mange ytringer personen selv uttrykker. Man kan også trekke frem informasjon om lyttemiljø og kommunikasjonsmønstre mellom informanten og dem man har samtale med.

Personer i kontrollgruppen uten Alzheimer demens og aldersbetinget hørselstap skal ha fylt 65 år. Personer i denne gruppen vil bli testet med audiometri for å utelukke et hørselstap, samt bli testet med en kognitiv test. Testene er velprøvde, og brukes til vanlig for å avdekke hørselstap samt demenslignende symptomer. Dersom noen i gruppen skulle skåre utenfor godkjente mål vil de bli henvist videre til riktig instans, og ekskluderes fra studien. Hvis resultatene er innenfor normalområdet er personen kvalifisert til å delta i studien.

Du kommer til å bli bedt om å gjøre en LENA-innspilling som omfatter 4 timer med innspilleren slått på i hjemmet ditt. LENA-innspilleren er et lite apparat på størrelse med en mobiltelefon, som er plassert i et beskyttelsesetui man kan feste på brystet. Innspilleren registrerer lytte- og tale-miljø og kommunikasjon i 4 timer. Et avansert dataprogram regner ut antall ord som blir ytret, både av personer rundt, og forsøkspersonen selv. Den vil også registrere lyttemiljøet forøvrig som for eksempel elektronisk lyd (tv, radio). Ingen lydfiler vil bli lagret eller avlyttes. Hver avspilling blir kryptert, og deretter slettet etter endt innsamling. Ingen uautoriserte personer vil ha tilgang til innspillingene som vil bli kodet og behandlet på Universitetet i Oslo sin forskningslab.

Under innspillingen vil forsker være tilstede utenfor hjemmet deres. Dette er for å forsikre at alle som blir registrert av innspilleren har gitt sitt samtykke, som ved uventet besøk ol. Forsker skal også være til stede om du ønsker å avbryte innsamlingen av data.

Resultatet i denne pilotstudien inngår i masteravhandling ved UiO og vil muligens bli publisert i vitenskapelige artikler. Prosjektet avsluttes 1. Juni 2017. Studien vil være helt anonymisert slik at deltakeres identitet ikke blir publisert. Deltakerne av studien har rett til å trekke seg når som helst under forskningsprosjektets løp, men data som allerede er overført og innsamlet vil ikke bli trukket fra resultatene.

Har du/dere spørsmål til forskningsprosjektet kan dere kontakte følgende:

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Appendix 6
Informasjonsskriv om forskningsprosjekt til besøkende

Her pågår en innsamling av data i forbindelse med et forskningsprosjekt tilknyttet Universitetet i Oslo. Forskningsprosjektet vil undersøke lytte- og tale-språkmiljøet hos eldre personer med påvist Alzheimer demens i samspill med aldersbetinget hørselshemming som bor på sykehjem, i sammenligning hos en aldersmatchende gruppe som kun har påvist Alzheimer demens, og mot en gruppe som hverken har Alzheimer demens eller aldersbetinget hørselshemming. Formålet med prosjektet er å gi en oversikt over lytte- og tale-språkmiljøet hos de ulike gruppene, og undersøke om enkelte faktorer kan påvirke eventuell kommunikasjon og sosial omgang.

Det er for tiden et aktuelt tema å kartlegge kommunikasjon og sosialisering hos eldre med både Alzheimer demens, og eldre med et aldersbetinget hørselstap. Det er dog ikke mange studier som inkluderer begge disse gruppenes kommunikasjon- og sosialiserings-vansker. I denne pilotstudien er det ønskelig å se komorbiditeten av diagnosene, og om kommunikasjonen vil variere hos de ulike gruppene, i sammenligning med aldersmatchende gruppe uten påvist Alzheimer demens eller aldersbetinget hørselshemming.

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Det kommer til å bli gjort en LENA-innspilling på pasienter i denne avdelingen som omfatter en hel dag med innspilleren slått på. LENA-innspilleren er et lite apparat på størrelse med en mobiltelefon, som er plassert i et beskyttelsesetui man kan feste på brystet. Innspilleren kan registrerer lytte- og tale-miljø og kommunikasjon i 12-16 timer. Et avansert dataprogram regner ut antall ord som blir ytret, både av personer rundt, og forsøkspersonen selv. Den vil også registrere lyttemiljøet forøvrig som for eksempel elektronisk lyd (tv, radio). Ingen lydfiler vil bli lagret og avlyttes, og hver avspilling blir bli kodet og slettet etter endt innsamling. Ingen uautoriserte personer vil ha tilgang til innspillingene som vil bli kodet og behandlet på Universitetet i Oslo sin forskningslab.

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Har du/dere spørsmål til forskningsprosjektet kan dere kontakte følgende:

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Appendix 7

Informert samtykke

Jeg har lest og forstått at:

- Å delta i studien er frivillig.
- Jeg kan når som helst avbryte samarbeidet uten videre forklaring.
- Ved behov kan jeg kontakte prosjektansvarlig med spørsmål.

Jeg samtykker til å delta i prosjektet

☐

Sted og dato …………………………………………………………

Signatur ………………………………………………………………..

Leveres til:

Hilde Nøis

Prosjektansvarlig

Storgata 10d

3210 Sandefjord

Appendix 8

Aldring og helse
Nasjonal kompetansetjeneste

Helsedirektoratet

NORSK REVIDERT MINI MENTAL STATUS EVALUERING (MMSE-NR2)

Carsten Strobel & Knut Engedal, 2014

Pasient (PAS): ______________________ Fødselsdato/alder: ____________

Nasjonalitet/morsmål/tolk: ______________________ Høyre-/venstrehendt: ____________

Utdanning: ______________________ Antall år: ____ Yrke: ____________

Hørsel/høreapparat: ____________ Syn/briller: ____________ Geriatrisk leseprøve: ____________

Testleder (TL): ______________________ Dato: ____________ Klokken: ____________

Teststed/hjemmebesøk: ____________ Er PAS testet med MMSE-NR samme sted tidligere? Ja ☐ Nei ☐

Hvis ja, når? ____________ Når/hvor ble PAS sist testet med MMSE-NR (oppgavesett)? ____________

MMSE-NR er ikke en demenstest, kun et grovt kognitivt funksjonsmål som supplerer annen utredning som somatisk undersøkelse (inkl. medikamentgjennomgang) og komparentintervju (inkl. forløp/varighet av kognitiv svikt og endret ADL-funksjon). Alle som administrerer MMSE-NR bør ha opplæring og god kjennskap til manual (lastes ned fra www.aldringoghelse.no). Følg standardisert instruksjon, ikke gi ledetråder, se retningslinjer for administrasjon, oppfølgende spørsmål og skåring på skjema og i manual. Ved lav norskspråklig kompetanse og annet morsmål enn norsk bruk fagutdannet tolk, ikke slektninger/bekjente. For oppgave 16 og 18, bruk standardiserte oversettelser og stimuliark der disse foreligger.

Instruksjon

Utfør testing en-til-en, uten pårørende til stede. Unngå at PAS ser skjema og skåring, bruk f.eks. skriveunderlag med klemme. Les fet skrift (**bold**) høyt, tydelig og langsomt. Pause (markert: [*pause*]) skal vare 1 sekund. Samtlige spørsmål skal stilles, også om PAS har besvart oppgaveledd under tidligere stilte spørsmål. Instruksjon kan gjentas, unntatt på oppgave 12 og 17 hvor det er svært viktig at instruksjon kun gis én gang. Skriv ordrett ned svar på hvert spørsmål. PAS kan korrigere svar underveis, gi derfor ikke tilbakemelding om svar er rett eller galt.

Ved retesting skift alltid oppgavesett som angitt på oppgave 11, 12 og 13 for å redusere læringseffekt. Sett kryss i ruten for «0» ved feil svar og i ruten for «1» ved rett svar, gi aldri ½ poeng. Totalskåre regnes alltid fra 30 poeng: Er PAS ikke testbar på en oppgave pga. ikke-kognitive handikapp, angi hvorfor og sett ring rundt ruten for «0». Gir PAS utrykk for ikke å klare en oppgave, oppfordre likevel til å gjøre et forsøk. Er du usikker på hvordan et svar skåres etter å ha sjekket manual, rådfør deg med en erfaren kollega. Lavere alder og høyere utdanning gir ofte bedre skåre. Likeså testing på hjemmebesøk/vante omgivelser pga. stedsorienteringsledd. Lav motivasjon, dårlig dagsform, trettbarhet, afasi, lese- og skrivevansker, redusert syn og hørsel, depresjon, testangst, legemiddeleffekter (bivirkninger/interaksjoner), akutt somatisk sykdom, lav norskspråklig kompetanse, stress og liten testledererfaring kan påvirke resultat negativt. Totalskåre sier lite om spesifikke kognitive sviktområder som kan være diagnostisk og klinisk relevante, presisér derfor alltid utfall. Skåringsprofil og kvalitativ vurdering av utførelse kan også gi informasjon om kognitive restressurser og kompenserende mestringsstrategier som kan gi innspill til hvordan tilrettelegge aktivitet og samhandling. Bemerk påfallende forhold som lang tidsbruk, usikkerhet, mange korrigeringer, behov for gjentakelse av instruksjon, årsaker til testavbrudd e.l.

Skåring MMSE-NR2. Oppgavesett (ordsett/starttall oppgave 11, 12 og 13) administrert i dag: 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

		KOMMENTARER TIL SPESIFIKKE OPPGAVELEDD:	
Tidsorientering	*(oppgave 1–5)*		/5
Stedsorientering	*(oppgave 6–10)*		/5
Umiddelbar gjenkalling	*(oppgave 11)*		/3
Hoderegning	*(oppgave 12)*		/5
Utsatt gjenkalling	*(oppgave 13)*		/3
Språk og praksis	*(oppgave 14–19)*		/8
Figurkopiering	*(oppgave 20)*		/1
Total poengskåre			/30

Versjon 2, 18.05.2014

Vurderer du som testleder (TL) at samarbeid/motivasjon/testinnsats var uten anmerkning? Ja ☐ Nei ☐ Usikker ☐

Vurderer du at oppmerksomhet/bevissthetsnivå/våkenhet var uten anmerkning? Ja ☐ Nei ☐ Usikker ☐

Vurderes ikke resultat som valid/gyldig, angi årsak(er): ______________________

Spesielt å bemerke (henvisningsgrunn, medikamenter som kan påvirke kognitiv funksjon, atferd, dagsform, stemningsleie, smerter, afasi, ikke-kognitive handikapp, bruk av ikke-dominant hånd f.eks. ved lammelse, tidsbruk, vansker på distraksjonsbetingelsen, glemt briller/høreapparat e.l.):

____

____

____

TIDSORIENTERING

Det er TL sitt ansvar å forhindre at PAS kan ta i bruk ledetråder: Se ut av vindu (årstid, måned), bruke kalender, avis, innkallingsbrev (årstall, måned, ukedag, dato), sjekke dato på klokke, mobil e.l.

1. **Hvilket årstall har vi nå?** (Kun fullt årstall med 4 sifre gir poeng) ______ 0☐ 1☐
2. **Hvilken årstid har vi nå?** (Ta hensyn til vær og geografiske forhold) ______ 0☐ 1☐
3. **Hvilken måned har vi nå?** (Kun rett navn på måned gir poeng, ikke nummer på måned) ______ 0☐ 1☐
4. **Hvilken dag har vi i dag?** (Kun rett navn på ukedag gir poeng) ______ 0☐ 1☐
5. **Hvilken dato har vi i dag?** (Unngå følgefeil: Kun dagsledd må være rett, måned/år kan være feil) ______ 0☐ 1☐

STEDSORIENTERING

Bruk best egnet stedsord og spørsmålsstilling, sett ring rundt valgt alternativ. Landsdel* skal kun benyttes ved testing i Oslo.

6. **Hvilket land er vi i nå?** ______ 0☐ 1☐
7. **Hvilket (fylke/landsdel*) er vi i nå?** (For landsdel gi poeng for Østlandet og Sør-Norge) ______ 0☐ 1☐
8. **Hvilken (by/tettsted/kommune) er vi i nå?** ______ 0☐ 1☐
9. **Hva heter dette (stedet/sykehuset/sykehjemmet/legekontoret e.l.)?** Eller **Hvor er vi nå?** ______ 0☐ 1☐
10. **I hvilken etasje er vi nå?** (Still spørsmål selv der bygg kun har én etasje. Ta hensyn til språk/kultur) ______ 0☐ 1☐

Unngå at PAS kan se ut av vindu (sted, etasje). Avhengig av inngang vil bygg i skrånende terreng kunne oppfattes å ha ulik etasje-angivelse for samme etasje. Gi poeng om PAS i tråd med språk/kultur benevner norsk 1. etasje som grunnplan (f.eks. Erdgeschoss, ground floor, stuen) og norsk 2. etasje som 1. etasje (1. Stock/Etage, first floor, 1. sal). Ved testing på hjemmebesøk, se manual.

UMIDDELBAR GJENKALLING

Bruk alltid nytt ordsett som angitt ved retesting for å hindre læringseffekt fra tidligere administrasjon. Sett ring rundt dagens ordsett. Ved 1. adm. bruk oppgavesett 1, ved 2. adm. bruk sett 2 osv., ved 6. adm. bruk sett 1, ved 7. adm. bruk sett 2 osv.

11. **Hør godt etter. Jeg vil si 3 ord som du skal gjenta etter meg. Disse skal du også prøve å huske, for jeg kommer til å spørre deg om dem litt senere. Er du klar?**
Nå kommer ordene: .... *[pause]*, **...............** *[pause]*, **..............** *[pause]*. **Nå kan du gjenta disse ordene.**
Gjentar ikke PAS alle 3 ord, repeteres hele ordsettet inntil alle 3 ord gjengis i samme forsøk, opptil 3 presentasjoner. Gi *kun* poeng for riktige ord etter 1. presentasjon, rekkefølge PAS sier ordene er uten betydning. Antall presentasjoner: ______ stk.

Oppgavesett:	1	2	3	4	5		
Nå kommer ordene: ...	**HUS**	**STOL**	**SAFT**	**KATT**	**FLY**	______	0☐ 1☐
	KANIN	**BANAN**	**LAMPE**	**AVIS**	**EPLE**	______	0☐ 1☐
	TOG	**NÅL**	**BÅT**	**LØK**	**SKO**	______	0☐ 1☐

Etter 3 gjenkalte ord eller 3 presentasjoner, si: **Husk disse ordene, for jeg vil spørre deg om hvilke de er litt senere.**

HODEREGNING (Bruk alltid obligatorisk distraksjonsbetingelse i tillegg)

Bruk alltid nytt starttall som angitt ved retesting. Ved 6. adm. bruk oppgavesett 1 osv. Sett ring rundt dagens starttall, skriv ned tallsvar. Unngå følgefeil: Gi poeng når svar er minus 7 fra forrige tall, uavhengig av om forrige tallsvar var rett eller galt.

12. **Nå vil jeg at du trekker 7 fra ....** [*Gir ikke PAS tallsvar, si:* **Hva er .... minus 7?**] [*Rett etter tallsvar, si*]: **Og så fortsetter du å trekke 7 fra tallet du kom frem til, helt til jeg sier stopp.** [*Instruksjon gis kun én gang. Ikke informer underveis om subtraksjonstall eller hvor langt PAS har kommet*]. Ved færre enn 5 tallsvar, gå til distraksjonsbetingelsen.

Oppgavesett:	1	2	3	4	5		
Starttall: **Nå vil jeg at du trekker 7 fra ...**	**80**	**50**	**90**	**40**	**60**		
Og så fortsetter du å trekke 7 fra tallet du kom frem til, helt til jeg sier stopp →	73	43	83	33	53	______	0☐ 1☐
	66	36	76	26	46	______	0☐ 1☐
Ved behov si: **Og så videre**	59	29	69	19	39	______	0☐ 1☐
Ved behov si: **Og så videre**	52	22	62	12	32	______	0☐ 1☐
Ved behov si: **Og så videre**	45	15	55	5	25	______	0☐ 1☐

Etter 5 subtraksjoner, si: **Fint, det holder** [Gå til distraksjonsbetingelsen].

UTSATT GJENKALLING

13. **Hvilke 3 ord var det jeg ba deg om å huske?** *[Ikke gi ledetråder/stikkordshjelp, sett ring rundt dagens ordsett]*

Oppgavesett:	1	2	3	4	5		
	HUS	STOL	SAFT	KATT	FLY	____________	0☐ 1☐
	KANIN	BANAN	LAMPE	AVIS	EPLE	____________	0☐ 1☐
	TOG	NÅL	BÅT	LØK	SKO	____________	0☐ 1☐

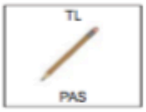
Nevnes mer enn 3 ord, må PAS velge hvilke 3 ord som skal være svaret, rekkefølge er uten betydning. Gi *kun* poeng for dagens ordsett og eksakt gjengivelse, dvs. bolighus, hytte, kaninen, kaniner, hare, togbane, lokomotiv e.l. gir ikke poeng.

BENEVNING

14. **Hva heter dette?** [*Vis stimuliarket riktig vei og pek på blyanten*] ____________ 0☐ 1☐

15. **Hva heter dette?** [*Vis stimuliarket riktig vei og pek på armbåndsuret*] ____________ 0☐ 1☐

Alternative poenggivende svar: Penn, gråblyant, fargeblyant, ur, klokke, klokkerem e.l.
Bruk kun stimuliarket i farger med blyant og armbåndsur, ikke andre objekter, gjelder også retesting. Eneste unntak er testing av sterkt synshemmete eller blinde, hvor stimuliobjektene blyant og armbåndsur kan presenteres taktilt med konkreter.



FRASEREPETISJON

16. **Gjenta *ordrett* det jeg sier. Er du klar?** [*Si tydelig*]: **«ALDRI ANNET ENN OM OG MEN».**

Gi poeng når hele frasen gjengis korrekt med alle 6 ord i riktig rekkefølge. Dialektvarianter godtas.
TL kan si frasen 3 ganger, men gi *kun* poeng etter 1. presentasjon. Antall presentasjoner: ________ stk.

ALDRI ANNET ENN OM OG MEN ____________ 0☐ 1☐

3-LEDDET KOMMANDO

Legg et ubrukt A4-ark på bordet midt foran PAS, kortsiden mot PAS. For å unngå at PAS starter før hele instruksjonen er gitt, legg egen hånd på arket til all instruksjon er gitt. Gi poeng for hver korrekt utførte delhandling.

17. **Hør godt etter, for jeg skal be deg gjøre 3 ting i en bestemt rekkefølge. Er du klar?**
Ta arket med én hånd [*pause*], **brett arket på midten kun én gang, med en eller begge hender** [*pause*], **og gi arket til meg** [*pause*]. **Vær så god!** [*Instruksjon gis kun én gang, enkeltledd kan ikke repeteres*]

TAR ARKET MED KUN <u>EN HÅND</u> ____________ 0☐ 1☐

BRETTER ARKET PÅ MIDTEN KUN <u>EN GANG</u> ____________ 0☐ 1☐

<u>GIR</u> ARKET TIL TL (gi også poeng om arket legges på bordet tydelig foran TL) ____________ 0☐ 1☐

LESNING

18. **Nå vil jeg at du gjør det som står på arket** [*Vis PAS teksten*]. PAS må lukke øynene for poeng. Lukker ikke PAS øynene, kan instruksjon gjentas 2 ganger til. Hver presentasjon gir mulighet for poeng. Antall presentasjoner: ______ stk.

LUKK ØYNENE DINE ____________ 0☐ 1☐

SETNINGSGENERERING

Legg nedre del av neste side MMSE-NR skjema med kortsiden foran PAS, og gi vedkommende en blyant.

19. **Skriv en meningsfull setning her.** [*Pek på øvre del av neste side*] ____________ 0☐ 1☐

Skrives imperativsetning med kun ett ord, f.eks. «Spis», si: **Skriv en lengre setning.** Skrives intet eller tidligere gitt setning/frase, f.eks.«Lukk øynene dine» eller «En meningsfull setning», si: **Skriv en setning du lager selv.** Skriver ikke PAS noe nå heller, si: **Skriv om været.**

Setningen må gi mening, men trenger ikke ha objekt og tidvis heller ikke subjekt eller verb, se manualeksempler. Ignorer stave- og grammatikalske feil. Gi poeng ved rett utførelse etter supplerende instruksjon og for spørresetning, om kriterier ellers er innfridd.

FIGURKOPIERING

Legg figurarket som vist med figurspissene mot PAS over øvre del av neste side (over setningen PAS skrev), viskelær ved siden av (skal ikke brukes som linjal). PAS får ikke rotere eller flytte på figurarket som TL må sørge for at blir liggende til PAS er ferdig.

20. **Kopier figuren så nøyaktig du kan her.** [*Pek på nedre del av neste side*] ____________ 0☐ 1☐

Du kan bruke viskelær. Ta deg god tid. Si fra når du er ferdig.

Er PAS misfornøyd med utførelse, oppfordre til å korrigere/tegne figuren på nytt, maks. 3 poenggivende forsøk. Gi poeng når to 5-kantede figurer former en 4-sidet figur der 5-kantene overlapper: 5-4-5. Rotert utførelse, størrelsesforskjell mellom 5-kantene eller hvor de overlapper er ikke avgjørende for skåring om kriterier ellers er innfridd, se skåringseksempler i manual. Er TL i tvil om utførelse er korrekt, be PAS tegne figuren på nytt.