Gender differences in the quantity of caregiver word use

A cross- sectional study using Language Environment Analysis^{TM}

An article- based master thesis

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Abstract

Background: Chrildrens early language exposure plays an essential role in shaping their linguistic development. Because most young children are taken care of by their family members in this important time period, their caregivers are the key contributors of talk to which the young children are exposed to (VanDam, Ambrose, & Moeller, 2012, p.402; Hart & Risley, 1995) There is evidence that female caregivers use more words close to young children than male caregivers, regardless of the childs hearing status (Pancsofar & Vernon-Feagans, 2006; Johnson et al., 2014; Nilsson, 2018). The objective of this present study was to investigate caregiver gender differences in the quantity of word use in the home environment of Norwegian children with and without hearing impairment.

Method: The sample in the present study consist of children with hearing impairment (n=8) and children with normal hearing (n=9) and their caregivers. Language Environmental Analysis (LENA) provided full one- day recordings which was used to measure caregiver word use. Only data from the hours of the recording day where both caregivers were present was used. The compared variables used are the means of word counts from female and male caregivers.

Analyses: A two tailed independent t-test and a paired t-test was used to compare the means of caregiver word count, both female and male, and in total.

Results: Results from the research done in collaboration with this thesis showed significant differences between female and male caregivers´ use of number of words. Female caregivers use a significantly higher number of words than male caregivers close to young children regardless of their hearing status.

Conclusion: Young children in the present study were exposed to a higher number of words from female caregivers. More research is needed on this subject in the future, both investigating the quantity and quality of interaction between young children and caregivers.

Preface

I am thankful for having had the opportunity to have gotten many new experiences throughout these two last years of studying at UiO. The last period of writing my master thesis has been both exciting and also challenging, but I am grateful to have been a part of the «words make a difference»- project, and writing this master thesis.

I would like to express my gratitude to my supervisor, Associate Professor Ulrika Löfkvist for all your kind help and support with the whole process, from beginning to completion of this thesis. I would like to thank my co- supervisor, Professor Henrik Daae Zachrisson for all help and advices concerning the statistical analyses.

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Nina Melsom Kristensen

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1 Introduction

1.1 Background and rationale for this thesis

This thesis is linked to the research program “Words make a difference” (“Ord gjør forskjell”), at the Department of Special Needs Education, University of Oslo. The objective of the research program is to validate the Language Environment Analysis (LENA) in Norwegian, Swedish (Löfkvist et al., in preparation) as well as in Italian (Löfkvist et al., in preparation) and Brazilian Portuguese (Ferreira, Levy, & Löfkvist, submitted). Another purpose is to examine the effects and possible correlations of type and amount of language use by caregivers, on the spoken language development in young children with Hearing Impairment (HI), compared to age-matched children with Normal Hearing (NH).

The overall purpose of the current study and master thesis was to find out if there were any differences in the amount of words (word count) used by caregivers close to young children with hearing impairment aged 18-71 months using or not using hearing aids (HA), bone anchored hearing aids (BAHA) and /or cochlear implants (CI), compared to children with normal hearing. In the present study, caregiver refers to the main provider of a child in the home. This is often the parents of the child, but could also mean other family members, like foster parents or grandparents. The specific aim was to investigate possible caregiver gender differences in the quantity of language stimulation, and to investigate whether female and male caregivers used similar numbers of words close to children in their home environment, regardless of the child’s hearing level (HI, NH).

There is evidence that female caregivers use a higher number of words with normal hearing children (Pancsofar & Vernon-Feagans, 2006; Johnson, Caskey, Rand, Tucker, & Vohr, 2014). There is some evidence from a Swedish master study by Nilsson (2018) that show similar results of higher word count from female caregivers in a cohort of 28 children with hearing impairment and normal hearing. Nilsson (2018) found that female caregivers used significantly more words close to their child than male caregivers in three groups; children with CI (n=17) and children with HA (n=11), and children with NH (n= 12) (Nilsson, 2018). Nilsson (2018) and Johnson with colleagues (2014) used the LENA technology to measure the numbers of adult words. There are so far no known Norwegian studies that have investigated the language environment with the LENA technology, and with focus on gender caregiver differences. This thesis will hopefully contribute with new and important knowledge on this topic.

There are several studies that have examined the interaction patterns between female caregivers, related to the concept of maternal sensitivity, and young children (Kim & Mahoney, 2004; Vohr et al., 2010; Quittner et al., 2013; Lloyd & Masur, 2014). However, studies that specifically examine the interaction patterns between children and male caregivers (paternal sensitivity) are rare (Nordahl et al.,, Janson, Manger & Zachrisson, 2014), even if shared parenting nowadays is more common in the modern society, and especially in the Nordic countries, where gender equality is common. Based on this situation, the thesis will have a specific focus on automatically measured and analyzed language data from all-day LENA recordings, and the quantitative interaction between both female respectively male caregivers and young children. One of the aims of this study was to shed some light on this caregiver gender issue, and indirectly to challenge the gender norms and current traditions concerning these terms. Instead of using maternal and paternal as a term this thesis will operate with the term caregiver sensitivity. This term (caregiver sensitivity) will in this thesis refer to caregivers' amount of words (quantitative word count). There have not been any measures in the current study of either maternal or paternal/ caregiver sensitivity, and therefore the term will refer only to the measures of quantitative word counts.

Even if father involvement and shared parenting is more common in the upbringing of children, it is still mostly mothers who stay at home during the first years in life, and they are also more often the ones who stay at home with sick children (SSB, 2017). It is so far unclear how increased shared parenting, but with continuously gender-based caregiver differences in childcarechildcare, affects the children's language and psychosocial development. Also, today many families consist of more different compositions than the traditional "father-mother-child-model", like one-parent-households or several primary caregivers because the biological parents have new partners. This could also potentially influence some of the variation of language environment in relation to gender aspects. Researchers, clinicians and the society should start to acknowledge gender norms as aspects that may influence the child development differently, in real life situations.

In the master thesis the term sex will be used, and not gender. The term gender refers to certain cultural associations with a person's biological sex (American Psychological Association, 2012). According to American Psychological Association (2015) gender is the condition of being female, male or neutral (American Psychological Association, 2015). The term sex refers to the sex assigned at birth based on the appearance of external genitalia (American Psychological Association, 2015). The term refers to a person's biological status and is typically categorized as male, female or intersex (American Psychological Association, 2012).

The aim of this thesis was to find out if there is a difference in number of spoken words between female and male caregivers in interaction with young children, and how caregiver sensitivity influences childrens early language development. Within the thesis work I have explored and investigated the literature on caregiver (maternal and paternal) sensitivity, and how this affects children’s early language development, both in children with and without HI. So far it has been difficult to examine the quantity use of spoken language from caregivers with all-day recordings and in real life situations, without the presence of researchers or clinicians. However, new technology (LENA) has been introduced that may be used to examine young childrens’ listening environment and verbal communication, including to screen for caregiver gender differences (Gilkerson, Coulter, & Richards, 2008).

1.2 Research question

The background and the rationale of the thesis has led to the following research question:

Do female caregivers use more words in the home environment close to children with normal hearing aged 18- 56 months, compared to male caregivers, and regardless if the children have a hearing impairment or not?

The thesis will work with a hypothesis that female caregivers use more words than male caregivers in the home environment, near young children in the ages of 18-56 months, regardless if the children have a hearing impairment or not (Johnson et al., 2014; Nilsson, 2018).

1.3 The structure of the thesis

This master thesis is an article-based thesis and consists of a summary of the thesis and a submitted manuscript that is sent to an international peer-reviewed journal, and with the goal of becoming published, hereby referred to as article in the summary. The summary of the thesis consists mostly of the theoretical and empirical background, and methodological considerations (reflections), and the article consist of the study *(Female caregivers talk more to 18-56-months-old children with and without hearing impairment than male caregivers measured with LENA – a cross-sectional study).* Chapter one in the summary of the thesis provides the background, theme and object of the thesis that led to the current research question and the hypothesis being used in the study. Chapter two provides an overview of the theoretical and empirical background used in the master thesis, and some of the theoretical background used in the article. Chapter three consist of the methodological considerations and my own reflections when I conducted the current study. It also provides an overview of the recruitment procedure, sampling, choosing of statistical analyses, ethical implications and description of how the study was carried out in more details. Chapter four consists of a short overall conclusion and the future perspective regarding implications, both in clinical settings and in research. The collection of the data in the study was done in collaboration with another master's student, Catharina Fallet Sundby besides from myself. We recruited the participants together, but our theses have different areas of focus. Catharina's focus was on childrens expressive vocabulary and the relationship between expressive vocabulary growth, adult words and conversational turns in caregiver- child interactions, and my focus was on caregiver gender differences.

The measurements in the article were quantitative, which means that there were not any qualitative measurements of the interactions between the child and caregivers. This may limit the research in some ways but will not change the importance of exploring the quantitative measurements of caregiver word use, hereby referred to as word count. Measurements of the participating childrens vocabulary and/or language knowledge was not included as material in the study protocol, because the focus was on exploring possible gender caregiver differences of word use in two different groups (HI, NH).

1.4 List of abbreviations

NH	Normal Hearing
HI	Hearing Impairment
LENA	Language Environment Analysis
DLP	Digital Language Processor
CI	Cochlear Implant
HA	Hearing Aids
BAHA	Bone anchored hearing aid
SES	Socio- economic status
ADEX	Advanced Data Extractor
ITS	Interpreted Time Segments

1.5 List of definitions (used in this thesis)

The term **Word Count** refers in this thesis to the caregivers´ number of words. The term can also be addressed as caregiver word use, or number of words from caregivers.

Researcher in this thesis addresses the researchers in charge of this study, which was the master students Catharina Fallet Sundby and me Nina Melsom Kristensen. Sometimes the term **us** is also used.

Socio- economic status refers to the caregivers´ educational level in this thesis.

Caregivers refers in this thesis to the child’s primary providers, usually parents or other primary caregivers such as grandparents, adoptive parents or other caretakers.

2 Theoretical and empirical background

2.1 Language development

The early exposure to language input plays a crucial role in shaping the linguistic development in infancy. Because most young children are taken care of by their family members in this important time period, their caregivers are the key contributors of talk to which the young children are exposed to (VanDam, Ambrose, & Moeller, 2012, p.402; Hart & Risley, 1995). Caregivers vary in how talkative they are with their children, and these differences have a significant impact on childrens language development both in typically developed children with NH and children with HI (VanDam et al., 2012, p.402; Gilkerson & Richards, 2009; Hart & Risley, 1995). A high amount of language stimuli from caregivers provides children with the opportunity to make stronger connections between the phonological form of a word and the words meaning. Children of less talkative caregivers are often less exposed to instances of individual words, than children of more talkative caregivers (Huttenlocher, Haight, Bryk, Seltzer & Lyons, 1991; VanDam et al., 2012, p.402).

2.1.1 Language development in typically developed children with normal hearing

Infants' early listening experiences, including the early experience of perceived speech sounds and environmental sounds begin already in the 20th pregnancy week. The inner ear (cochlea) is then already developed and matures further in these weeks, and the baby can begin to hear low-frequency sounds such as heartbeats and the mothers voice (Cole &Flexer, 2011, p. 3). In the prelinguistic period infants learn to articulate a variety of speech-like sounds, and to "tune in" to their own vocal input and adult input. The infant begins to create a "mental dictionary" as they listen to their caregivers' input (Ertmer & Stoel- Gammon, 2016). This later allows them to produce and understand words. When infants hear their own babble, they start to associate the articulatory movements with the resulting acoustic signal. This association is very important for learning to produce the articulatory movements associated with word production (Ertmer & Stoel- Gammon, 2016, s. 216).

At birth, infants produce speech-like sounds such as cries, burps, wheezes and coughs.

Later on, they begin to smile and produce “coos” and “goos”. The infant’s vocalizations are often imitated by their caregivers, and the baby and caregiver start to participate in conversational turns with “words” and vocalizations. At around four to six months the vocalizations become more varied, and by six to seven months most infants produce consonant-vowel (CV) syllable vocalizations, also called “canonical babbling”. Infants vocalizations develop and increase dramatically in the first year (Ertmer & Stoel- Gammon, 2016, s p. 216). At around six to 12 months, the infant`s babbling develops further, and the vocalizations now consist of a variety of consonants, but stops, nasals and glides tend to be the most frequent speech sounds. Around the time when babies produce their first words, their vocalizations consist mostly of “jargon speech”; long utterances with sentence-like intonation patterns but that lack clearly identifiable words (Ertmer & Stoel- Gammon, 2016 p. 217).

A child with normal hearing will typically produce their first words around eight to 15 months of age (Kuhl, 2010). Before uttering their first words, children must accomplish two things that together forms lexical- semantic knowledge; to recognize familiar strings of sounds in the speech signal, and then attach meaning of the sounds to an object (Löfkvist, 2014, p.7). The child knows approximately 50 words around the age of 13 to 24 months, and with these words as a foundation they start to combine words and form sentences (Bloom, 2002).

There is a large variation in young childrens vocabulary knowledge. Both related to the understanding of words, their naming ability, and the size of the vocabulary. The vocabulary spurt period is usually starting around 18 months, and the term refers to a time period when children start to use and learn words rapidly (Bloom & Markson, 1998). At the age of two, childrens phonology continues to develop and the focus on grammatical and syntactic learning is emerging. When the children are around three years old, they learn approximately four new words every day (Fenson et al., 1994). Vocabulary learning is a life-long process, built on achieved world knowledge and processing skills, which result in new words which may be learnt every day, and especially in childhood (Kavé, Knafo, & Gilboa, 2010).

2.1.2 Language development in infants and young children with hearing impairment

The cochlea develops and matures around week 20 of the pregnancy, and children with hearing impairment has therefore already missed 20 weeks with auditory stimuli when they are born (Cole & Flexer, 2011 p.3). One major concern surrounding children with hearing impairment is that speech sounds are prevented from reaching their brain, due to their impairment. Neural imaging has shown that the auditory cortex is more active when children listen or read (Cole & Flexer, 2011, p.5). There is a difference between the concept of hearing and listening. Hearing is defined by acoustic input reaching the brain and listening means deliberately or incidentally having attention towards acoustic input. To hear is a prerequisite for learning to listen (Cole & Flexer, 2011 p.12). Early and frequent acoustic stimuli is crucial for the hearing paths to mature. Normal maturation of the central hearing paths is crucial for a normal spoken language development in children (Cole & Flexer, 2011, p. 6). Conversational turns that take place between infants and adult caregivers in this phase are elicited when the infant use “cooing-vocalizations”, that are based on the infant’s ability to hear their voice and adult’s words. Children with hearing impairment are less likely to imitate their caregivers which may decrease conversational turns between the caregiver and the child (Ertmer & Stoel- Gammon, 2016, s p. 217). A hearing impairment can be a risk for a delay of canonical babbling (Moeller et al., 2007a: Ertmer & Stoel- Gammon, 2016, p.218). There is a large variation in language development in children, and some children with hearing impairment begin to babble within the normal age range (Oller & Eilers, 1988; Nathani, Oller, & Neil, 2007; Ertmer & Stoel- Gammon, 2016, p.218).

Hearing impairment (mild to severe) has an impact on children’s oral language development by restricting the access to hear speech and experience spoken language as easily as for children with NH (Moeller & Tomblin, 2015; Tomblin et al., 2015, p.76S). Children with mild to moderate hearing impairment have unlike children with severe and profound hearing impairment some access to language input (speech). This access is however dependent on the extent of the speech signal, hearing aid technology use and existence of noise in the environment (Tomblin et al., 2015). These factors explain the impact quantity and quality of language input have on children’s language learning. A hearing impairment could result in threats to the language learning system and accessing of important linguistic cues. However, it is possible that the language learning system of children with mild to severe hearing impairment only needs a minimum amount of information for successful language development (Tomblin et al., 2015, p. 76S).

A profound hearing impairment will exclude a big amount of speech information, and this will further affect the child’s oral speech and spoken language ability, especially without any amplification of hearing aid technology. Children with cochlear implants have shown relatively adequate speech and language development, despite the poorer acoustic because of the devices (Tomblin et al., 2015, p. 77S). In the study by Tomblin and colleagues (2015) the authors examined language outcomes of preschool children with mild to severe hearing impairment, and how aided hearing influenced language growth. The results indicated that children with mild to severe hearing impairment may be at risk for language delays, especially if the hearing impairment is moderate or greater. The risk for language delays could be minimized by intervention through early aided hearing, and consistent use of the hearing aid technology (Tomblin et al., 2015, p.90S).

2.2 Hearing impairment

The first three years of a child's life is crucial considering development of listening, speech and language skills. If in these three years they are not exposed to auditory input, they are more likely to develop a language delay, and later also have literacy delay (Tye- Murray, 2015, p. 483). One other crucial factor for language development in the early years is the cognitive development. The neural pathways and cognitive skills necessary to interpreting auditory input are starting to develop during these early years. A hearing impairment could easily be a hindrance for achieving underlying cognitive skills that are necessary to acquire adequate language (Tye-Murray, 2015, p.483).

Hearing impairment can in one way be described as sounds that do not reach the brain. In other words, there is something in either the outer, middle or inner ear that prohibits the sound from getting through and reaching the brain. Hearing impairment is categorized based on degree (mild to profound), type (sensorineural, conductive, mixed, unilateral, bilateral, asymmetrical, symmetrical, prelingual, perilingual, postlingual) and etiology (congenital, acquired) which is related to cause of the hearing impairment or deafness. One example of the most common genetic, and non-syndromic cause of hearing impairment or deafness is connexin 26 mutation while the most common congenital, and acquired hearing impairment or deafness is congenital cytomegalovirus (CMV) infection (Alford et al., 2014). The pure-tone average (PTA) often defines the degree of the hearing impairment, from mild (hearing impairment) to profound (deafness). The audiogram gives an overall picture of the hearing impairment and sensitivity (Tye- Murray, 2015, pp. 12-13).

Cochlear implants and hearing aid technology provide children with hearing impairment with the opportunity to hear environmental sounds, speech and language input (Ertmer & Stoel- Gammon, 2016, p.218). The use of these technologies aims to make speech audible for patients with a hearing impairment or deafness (Tye- Murray, 2015, p.122), and to provide them with access to speech signals at a safe and comfortable level, both for infants and children (Tye- Murray, 2015, p.533). There is a variety of hearing aid technologies and cochlear implant (CI) is one of them. The CI-system consists of two parts; one outer part, that reminds of a hearing aid (microphone, transmitter/coli), and that is connected to an implanted part that consists of a receiver and an electrode, that is inserted in the cochlea where it sends impulses to the auditory nerve and thereafter to the brain. Deaf infants should be identified as early as possible after birth, to reduce the negative effects of auditory deprivation (Kronenberger et al., 2014).

2.2.1 Follow- up procedure after detected hearing impairment in Norway

The Universal newborn hearing screening (UNHS) system (2007) aims to screen for hearing impairment in all newborn babies within the first days after birth. Testing of all babies with automated auditory brainstem response (A-ABR) and otoacoustic emission (OAE) will hopefully decrease the age at identification of hearing impairment and reduce hearing-related risks for language delays (Tye- Murray, 2015, p.484; Joint Committee on Infant Hearing, 2007). In Norway there is a recommendation to follow the guidelines "*National professional guidelines for newborn screening*" (Nasjonal faglig retningslinje for screening av hørsel hos nyfødte) from "the Norwegian Directorate of Health". These guidelines recommend that all infants should be screened 24 to 72 hours postpartum, and if they do not pass, they should be referred to further audiological evaluation. One thing to bear in mind is that this is only a recommendation and not a directive (Norwegian Directorate of Health, 2008).

All parents are offered newborn hearing screening at the hospital, and this offer makes the basis for an expectation of an adequate follow- up procedure. One of the findings from the current study illustrated an unexpected result of clinical practice. The majority of the participants reported that they were not pleased with the initial clinical hearing care procedures, and none of the participants were offered individualized family centred intervention. Family centred intervention is an evidence- based intervention approach designed to support the families and caregivers of children with a hearing impairment and teach the caregivers how they can help and support their child to have the best preconditions for later language learning, despite their hearing impairment. One of the pillars in family centred intervention is that caregivers and families of children with a hearing impairment are empowered and trained by clinicians to be advocates and models for language learning of their young children (Moeller, Ertmer & Stoel- Gammon, 2016).

2.3 Auditory deprivation

When a child with a hearing impairment experience auditory deprivation over a longer period, or extended periods of poor auditory access to linguistic input and environmental sounds, the auditory system undergo a cross-modal reorganization (Sharma & Campbell, 2011). This can lead to diminished connections within the auditory nerve and the auditory centers of the brain (Teoh, Pisoni & Miyamoto, 2004; Estabrooks, Maclver- Lux & Rhoades, 2016, p.220). If this period is prolonged, the auditory performance decreases (Teoh, Pisoni & Miyamoto, 2004; Estabrooks, Maclver- Lux & Rhoades, 2016 p. 220). The neural networks in the brain reorganizes for other senses when it receives weakened amount of auditory input (Sharma, Gilley, Dorman & Baldwin, 2007; Coez et al., 2011; Estabrooks, Maclver- Lux & Rhoades, 2016, p. 220). The sensitive period for language learning in typically hearing children is from birth to approximately three years after birth. In this period the structure in the brain changes and organizes based on experience. Frequent experience-based connections or synapses are strengthened, and infrequently used connections (synapses) are “pruned” or cut to make room for the strengthened connections. These experience- dependent consequences are called neuroplasticity (Suskind, 2015).

Studies show that children with hearing impairment or deafness who went through cochlear implantation within the sensitive period, showed better outcomes regarding language and cortical auditory evoked potential (Sharma, Dorman & Kral, 2005). Aided hearing with hearing aid technology such as cochlear implants and hearing aids are critical within the sensitive period for auditory cortical development. The opportunity for early access to sound and speech is critical for optimal language development, and also preventing re- organization of the cortex, which could result in limiting the capacity for oral language learning (Sharma & Campbell, 2011).

2.4 Caregiver sensitivity

Caregiver sensitivity refers to the caregiver’s ability to perceive, interpret, and respond to the child's signals quickly and appropriately (Mesman, Oster, & Camras, 2012). Sensitive caregivers foster safe attachment, and according to attachment theory, caregivers' sensitivity to the child's needs and signals is central for positive development (Mesman et al., 2012). Caregivers have a big impact on children's cognitive, linguistic and social development. Quittner et al. (2013) examined the effect of parental behavior on the dyadic interaction with deaf children and their language development during the first four years after cochlear implantation (CI). Previous studies in children with CI have not investigated the effect of maternal sensitivity and the data from the study (2013) indicate that maternal sensitivity and cognitive stimuli predicted an increase in linguistic growth in the children. Linguistic stimulation was strongly related to language growth only in the context of high maternal sensitivity (Quittner et al., 2013).

Another study (Ambrose, Walker, Unflat-Berry, Oleson & Moeller, 2015) investigated the quality and quantity of utterances from caregivers to both children with mild to severe HI and children with NH. A five-minute semi-structured interaction between parents and children was carried out when the child was 18 months and three years old. At the 18-month check-up, the parents filled out a standardized survey, and at a three-year check-up, a standardized language test was done. The results from control at 18 months of age showed that children with HI were exposed to more directives (example; giving a command rather than showing interest for the child’s own initiative) than the children with NH. At the three-year control, there were significant differences between the groups on the number of utterances from parents, and children with HI were exposed to fewer words and poorer quality of the stimuli they received (Ambrose et al., 2015).

Results from the study conducted by VanDam, Ambrose & Moeller (2012) indicated that children with normal hearing and children with hearing impairment were exposed to a similar amount of adult words. However similar amount of exposure may not correlate with similar amount of access to adult words, especially for children with hearing impairment (VanDam et al., 2012, p.414).

Hurtado, Marchman, Fernald (2008) showed in their study indications that mothers of Spanish speaking children who used more utterances also used more words, word tokens and word types than mothers who used fewer utterances. The results also indicated that maternal talk was uncorrelated with hearing impairment. Number of utterances from mothers correlated significantly with children’s vocabulary at 24 months (Hurtado et al., 2008, p.F34). Children of mothers who used more utterances had a larger increase in vocabulary from 18 to 24 months, which is consistent with other studies on English speaking mothers and infants (Hoff & Naigles, 2002; Hurtado et al., 2008, p.F35). Talkative mothers in the study used on average seven times more words, five times more utterances, three times more different words and sentences that were twice as long compared to less talkative mothers (Hurtado et al., 2008, p.F37). Other findings from the study showed that quantity and quality of adult speech predicted children's efficiency in receptive language development. The study provides evidence that caregivers´ stimuli influences both vocabulary knowledge and lexical processing skills, and that this later forms the foundation for continued lexical and grammatical growth (Hurtado et al, 2008, p.F37).

A study carried out by Quittner, Cruz, Barker, Tobey, Eisenberg & Niparko (2013) presented results that showed a correlation between high maternal sensitivity and language growth, and also that maternal sensitivity and cognitive stimulation predicted a significant increase in oral language growth (Quittner et al., 2013, p. 4-5).

2.5 Gender differences

All children need rich and varied linguistic stimuli from their caregivers and their surroundings. Vocabulary vary from person to person, depending on age, cultural differences, interest and status. This also applies to gender, and it is no surprise that men and women have different ways to communicate with each other, with children and other adults. Johnson, Caskey, Rand, Tucker, & Vohr (2014) aimed to test the hypothesis that reciprocal vocalizations of mother- infant dyad are more frequent than those of father- infant dyads (Johnson et al., 2014). The results from the study showed that utterances between mothers and children/ infants have a positive effect on language development (Johnson et al., 2014). Results from Johnson et al. (2014) also showed that mothers more often than fathers responded to infant cues, and that infants showed a preferential response to their mother's voice in the first months of life. Johnson et al. (2014) suggested that this behavior could be explained by the fact that mothers are often the primary caregiver with the most direct interaction with infants (Johnson et al, 2014). Maternal and paternal input to infants are similar in the first three months of life. However paternal input often consists of more challenging cues, utterances and questions, encouraging children to use more challenging vocabulary and longer utterances (Johnson, et al, 2014).

The study Nilsson (2018) found that women accounted for around 71% of words between caregiver and children, and men accounted for around 29% of words between caregiver and children (Nilsson, 2018, p.21). Mean of words per hour was 987 for women, and 403 for men (Nilsson, 2018, p.30). Nilsson`s (2018) key findings from the study showed that children with a hearing impairment and that used HA heard a greater amount of words from their caregivers (both females and males), but that children with CI and NH were involved in more conversational turns with their parents. Nilsson (2018) notes that this can be due to an effect from individualized family-centered intervention actions that usually are provided to all families with CI, but not to all families with HA. Families with children who have CI may thereby be more aware about the importance of meaningful language stimulation, including to listen to the child’s own initiatives in dialogues, which may result in more favorable language development. Children with NH heard the least amount of words, and female caregivers used more words in all groups (Nilsson, 2018).

Zaidman- Zait, Most, Tarrasch and Haddad (2018) investigated parents’ involvement in intervention programs for children with hearing impairment. They found that mothers were significantly more involved in children’s intervention than fathers were. Mothers reported that they were more interested and had a higher attendance in the intervention programs than fathers and were more actively engaged with professionals (Zaidman- Zait et al., 2018). Previous studies have also found that female caregivers more often than male caregivers act as their child’s main provider, especially with children with disabilities (Brett, 2002; Tehee, Honan & Hevey, 2009).

Father involvement in child development has changed over the last decade, and fathers are now more involved, and their role as caregivers are unique and may differ in many ways from mothers. Fathers parenting role has an important consequence in terms of parenting behaviors, but there are still barriers regarding work hours, and maternal “gatekeeping” to mention some (Yogman, Craig & Garfield, 2016). Fathers has shown to be competent and capable during infancy, resulting in infants having similar experiences psychological as with mothers (Yogman et al., 2016). Male caregivers are more likely to be young children’s play partners, and their role in playing tends to be more stimulating and arousing for the child compared to mothers (Yogman, 1981).

Male caregivers are also just as likely as mothers to match their emotions with the child, and their quality of interactions are more intense than mothers (Yogman, Lester & Hoffman, 1983; Feldman, 2003). Pancosfar & Vernon- Feagans (2006) found that male caregiver- child interactions were shown to be a unique predictor of the child’s later advanced language development. Male caregivers` input made a unique and significant contribution to the child’s later expressive language skills at 36 months of age, considering parent education and quality of childcare (Pancosfar & Vernon- Feagans, 2006).

3 Method

3.1 Research design

This study has a descriptive, cross sectional design with analyses based on quantitative data from a sample (N=17). Language Environmental Analysis (LENA) provided full one-day recordings which was used to measure caregiver word counts. Only data from the hours of the recording day where both caregivers were present was used. The compared variables used are the means of word counts from female and male caregivers. A descriptive study refers to a study that showcase things as it is, without any purpose of changing, influence or affect the variables. There was not given any treatment, guidance or instruction to the participants in advance that could have affected the outcome or the results in the current study. This is a criterion for a study to be descriptive (Kleven, 2002 pp. 265- 266).

The data displayed in the study was extracted from two groups; children with hearing impairment (HI) (n=8), and children with normal hearing (NH) (n=9). Both groups are relevant because of the thesis' research questions that aims to investigate the possible similarities and differences between the two groups on the chosen variables and measurements. The chosen variables in this study was number of adult words from female and male caregivers, presented close to both children with HI and NH and in total. This study will show a "snapshot" of a population at a specific point in time. The "snapshot" showcased was the all- day recording, and the sample was the participating children (HI, NH). This study will show a sample consisting of individuals with different ages, hearing status and some difference in socioeconomic status in different parts of Norway (Cohen, Manion & Morrison, 2011, p. 267).

Prior to the recruitment process and data gathering, a test pilot was conducted including a child with normal hearing, 25 months of age with a full- day recording. This made it possible for the researchers in charge to practice all procedures before organizing and administrate the study.

3.2 Ethical implications

With research comes the possibility of new and valuable insight in different disciplines, cases and questions. Research is carried out in different context, often with humans or animals as subjects. A researcher could also be called "finder of facts", implicating that what we read in research should be facts and not assumptions or interpretations. To find these facts, the researcher is obligated to follow several norms of research ethics. These norms strive to be an assurance both for the researcher and all parties participating, avoiding any burdens or liabilities (NESH, 2016). Researchers are responsible for presenting knowledge and data that are valid and are therefore subject to high expectations regarding all aspects of the research process. For instance, choosing of research questions, methodological approaches and analytical expectations needs careful consideration (NESH, 2016).

3.2.1 Careful and satisfactory recruitment and sampling

Informants recruited to research projects should never feel pressured or obligated to participate (NESH, 2016). The participants in this study was not approached directly, all information regarding this study was first handed out or distributed via relevant instances and institutions. Further, the interested caregivers had to take initiative and contact the researchers in charge of the study to enroll. Caregivers who contacted us, but did not respond, was not contacted further. All correspondence between the researchers and participants were via home visits or video- conference. It was not possible making home visits to all participating families, due to their geographically whereabouts. It would have been preferable to do so, but due to limited time, this was the most attainable solution. If any of the participating families wanted more information or had any questions, they contacted us at any time during the process.

3.2.2 Handling of personal data

All collected data was anonymized and encoded and cannot be traced back to the participant. From the recording, six ten- minute samples (60 minutes) were extracted and transcribed and analyzed by a qualified research assistant to validate the data from the LENA software. No other files containing audio was played or listened to beyond this. Non-unauthorized personnel were not able to access the encoded material, and the material was anonymized and kept separated from consent forms and other documents where the child’s identity appears (appendix nr: 10;2016/ 2235). The encoded material was kept in a fireproof cabinet, separate from the consent forms, in accordance with the current guidelines by the Institute for Special Needs Education, UiO (2016/ 2235). NESH (2016) states that all ongoing research documents where the participants identity may occur, should always be kept separate from the research data (NESH, 2016).

The project and the study are approved by Regional Committees for Medical and Health Research Ethics (REK), and all the data and materials will be terminated at the date agreed with REK (2016/ 2235; NESH, 2016). Results from the project can be further used and presented in scientific research papers and articles, and in master- or doctoral theses. All the participating families was given this information and approved to continue with the process. If the results are to be presented or published, all personal data will be anonymized. The participants had the right to apply for access and insight into the data and the opportunity to correct any errors throughout the whole period (appendix nr: 10; 2016/ 2235).

3.2.3 Informed consent

All participants wanting to participate in the study had to fill out a consent form prior to the recording. Since the participants were children under the age of 6, the parents filled out these forms. Through informed consent the participants got a full overview of the study, and what the participation entailed. This information was given both orally and in writing to the caregivers because the children participating was under the age of 6 (NESH, 2016; Fossheim, Hølen & Ingierd, 2013). The children in the study was given adjusted information about the vest and the digital language processor (DLP), and the opportunity to touch and feel the vest and DLP before wearing it. The children participating should not in any way feel obligated to go through with the recording and wearing the vest. If there were any situations where for one reason or another the child didn’t want to wear the vest, they would not be asked to continue the participation. Two children in the study withdrew due to this. All the participants were also informed of their right to withdraw from the study at any time without any reason for their withdrawal. If any of the participants wants to withdraw their consent and exit the study, all data and personal details will be terminated.

3.2.4 Children as a vulnerable group

The group of participants are vulnerable, but this does not give us a reason to not request consent or recruit informants from this group. When recruiting from vulnerable groups it is important to exercise satisfactory ethics regarding research, and obtaining consent (Ruyter, 2003). When conducting research, the researcher must always conduct the research in a satisfactory and ethical manner. This means avoiding any severe burdens or liabilities for the participating party as a result of the research (NESH, 2016). The LENA method entails using recording in the participants home environment. This could be perceived as invasive. In all cases, information was given to the families about why it is important to do the recording in the home, and how the data would be administered and presented in the research paper. The families also had full right to gain full access into the data and the study (appendix nr: 10; 2016/ 2235).

3.3 Participants

The sample in this study consists of 17 individuals from two groups; children with hearing impairment (n=8), and children with normal hearing (n=9). It has been considered that this sample is probably not a representative sample of the population, because of the small sample size (Cohen, Manion & Morrison, 2011).

3.3.1 Recruitment process

Participants were recruited between late autumn 2018 and February 2019. They were recruited from different institutions and instances. Table 1 illustrates the arenas for recruitment, and all instances and institutions has been categorized in three categories: (1): Facebook, (2): Public and open childcare center, (3): Public and municipal health services, including: National service for special needs education (Statped), Audiology Centers, Health care center for families and children, hospitals, The children’s and young people’s psychiatric out- patient clinic (BUP), Educational and Psychological Counselling Service (PPT), Multidisciplinary Center and Educational audiologists. No potential participants were contacted directly. Interested caregivers contacted us, they got information about the study, and had to sign consent forms before enrolling in the study. Participants that enrolled in the study and were within reasonable geographical proximity received home visits, and those who lived in other parts of the country received the Digital Language Processor (DLP) with instructions and forms to fill out via mail. The participants who received their equipment via mail also got video calls via skype for instruction on how to use the DLP.

Table 1.

Arenas for recruitment.

	Facebook	Public (open) childcare center	Public and municipal health services
Meets the inclusion criteria	21	2	5
Exclusions/ withdrawal	8	1	2
Total	13	1	3

Notes: Exclusions or withdrawals where due to participants not meeting the inclusion criteria or withdrew due to other or unknown reasons.

3.3.2 Facebook

A Facebook page was created and established in December 2018 under the name “words make a difference” where information about the project and the method (LENA) was distributed. I addition to the Facebook page, information was distributed in different groups that could be relevant for recruitment (groups for caregivers of children with hearing impairment etc.). When the page was created there was not much interest from participants, but one reason for this can be that the page was created right before the Christmas holiday. After the Christmas holiday the page got many views and caregivers of children with or without hearing impairment contacted the test administrators for participation in the project. In total 24 parents approached us on Facebook and wanted to be a part of the project. Of these 24, 21 participants met the inclusion criteria for participation, and 13 participated in the study in total.

3.3.3 Public childcare centers and open public childcare centers

Several public childcare centres and open childcare centres was contacted in this process. Some of them wanted visits to get more information about the project and participation. The information was distributed to parents in the public childcare centres, and information was also given to the staff of the public childcare centres. It was emphasized that these public childcare centres were only an arena for recruitment and would not be a part of the project. In total two participants were recruited from public childcare centres and open public childcare centre, both cases met the inclusion criteria, but one of them withdrew. Open childcare centre is a public centre free of charge where children and their caregivers can meet other children and caregivers before they start to go to the public childcare centre (Oslo Kommune, 2019).

3.3.4 Public and municipal health services

Information such as posters, flyers and pamphlets were handed out in different public and municipal health services (National service for special needs education (Statped), Audiology Centers, Health care center for families and children, hospitals, The children's and young people's psychiatric out- patient clinic (BUP), Educational and Psychological Counselling Service (PPT), Multidisciplinary Center, and audiology centers and health clinics for families and children). Information was given to educational audiologists and they relayed and forwarded the information to possible participants. National service for special needs education (Statped) forwarded the information through a letter via mail, and participants contacted us for more information and participation. In total five participants from public and municipal health services met the inclusion criteria and wanted to participate in the project, but one withdrew.

3.3.5 Participants

Participants were selected from two groups; children with hearing impairment and children with normal hearing. Table 2 present the final inclusion criteria for participation. For children with hearing impairment, the inclusion criteria had to be expanded due to a too narrow age- and hearing impairment type- criterion. The initial age- criterion was 18- 48 months, but the upper limit was expanded to 71 months. The initial hearing type- criterion was mild to moderate hearing impairment, this was expanded to any type or degree of hearing impairment. The final sample consisted of children aged 18- 56 months, and with any type or degree of hearing impairment, or normal hearing (appendix: 11).

Table 2.

Inclusion Criteria for the participants.

Children with normal hearing (NH)	Children with hearing impairment (HI)
18- 56 months of age	18- 56 months of age
Normal hearing	Known hearing impairment, regardless of degree or the nature of the hearing impairment/ etiology; unilateral, bilateral, uses/ does not use HA, and/ or CI/BAHA
No other known neurological or developmental/ clinical diagnoses	No other known neurological or developmental/ clinical diagnoses
The child and one of the caregivers must use Norwegian as their spoken language	The child and one of the caregivers must use Norwegian as their spoken language

The inclusion criteria were relative wide because of the challenges with recruitment. In Norway there is yet no national register for children with hearing impairments, and therefore the whereabouts of the children are relatively unknown. A taskgroup «Kvalitetsregister ØNH- hørselsregister for barn» by «Nasjonal behandlingstjeneste for hørsel og psykisk helse (NBHP)» is now developing a national register for children with hearing impairment (Den Norske legeforening, 2019). By creating such a register there would hopefully be easier to map the whereabouts of children with hearing impairment, and also ensure sufficient and adequate follow- up and early intervention for this group of children and their families.

Based on the feedback and verbal reports from the parents in the study, most of the participating children with hearing impairment and their families had not had an adequate and satisfactory follow-up, or intervention actions that had started early enough. Some of the children in the sample (HI) did not receive their hearing aid technology right after their hearing diagnoses was known, and none of the families had received individualized family centred intervention.

3.4 Methodological considerations

3.4.1 Validity

When conducting research, the researcher must reflect over how validity and reliability will affect the process and outcomes. One of those reflections concerns the threats to the validity of a study. Being cautious and considerate about all the limitations and possibilities when doing research may limit the threats against validity (Cohen, Manion & Morrison, 2011). The validity of a study tells us for example if an instrument or a test measures what it is supposed to measure, or if the results from a study can be generalized to a wider population. Validity can be ensured through careful sampling and proper/ satisfactory instrumentation and treatment of the statistical data. Nevertheless, we can never be guaranteed that the validity will be without error.

There are many forms of validity, and this thesis will only highlight a few that is relevant to the current study. There are many things that can be done to ensure greater validity, for example to select an appropriate methodology and instrumentation, and careful and satisfactory sampling is some of them. Reliability and validity are not the same, but may at some occasions overlap. If results from a study are going to be valid, the measurements must be reliable. In other words, the results must be verifiable (Cohen, Manion & Morrison, 2018).

3.4.2 Validity in quantitative research

Validity in quantitative research often strives to be faithful to several features; controllability, replicability, consistency, predictability, observability and objectivity are some of these features. Validity means being true to the assumptions underpinning the statistics used, the construct and content validity of the measures used, careful sampling and avoidance of a range of threats to internal and external validity (Cohen, Manion & Morrison 2018, p.247). Cook and Campbell (1979) developed a general validity system for causal research. Although the current research was not causal, the same validity system will apply and was based on this system (Lund, 2002, p. 104).

3.4.3 Internal validity

The internal validity in a quantitative study tell us about how the results in a study can be explained though the predicted hypothesis, which in this study is that female caregivers use a higher number of words near young children in the home environment than male caregivers (Cohen, Manion & Morrison, 2018). Because of this study being a descriptive study, the depths of internal validity will not be explained further on in the thesis.

3.4.4 External validity

The external validity in quantitative research concerns generalizability; in which capacity can we generalize from a sample to a population. One of the threats to the external validity includes generalizing from a small sample or a sub- group to a broad population, and whether the results from a study is valid in a wider population (Cohen, Manion & Morrison, 2018, p. 254). This concern is valid in this study because of the small sample (n=17). The small sample size is likely to limit the degree of generalization to a wider population in this study. Nevertheless, it is of importance to perform research with small sample sizes. Even with a small sample size it is possible to look at tendencies between the variables, even if there are no statistically significant findings (Cohen, 1995).

Sampling procedure and random sampling is one way to ensure that the threats to external validity is minimized. Random sampling draws randomly from a wider population and is useful regarding generalizability. This is a strength because this procedure seeks representativeness of a wider population, which was one of the aims in the study (Cohen, Manion & Morrison, 2011, p. 153). The participants in the current research was not drawn by random sampling, but instead by the method convenience sampling. This method was used because of the inclusion criteria, and also because of the narrow target population which makes it challenging to draw a random selection of cases. However, we know that the target population is bigger than our sample, but with the challenges concerning recruitment the sample consists of eight children with HI and nine children with NH. As previously mentioned, a register for children with hearing impairment is now being established. If similar research is performed in the future, children with HI and their families might be more accessible and reachable (Den Norske legeforening, 2019).

3.4.5 Statistical conclusion validity

A precondition for statistical conclusion validity is whether the correlation or tendency examined is statistically significant or has a reasonably strong connection. A reasonably strong connection is determined by the field of expertise, which in this case is the field of educational audiology as a part of educational research (Lund, 2002, p. 105). The significance level is measured by a p- value. In the field of educational research and audiology, the p- value is set to be 0.05. If the p- value is higher than 0.05, there is a 5 % chance that the effect measured is due to chance, and that this effect can be seen in the sample, but not in the wider population. If the p- value is 0.05 or lower, there is a 5 % chance that the effect seen in the sample can also be seen in the wider population (Lund, 2002, pp.113- 114).

Threats to the statistical conclusion validity concerns type 1 and type 2 errors, which means to reject a true null- hypothesis, or to accept a false null- hypothesis (Lund, 2002, p. 114). In the current study, the sample size is small (N=17), and this may contribute to do a type 1 or 2 error. The results from the study indicates that there are significant differences in the variables (caregiver word counts), but we cannot reject the possibility of making an error such as this. Having a bigger sample size, stricter level of significance, wider spread in population- variance, effect size and use of a two- tailed test are all conditions that can minimize the threats to statistical conclusion validity (Lund, 2002, pp. 114- 115).

Cohen`s d is a measurement used to measure effect size, and with this we can estimate the effect in the sample, because we cannot measure it in the population (Field, 2013, p. 80). The effect size is related to the difference between two groups and can be estimated based on the means of difference between the groups. Knowing the effect size, for example a “small” effect size of 0.02 as defined by Cohen’s d, tells us that the difference in means are trivial, even if the results are significantly different (Field, 2013).

3.4.6 Construct validity

Construct validity concerns how well an instrument measures the variables it’s supposed to measure (Cohen, Manion & Morrison, 2011). In this context the instrument is the LENA system, and the variables are female and male caregivers´ word count. LENA has been validated in several languages, not yet in Norwegian, but this current study will contribute to the validation in Norwegian. The LENA natural language study (NLS) validated the system, and the results indicated reasonable levels of agreement with respectively 82 % and 76 % of the segments coded as adult speech and child vocalizations (Gilkerson & Richards, 2008). This means that construct validity was strengthened and the LENA system measures what it’s supposed to measure. The researchers in this study also did a validation on the data material and got similar results as the NLS (Gilkerson & Richards, 2008).

The threats against construct validity can be split into two; random errors of measurement and systematic errors of measurements. Random errors of measurements do not mean that the errors are random, but that they “behave” random. Systematic errors are errors that concern the instrument, methods of measurements, and human errors: the researcher reads the measurements wrongfully (Lund, 2002). There are strengths and weaknesses on how well a concept can be operationalized, and in the process irrelevant information can interfere, resulting in random and systematic errors of measurements (Kleven, 2002, p.152).

3.4.7 Validation of the LENA system

The LENA natural language study (Gilkerson, Richards, Warren & Montgomery, 2017; Gilkerson & Richards, 2008) aimed to validate the reliability of the automated software, and the LENA system correctly identified 82 % and 76 % of the segments coded as adult speech and child vocalizations which indicated reasonable levels of agreement (Christakis et al., 2009; Warren et al., 2010; Xu et al., 2008; & Zimmerman et al., 2009). LENA is validated in different languages such as Spanish, French, Mandarin, Korean and Vietnamese (Canault, Le Normand, Foudil, Loundon, & Thai-Van, 2015; Ganek & Eriks-Brophy, 2017; Gilkerson et al., 2015; Pae et al., 2016; Weisleder & Fernald, 2013).

From the total of 17 recordings (210 hours), six recordings were drawn (60 minutes in total) to validate the reliability of the measures from the LENA recordings. From these six recordings, six ten- minute intervals were transcribed manually by a qualified research assistant. The validation displayed that LENA measured adult words with 78 % accuracy and child vocalizations with 51 % accuracy. The reliability in adult words showed a percentage that was within reasonable levels of agreement. For child vocalizations the percentage is low, and for a reasonable agreement it should be higher. A reason for this low percentage could be that LENA in some individual cases measured a higher accuracy on child vocalizations and adult words than others. This could be a result of the environment the child was in at the day of recording (noise, other adults and children, etc.). At some occasions the software will mislabel a speaker. An example is when a woman raises her vocal pitch and may be labelled as a child (Gilkerson, et al., 2008) Another example is when two speakers speak at the same time (overlapping speech), the software will discard both utterances, and in this sample this may be an explanation for some individual cases, resulting in low percentage (Warren et al., 2010; Xu et al., 2008).

3.5 Reliability

Reliability concerns the amount of measurement errors in research data, and the psychometrics of an instrument (Kleven, 2002, p. 154). LENA has been validated in several languages, not yet in Norwegian, but the data material in the present research has been validated by a qualified research assistant. See chapter 3.4.7 for more information on this validation.

There are several adjustments we can do to ensure reliability in research. One example is estimating the reliability coefficient through measuring something twice. Doing this will tell us how well the correlation between the two test occasions are, and high correlation indicates high reliability (Kleven, 2002, p. 159). Another example is doing two test occasions with a short time interval. Testing the correlation between the two occasions gives us an estimate called Pearson`s correlation. A high correlation indicates higher reliability (Kleven, 2002, p. 159). A test- retest is also an estimate of reliability. However, there are weaknesses and flaws with all these estimates. A test- retest could give a false high estimate if the test and retest occasions are too close in time. This could give the informant the possibility of remembering their answers from the test occasion, which again may provide a false estimate. All these estimates limit the possibility of measurement errors. In the current research it was not possible to implement this, but it would be preferred in the future to have two test occasions considering the informants were young children.

One other aspect is considering the Internal consistency in a study. This concerns how similar results can be if they are measured in different samples. In other words, it says something about how compliant the different measurement links are (Cohen, Manion & Morrison, 2011; Kleven, 2002). To measure the internal consistency, we can use the alpha-coefficient. This gives an estimate of scale reliability and how closely a set of items are related as a group (Cohen, Manion & Morrison, 2011; Kleven, 2002).

3.6 Instrument

3.6.1 Language Environment Analysis (LENA)

Language Environment Analysis (LENA) was used to answer the thesis` research question and hypothesis, as well as collecting and analyzing the data. The LENA device is a small and childproof device that consists of a Digital Language Processor (DLP), and a gender- neutral vest that the child wears in the home environment (12-16 hours). The LENA-program measures: (1): the (key)child's utterances/ words, (2): adult utterances/ words, (3): conversational turns between the child and caregivers, (4): TV and electronic sound, (5): the overall hearing and sound-environment in the child's home environment (lena foundation, 2019).

The participating caregivers filled out several forms and questionnaires prior to the recording; MacArthur- Bates Communicative Inventory; Words and sentences, version 17th of January 2012 (Simonsen, Kristoffersen, Bleses, Wehberg & Jørgensen, 2014), declaration of consent, Developmental Snapshot, activity journal, and a form concerning the caregivers´ background information and their child’s hearing status. Together with the parents, the researcher filled out Developmental Snapshot, which gives an estimate of the child's developmental age compared to the child's chronological age (LENA pro user guide, 2015). Details about the caregiver’s background, educational level, and native language was obtained. Caregivers of children with hearing impairment filled out a document concerning the degree and type of the hearing impairment, when it was detected, age at diagnose and if the child used any assistive hearing devices/ technology, and if they had received any intervention (family- centered or not). All activities, sleep, meals etc. on the day of recording were registered in an activity journal at the same day as the recording.

After the data collection was finished, the material was transferred to the LENA software that analyzed the raw data. A statistical analysis was done using the Statistical Package for the Social Sciences (SPSS). A significant effect of gender was evidence that one gender uses a larger number of utterances than the other gender, and a significant interaction effect was evidence that number of utterances from females and males differ in both groups (HI, NH). It is considered that LENA doesn’t measure quality of interaction and communication, only quantity. It is important to emphasize this because the recordings cannot give us any information about the quality of the interaction between female and male caregivers and children in this study or thesis. And therefore, no conclusions can be drawn about why there was a difference in number of words in caregivers regardless of the child’s hearing status (HI or NH).

3.6.2 Digital Language Processor (DLP)

The Digital Language Processor (DLP) is a small wearable recorder device, that children wear during the day of recording, including the participating children of the present study. The DLP is not like a traditional recorder, but is instead based of voice recognition, algorithms, and functioning as a pedometer for words (LENA user guide, 2015).

The child wears a vest with the DLP in a pocket (appendix nr: 3), throughout a whole day which allows the child to play unrestrained while wearing it. If the child sleeps during daytime, the recorder can preferably lie next to the child to record the listening environment. The DLP is worn from when the child wakes up until he/she goes to sleep. The parents have the responsibility to turn the DLP on and off at the recording day, as well as to return the DLP to the researchers, either by regular mail or delivered in person to the researcher. The participating parents in the study received the DLP together with user instructions and depending on their geographically whereabouts they received the instructions orally either via video conference or via home visits (appendix nr: 4).

3.6.3 LENA Advanced Data Extractor (ADEX) & Interpreted Time Segments (ITS)

The LENA Advanced Data Extractor (ADEX) is an appliance that provides access to data from processed audio recorded files collected through the LENA equipment, that have been exported from the LENA pro software. LENA ADEX also provides access to LENA Developmental Snapshot. The developmental snapshot is a questionnaire that the researcher fills out together with the caregivers, and which gives an estimate of the child’s general developmental age compared to their chronological age (The LENA Advanced Data Extractor, 2011).

The LENA software provides an overview of the data collected from the recording. Data from the recorder is visually shown in a user-friendly bar charts; daily, hourly or with five- minute intervals. The estimated data can be exported to Interpreted Time Segments (ITS) which gives a segmented information of the audio file to further examine the data. The LENA software ADEX can distinguish between male and female voices from ITS-files, and therefore count the number of words from each gender. The ITS- files provides a view of the number of words from females and males, key child and other adults or children that are present during the recording (LENA pro user guide, 2015).

3.7 Statistical Analyses

To compare the means of word counts from female and male caregivers between the two groups of children (HI, NH) a two- tailed independent samples test was performed. And to compare the means between female and male caregivers word count in both groups (HI, NH), a paired samples test was conducted. A simple bar plot of the means of word count (female, male) across groups, and in total with a confidence interval 95 % was also examined to find out if the means were significantly different. No other statistical analyses were used in the article.

4 Conclusion

The study linked to this thesis had limitations concerning the sample size, variation in caregivers` educational level and limited validation material. However, the results indicate that the LENA system can be used also in a Norwegian context, and that LENA can contribute with new knowledge about caregiver gender differences in amount of language use, both in typical and clinical groups. This should be further investigated in a broader sample with families of different socio-economic status level, including to explore the more qualitative aspects of interaction patterns between young children and female respectively male caregivers.

The results from the current research illustrated that Norwegian female caregivers talked more to the children than male caregivers, regardless of the children’s hearing status. Children with hearing impairment were exposed to a higher amount of words than children with normal hearing. This result is encouraging because children with hearing impairment require a higher amount of language stimuli because of their reduced hearing level.

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5 Article manuscript

“Female caregivers talk more to 18-56-months-old children with and without hearing impairment than male caregivers measured with LENATM – a cross-sectional study”

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Female caregivers talk more to 18-56-months-old children with and without hearing impairment than male caregivers measured with LENA^{TM} – a cross-sectional study

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Abstract:

The objective was to investigate caregiver gender differences in word count use per day (number of adult words), in a sample consisting of Norwegian children (N=17) with hearing impairment (HI) (n=8) and normal hearing (NH) (n=9), aged 18-56 months. The current study had a cross-sectional, descriptive study design. One all-day recording with the LENA technology was conducted to measure adult words in the home environment (Md length: 12.46 hours, 9.13-16 hours). Female caregivers used a significantly higher amount of words than male caregivers close to the children, regardless of their hearing status, HI: *p*=.01, NH: *p*=.01. All children in the present study were exposed to a higher number of words from female caregivers. However, there is a need to conduct more and further research and investigate not only the quantity of word use but also the possible differences and/or similarities in the qualitative interaction patterns between caregivers of different sexes and young children.

Keywords: Gender differences, caregivers, hearing impairment, children, home environment, number of words

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1 Introduction

Children benefit from rich and varied linguistic stimuli from caregivers in their every-day life experience when learning spoken language. Vocabulary knowledge varies from person to person and is dependent on age [1], non-verbal cognitive abilities [2,3], and socio-economic status level [4,5,6]. The vocabulary knowledge also applies to gender, and it is no surprise that men and women may partly have different ways to communicate with each other, with children and other adults [7]. So far it has been difficult to examine the quantity use of spoken language from caregivers with all-day recordings and in real life situations, and without the presence of researchers or clinicians.

However, a new technology system; Language Environmental Analysis (LENA)- has been introduced [8]. The LENA system consists of a Digital Language Processor (DLP) and software that may be used to record and examine young children's listening environment and verbal communication with all-day recordings, including screening for possible caregiver gender differences with regards to their amount of talking [9]. After the transmission of audio files from the DLP to the software, and the analysis has been made of the recorded material, the data files may be extracted and analyzed further by Advanced Data Extractor (ADEX) [10]. In ADEX, it is possible to examine the Interpreted Time Segments- files (ITS-files), and for instance separate word use of female and male caregivers during the recording day. By using the LENA technology system including ADEX to map female and male caregivers word count, we can get a better picture of the child´s actual language exposure in the home, and gain new knowledge about the child´s language exposure, and how it is related to the gender of caregivers.

1.1 Caregiver Gender Differences

There is evidence that female caregivers use more words than male caregivers when they are near children with normal hearing (NH) [11,12]. In the Swedish study by Nilsson, [13], similar results were shown for 28 children with hearing impairment (HI) and 12 controls with normal hearing. Female caregivers used significantly more words than male caregivers in three groups; children with normal hearing (n=12), children with cochlear implants (CI) (n=17) and children with hearing aids (HA) (n=11) [13]. Around 71 % of all detected adult words in the sample (N=40) were spoken by female caregivers and 29 % by male caregivers (CI= 72 % female, 28% male), (HA= 70 % female, 30 % male), (NH= 71 % female, 29 % male) [13].

In today's society, it is common with shared parenting, and fathers are expected to take more responsibility for the care of their child during early childhood, which potentially also includes the responsibility for early language stimulation. Several studies have examined the interaction between female caregivers (primarily mothers) and children [14,15,16,17], but fewer studies have specifically investigated the interaction patterns between children and male caregivers [18]. For instance, the quantitative exploration of similarities and differences between male and female caregivers in how much they interact with their child verbally, as well as the qualitative interaction patterns between female and male caregivers and young children. On this basis, the current study had a specific focus on quantitative interaction between both female and male caregivers and children.

Existing literature has mainly focused more on maternal sensitivity and the importance of higher educational level of mothers as the primary association with variation in child development outcome [4,19]. There has been less focus on the importance of paternal sensitivity in interactions between adult male caregivers and children, aside from the effect of the number of male words spoken close to the child. Traditionally the concept of parental sensitivity has primarily been designated to concern maternal sensitivity rather than paternal [20]. Parents are usually the most important caregivers. In real life, many young children might only live with one parent or have four primary caregivers (divorced parents with new partners) and sometimes other caregivers like grand-parents or neighbors are equally involved in the child's everyday life. Therefore, instead of using either maternal or paternal sensitivity, this study will operate with the term caregiver sensitivity and caregiver language use.

Few studies have explored the effects of caregiver sensitivity in children with hearing impairment. Quittner and colleagues [16] examined the effect of maternal sensitivity on early interaction patterns (linguistic stimulation) and later language and cognitive outcome in 188 deaf children with CI. The results indicated that age at implantation was an important factor but also that especially maternal sensitivity was equally important, together with positive effects from cognitive stimulation during the first year with CI. Higher level of maternal sensitivity was the factor that predicted increased linguistic growth the most. Linguistic stimulation from mothers was strongly related to language growth, but only in the context of higher levels of maternal sensitivity [16].

In a study by Ambrose and colleagues [21] one aim was to examine the quality and quantity of utterances from caregivers of 156 children with mild to severe HI in comparison to 59 age-matched controls with NH. A five-minute semi-structured interaction situation between parents and children was conducted and videotaped when the children were 18 months and 3 years respectively. At the 18-month test occasion, the parents also filled out a standardized survey, and at the 3-year follow-up, a standardized language test was performed. The results from the first test occasion (18 months of age) showed that children with HI were exposed to more directives (example: an instruction or demand) during the interactions than children with NH. At the second occasion at 3 years of age, there were significant differences between the two groups (HI vs. NH) concerning the number of words uttered by parents, and children with HI were also exposed to poorer quality of language stimulation [21].

VanDam, Ambrose & Moeller [22] investigated whether the amount of spoken language stimulation was similar in children with HI in comparison to children with normal hearing [22]. Children with NH (n=8) and children with HI (n=22) were exposed to similar amount of adult words in the home environment (from all-day recordings). VanDam with colleagues [22] suggested that this could be explained by the notion that parents of children with hearing impairment may be sensitive to the child's level of audible access due to the hearing impairment, which also influences their own language use to be similar to that for the NH cohorts. However, similar amount of exposure may not necessarily correlate with similar amount of access to adult words, especially for children with hearing impairment [22].

Hurtado, Marchman & Fernald [23] investigated the interaction in 27 mother-child dyads, and their results indicated that mothers of Spanish-speaking children who used more utterances had a more diverse use of words, word tokens, and types, than mothers who used fewer utterances. The study's results also indicated that maternal talk was uncorrelated with hearing impairment. The number of utterances from mothers correlated significantly with children's vocabulary at 24 months, but not at 18 months [23]. Children of mothers who used more utterances had a larger increase in their vocabulary from 18 to 24 months, which is consistent with other studies on English-speaking mothers and infants [24,23]. Other findings from the study by Hurtado et al. [23] showed that the quantity and quality of adult speech predicted the children's efficiency in receptive language development. The study provides evidence that caregiver`s stimuli influenced both on vocabulary knowledge and lexical processing skills, and that this later forms the foundation for continued lexical and grammatical growth [23].

Today it is a higher degree of shared parenting in Norwegian society. After a child is born parents are entitled to 12 months of paid parental leave, and 15 weeks is only dedicated to one of the parents, while the remaining weeks could be decided within the family [25]. Around 37 % of Norwegian fathers take out more parental leave than they have to, but still one out of four fathers do not use their right to take parental leave. This means that

Norwegian mothers stay at home more often in the first year of the child’s life. Thereafter, around 91 % of the children start at childcare centers. This indicates that female caregivers in general work fewer hours per week than men [25]. These statistical facts indicate that the traditional “mother, father and child-model” is still the dominating family model. However, the variation of family constellations is broader, with sometimes four primary caregivers or only one caregiver.

It is still unclear how the common diversity of shared parenting responsibility in many families’ actually affect the child’s language stimulation as provided in the home environment, and thus its language development. Diverse family constellations are rarely acknowledged in research or in clinical practice such as in family-centered intervention. This situation could potentially influence negatively on the reliability of research findings concerning language stimulation in the home environment, as well as potentially affect some children’s opportunities to learn language, as it is important to have engaged and well-informed caregivers as part of daily life experiences [26]. It is for instance not yet known whether the Swedish finding by Nilsson [13] indicating that female caregivers speak significantly more than male caregivers is also valid in a different linguistic context that promotes shared parenting although socio- culturally similar and with similar gender-based norms.

1.2 Aims of this study

The objective of the current study was to explore any possible caregiver gender differences in Norwegian families. More specifically to investigate the number of words produced by female caregivers in comparison to male caregivers, who communicate with or who speak close to younger children, in a sample of children with and without hearing impairment aged 18 to 56 months and their families.

The specific aims of the study were to examine the number of words provided by female and male caregivers to children aged 18 to 56 months with and without hearing impairment in the home environment.

The research study was approved by the Regional Committees for Medical and Health Research Ethics (REK) in Oslo, Norway.

All parties participating in the study signed forms of consents prior to the LENA- recordings.

1.3 Research question

Do female caregivers use more words in the home environment when in close proximity children aged 18- 56 months, regardless if the children have a hearing impairment or normal hearing, compared to male caregivers? It was hypothesized that female caregivers use more words close to children aged 18 to 56 months in the home environment, regardless of the child's hearing status [12,13].

2 Method

2.1 Study design

The study is descriptive, cross- sectional, with a convenience sampling method. The analyses in this article are based on the means of word counts (number of words) from female and male caregivers in the hours of the recording day where both sexes were present.

2.2 Participants

Children aged 18 - 56 months (mean= 32.25) and their families were invited to participate in the study if they met the inclusion criteria; aged between 18-71 months, either had a hearing impairment of any type and degree or were normal hearing and had at least one parent who spoke fluent Norwegian at home. The exclusion criteria were: clinical or additional diagnoses like Developmental Language Disorder or Autism-Spectrum Disorder or having two parents who spoke another language than Norwegian. The sample in this study consisted of 17 individuals from two groups; children with hearing impairment (n=8) and children with normal hearing (n=9). Participants were recruited through different arenas; advertisements on Facebook (groups for caregivers of children with and without HI), educational audiologists, public childcare centers and through municipal and public services. Caregivers who expressed interest first received written information about the study. They could then contact the test administrators to sign forms of consent and were thus enrolled in the study.

Eight children in the test group (HI) and nine children in the control group (NH) participated in the study (Table 1.). In the test group (HI) sex was evenly distributed with four girls and four boys. The control group (NH) was not evenly distributed with eight boys and one girl. The mean of word counts for female and male caregivers were examined to find out if there were any group differences (HI vs. NH), with and without the results of the girl's caregivers. The female caregiver word count for the girl differentiated .12 % SD from the group mean. The male caregiver word count for the girl differentiated .01% SD from the group mean. The means for both female and male caregiver word count per hour was not different from each other and the girl was therefore included in the study.

Table 1

Background characteristics of the participants (N=17).

		Group 1 (HI) (n=8)	Group 2 (NH) (n=9)	Total (HI, NH) (N=17)
Sample descriptivies		M (SD)/ % Range	M (SD)/ % Range	M (SD)/ % Range
	Age	36.61 (12.60) 38	28.38 (9.39) 23.02	32.25 (11.47) 38
	Boys	50 % (n=4)	88.89 % (n=8)	70.59 % (n=12)
	Girls	50 % (n=4)	11.11 % (n=1)	29.41 % (n=5)
Educational level mother				
	Primary School			
	High School	12.5% (n=1)	22.2 % (n=2)	17.6 % (n=3)
	Higher Education	87.5 % (n=7)	77.8 % (n=7)	82.4 % (n=14)
Educational level father				
	Primary School		11.1 % (n=1)	5.9 % (n=1)
	High School	37.5 % (n=3)	44.4 % (n=4)	41.2 % (n=7)
	Higher Education	62.5 % (n=5)	44.4 % (n=4)	52.9 % (n=9)
Word Count Caregiver				
	Male	723.10 (97.1) 293.14	400.49 (101.18) 315.07	552.31 (191.81) 675.15
	Female	925.34 (204.82) 429.39	746.68 (299.57) 935.73	830.76 (267.72) 935.73

In the study female and male caregivers of 17 children participated. All families consisted of the traditional father-mother-child model. In Table 1. some background characteristics of the participants are described. The educational level was high in the sample and not statistically significant different between groups for females x2 (1) = .28, p= .60 or between males x2 (2) = 1.20, p= .55. There was a somewhat wider spread regarding the educational level among male caregivers. However, because the educational level was similar between the groups, no conclusion could be drawn about whether socio-economical factor could explain outcome differences.

Table 2

Follow-up procedure and early intervention in children with HI (n=8).

Age at hearing diagnose	Age at hearing aid fitting	Degree of hearing impairment	Follow- up procedure after HI identification	Type of hearing aid technology	Has been offered family-centered intervention
2 months	5 months	Mild	Hospital and Educational audiologist in the childcare center	Unilateral BAHA	No
6 months	9 months	Moderate	Educator in the childcare center	Bilateral HA	No
18 months	18 months	Severe	Special needs educator	Bilateral HA	No
5 weeks	6 months	Profound	Educational audiologist, National service for special needs education	Bilateral CI	No
5 weeks	3 months	Moderate	Audiology center	Bilateral HA	No
26 months	31 months	Profound	Educational and psychological counseling service	Unilateral BAHA	No
*	No use of HA	Moderate-severe	Educational and psychological counseling service	No use of HA	No

3 months	12 months	Moderate	Educational and psychological counseling service, National service for special needs education	Unilateral BAHA	No

Note: Self-reported follow- up procedure for the participating children (HI, n=8). *Unknown ages at hearing diagnoses.

2.3 LENA – a technical system to measure audio-and language environment

The method used in this study was Language Environment Analysis (LENA). LENA is an instrument that aims to map and analyze the audio and language environment in for instance the homes of young children. LENA measures the quantity of a variety of variables based on features such as pitch, volume, and intonation. Among the measured variables are; (1) the (key) child's utterances, (2) adult words, (3) verbal conversational turns between the child and caregivers, (4) TV and electronic sound, (5) and the overall audio environment in the child's home [27,28,29]. The accuracy of the LENA system was tested in the LENA Natural Language study, using 70 one- hour test files from 70 families. The measure of adult word count showed a mean per- hour error rate of two percent compared to human transcribers. These data indicate that LENA is a reliable measure of adult word count [29].

Table 3

Recording length and audio environment result from the LENA recording (N=17).

	N	Range	Min	Max	Mean	Std. Deviation
Recording (hours)	17	6.87	9.13	16	12.35	1.63
Electronic Audio	17	17	1	18	6.47	5.27
Noise	17	10	2	12	5.41	2.40
Silence	17	35	25	60	38.94	10.03
Distant	17	19	15	34	22.29	5.76
Meaningful	17	24	15	39	26.88	6.06

Notes. Electronic Audio, Noise, Silence, Distant and Meaningful are presented as mean percentage (%) of the recording time.

When the software has identified and labeled the segments, they are then compared to a human-made training model. Each of the segments is compared to a silence in a likelihood ratio test, and the segments marked closer to silence is labeled unclear and they are cut from the analysis. Segments labeled as key child are categorized as different categories [9,30].

The LENA equipment consists of a Digital Language Processor (DLP) and a gender-neutral vest with a pocket in the front that secures the DLP [29]. The child wears the vest in the home throughout a whole day of recording (10-16 hours), and if the child sleeps during the day, the DLP is recommended to lie next to the child. After the recording day, the parents return the equipment, and the LENA software (LENA Pro, ADEX) analyze the raw data from transferred DLPs. The quantitative data from the recording can be visually shown in user-friendly bar charts and graphs in the LENA software (LENA Pro), illustrating daily-, hourly-, or with five- minutes intervals outcome. The Interpreted Time Segments files can be used to investigate the audio file further through another program: ADEX [10]. The ITS- files consist of segmented information of the audio file and identify the speakers and characteristics in the audio segment. The ITS- files present an opportunity to identify the number of words from each of the individuals represented during the day; Adult Male, Adult Female, Key Child and Other Children [28].

In the present study, the raw data from the DLPs were analyzed using both the LENA software and the Interpreted Time Segments. The analysis of the ITS- files made it possible to differentiate between Norwegian male and female caregivers’ word-count, and to get the estimated amount of words from each gender (caregiver) [28]. Parents of participating children filled out an “activity journal” during the day of the recording, where they among other things also stated who was present each hour of the recording day. Word count for male and female caregivers was extracted from the ITS files, and only the data containing the hours where both male and female caregivers were present, were included in the analysis of the study.

2.4 Validation

The LENA natural language study [31,32] (Gilkerson & Richards, 2008; s & Warren, 2017) aimed to validate the reliability of the automated software in American English. The LENA system correctly identified 82 % and 76 % of the segments coded as adult speech and child vocalizations respectively, which indicated reasonable levels of agreement [33,34,35,36]. LENA has also been validated in other languages such as Spanish [37], French [38], Mandarin [39], Korean [40] and Vietnamese [29]. LENA has not been validated in the Norwegian language yet, but this study contributes with a small sample of recorded material that has been compared to written transcripts, for validity and reliability reasons.

From the total of 17 recordings (210 hours), six recordings of children with NH were randomly drawn to validate the reliability of the measures from the LENA recording. From these six recordings, six ten- minute intervals were transcribed manually by a qualified research assistant (in total 60 minutes/ one hour). The validation showed that LENA measured adult words with 78 % accuracy and child vocalizations with 51 % accuracy. The reliability of adult words showed a percentage that was within reasonable levels of agreement. For child vocalizations, the percentage was too low to indicate reasonable agreement. One reason for this could be that LENA in some individual cases, measured a lower accuracy on child vocalizations than others, and therefore the variation contributed to a low percentage. This could be explained by the audio environment the child was in at the particular recording time (noise, talk from other adults and children, etc.). At some occasions, the software can mislabel a speaker, for instance when a woman raises her vocal pitch and may be labeled as a child [9]. Another example is when two speakers speak at the same time (overlapping speech), then the software might discard both utterances, and in this sample, this may explain some individual variation among cases [34,36].

2.5 Statistical analyses

The statistical analyses used to compare the means of caregiver word count in this study was an independent t-test and a paired t-test. The independent t- test was used to investigate the differences in means of word counts between female and male caregivers across the groups (HI vs. NH). The paired samples t- test was used to examine the means of wordcounts between female and male caregivers in total.

2.6 Covariates

The caregivers´ (socioeconomic) educational level is coded as primary school (0), high school (1), higher education (2). Sex is coded as boy/ male (0) and girl/ female (1). The participants and their hearing status are coded as NH (0) and HI (1). Siblings are coded as no siblings (0) and yes, siblings (1).

3 Results

The aim of this study was to investigate the differences in the number of words between male and female caregivers in the home environment of children with hearing impairment and children with normal hearing, aged 18-56 months. The current study`s hypotheses were supported by the results. The results clearly showed a significant difference in the use of number of words between children and female or male caregivers.

3.1 Descriptive results for caregiver word count in Norwegian children aged 18-56 months

The results from the study showed that female caregivers used a higher number of words in total than male caregivers, in both groups (HI, NH). There was one case (T2; NH) in which the male caregiver produced a higher number of words compared to the female caregiver. The difference in number of words between caregivers of different genders in this case was 181.14 words. The quantitative group mean data show that both female and male caregivers use a higher number of words in the test group (HI) (female= 925.34, SD=204.82 male= 723.10, SD= 97.10) compared to the control group (NH) (female= 746.68, SD= 299.57 male= 400.49, SD= 101.18) as shown in Figure 2. This tells us that children with hearing impairment in total are exposed to a higher number of adult words than children with normal hearing (on a quantitative level).

3.2 Inferential statistics for female and male caregiver wordcount

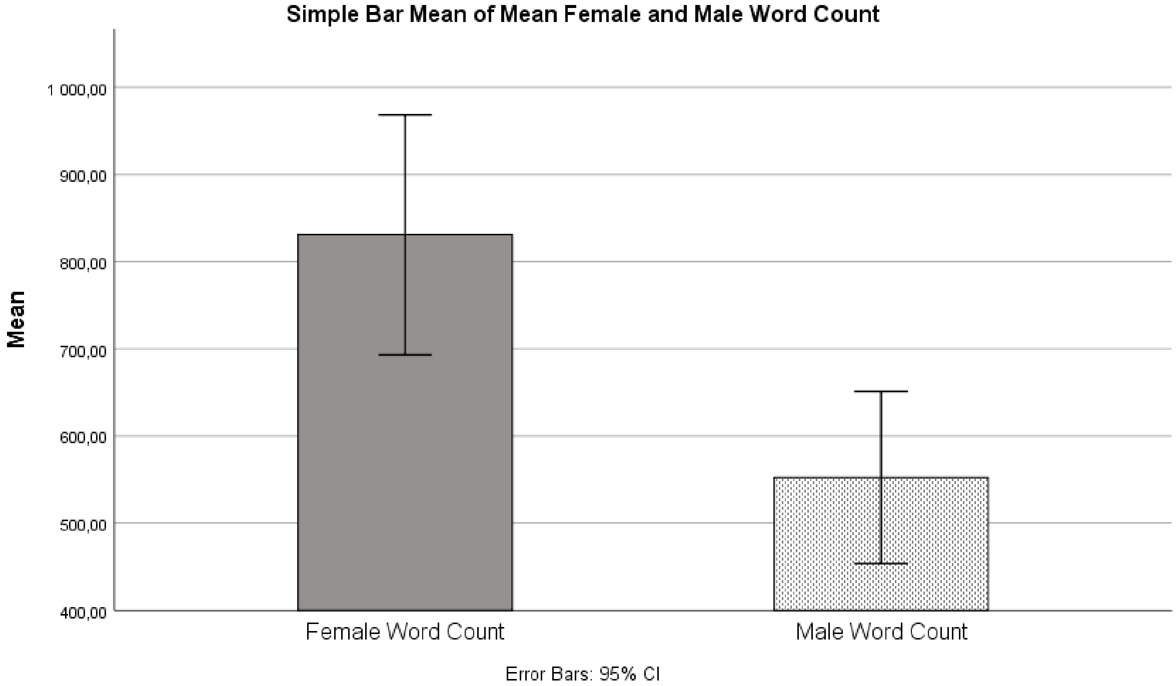

Figure 1. Mean of female and male caregiver word use per hour, with confidence interval (95%).

The bar plot in Figure 1. Shows the mean of words (total) for female (830.76, SD= 267.72) and male (552.31, SD= 191.81) caregivers with a Confidence Interval (CIs) set to 95 %. The means for female caregivers and for male caregivers' word count (total) are different from each other. The CIs 95 % does not overlap between female and male caregivers, and the means are therefore significantly different from each other.

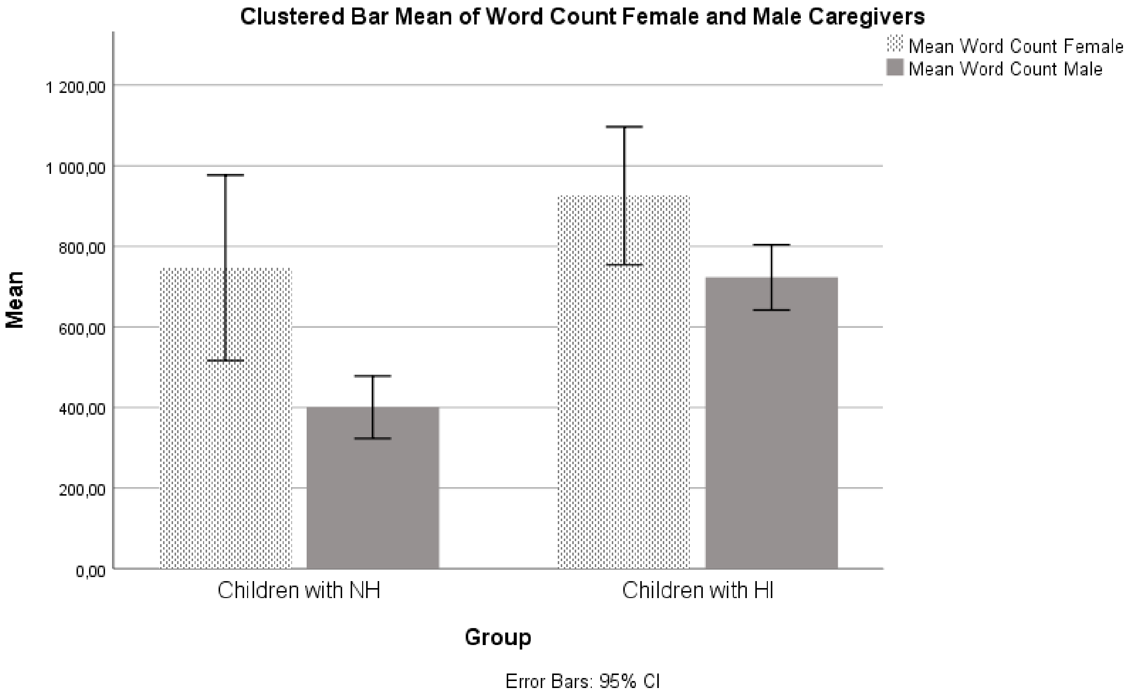

Figure 2. Mean of adult words in both groups (caregivers) per hour, split by gender with Confidence Intervals (95%).

Figure 2. presents the data with means from male and female caregivers word count during the recording hours where both sexes (caregivers) were present. Figure 2. Display the means for male caregivers (NH=400.49, HI=723.10) and female caregivers (NH=746.68, HI=925.34) split by group (HI, NH). The CIs 95 % did not overlap in the NH group (male, female), which tells us that the means do not come from the same populations and are therefore significantly different from each other. The means of word counts for male and female caregivers in the NH group are significantly different, with a higher amount of female words. The word count for female caregivers in the HI group was also higher than for male caregivers. The CIs (95 %) do not overlap between males in both groups (NH, HI), and displays that the true mean for male word count is not from the same population and is therefore significantly different. These results present that male caregivers in the HI group use a significantly higher amount of words than male caregivers in the NH group.

3.2.1 Was there a difference between the means of word counts for female and male caregivers across groups (HI vs. NH)?

To compare the means of the same variable (word count) between the two groups (HI, NH) and between caregivers (female, male), a two- tailed independent samples test was performed. Results from the test showed that the means for female caregivers between groups (HI, NH) were not significantly different (t (15) = -1.42, p=.18). This tells us that the average level for female word count in both groups was not significantly different from each other. The independent samples test presented results illustrating that the means for male caregivers' word count between groups (HI, NH) were significantly different (t (15) = -6.69, p=.001). These results indicate that the means for male caregivers' word count are different from each other.

3.2.2 Was there a difference between the means of word counts for female and male caregivers?

The paired samples test compares the means between female and male caregivers word counts in both groups (HI, NH). The results from the test showed that the means for female and male caregivers word count were significantly different in both groups, HI; (t (7) = 3.25, p=.01), NH; (t (8) = 3.24, p=.01). This tells us that the means from female and male caregivers are significantly different from each other in both groups.

4 Discussion

The purpose of this study was to investigate if there was a difference in the quantity of female and male caregivers word count in the home environment of children aged 18-56 months, regardless of the child's hearing status. The results from the recordings done with the LENA system showed that female caregivers used a higher number of words than male caregivers in both groups (HI, NH) and in the whole sample. The findings from the present study support previous studies which have investigated caregiver gender differences and the importance of amount of quantitative language stimuli to children with and without hearing impairment [23,12,13,22,21,16,37].

Several studies have previously underlined the importance of language stimuli from infants and young children's primary caregivers [27,37] and the relevancy of caregiver gender differences [12,13].

The findings of the current study are supported by the previous studies conducted by Johnson and colleagues [12] and Nilsson [13]. Johnson et al. [12] hypothesized that female caregivers had a higher number of words and support the hypothesis of the current research. Similarly to Johnson and colleagues [12] and Nilsson [13] the current study found that female caregivers produced a significantly higher number of words than male caregivers. Nilsson [13] also found that both children with hearing impairment and who used CI and/or HA were exposed to more words during the day than children with normal hearing [13]. Results from the present study showed that children with hearing impairment also were exposed to a higher number of words, compared to children with normal hearing.

Johnson and colleagues [12] investigated 33 late preterm and term infants with the LENA system, analyzing adult word count, infant vocalization and conversational turns. Findings from this study concluded that the infants in the study were exposed to more words from female caregivers than male caregivers from birth to seven months. The female caregivers responded more frequently to the infant’s vocalizations, and the infants also responded preferentially to the female caregivers’ speech during all three recording periods. When the infant grew older, the response to both caregivers increased [12]. Independent from the female caregivers, these infants had relatively few vocal interactions with the male caregiver, and the female caregiver was the primary responders to the infant’s verbal cues [12]. There was a significantly higher adult word count for female caregivers during all recordings, and although there was some variation, infants received nearly three times more language stimuli from the female caregivers than male caregivers [12]. These findings concur with the findings of the current study.

Gilkerson & Richards [27] have studied the effect of parent talk, and how talkative parents often have talkative children. Through the study by LENA foundation, caregivers of young children were asked to rate the amount of talk they conducted with their children. 99 % of the caregivers thought they were about or over the average when in reality 40 % of these caregivers actually were below the 50th percentile for adult word count [27]. This again supports the relevance and importance of caregivers` talk to young children. Gilkerson & Richards [27] also examined the effect of caregivers talk and how this predicted later language development. The findings implied that the more caregivers talk with their children in the first six months of life, the better the children’s language ability scores were later in life [27,37].

Matsuda et al. [41] examined among other things infant- directed speech (IDS) and which parts of the adult human brain that is active when IDS is processed. Through functional magnetic resonance imaging, findings indicated that female caregivers (primarily mothers) have increased brain cortical activation in specific language areas when they are listening to IDS, indicating that female caregivers have an intention to communicate with infants, and the difference in neural processing is dependent on experience [41]. This tells us that female caregivers and primarily mothers, may have a predisposition to IDS, but also that more exposure and experience of IDS might change male caregivers' predisposition in similar ways.

Zhang et al. [42] conducted an intervention study, investigating 22 caregiver- child interactions using the LENA system with the aim of examining caregivers word count and conversational turns. The researchers predicted that with feedback and intervention, caregivers would increase their adult word count and the conversational turns with the children. Caregivers in this study increased their word count with 24 % (approximately 5.000 words) through the first post- feedback recording. After this, the word count increased modestly, and then later declined over four to six months, back to baseline [42]. These results support why feedback to caregivers are of importance.

Suskind with colleagues [43] found that adult word count increased significantly (31.6 % increase) post- intervention, after six intervention sessions. These two study results illustrate the value of feedback to caregivers on their adult word count. A rich and early language environment will require more than a quantitative measure as given here with the LENA system. However, this quantitative measure and feedback gives an opportunity for caregivers to increase their adult word count and hopefully provide and affect young children with enriched language stimuli in the home environment, further leading to ideal cognitive and educational outcomes for children later in life [43].

The recommended 1-3-6 policy [44] was not achieved and demonstrated in the present study. The majority of the participants spontaneously reported that they were not pleased with their follow-up and the lack of early intervention actions after screening. The majority of the caregivers had higher education level, which previously has been proven to affect positively on the quality and engagement of parents in language stimulation [4]. Still, the retrospective frustration of participants in the current study, indicate that all caregivers benefit from individually based support and parent guidance, besides from early fitting of hearing technology. For families with lower socio-economic status level, the impact of family-centered intervention would have an important impact [43]. Use of LENA in clinical practice can give clinicians access to real life home environment of children with hearing impairment and their families. The results could be used in goal setting, and the individual goals can easily be evaluated with new recordings.

4.1 Follow- up procedure

Caregivers of participants in the study reported a wide spread of variation in follow-up procedure and intervention after HI identification (see Table 2.). Overall, the self-reported statistics showed insufficient and inadequate procedure concerning the follow- up after detected HI. None of the participants were offered early family- centred intervention, which is unexpected due to the widespread evidence- based research about why this is of importance. The follow-up statistics are startling considering the suggested best practice; joint committee of infant hearing screening program [44] which clearly states that newborn hearing screening should be done within one month postpartum, and if a child does not pass at the hearing screening, the hearing diagnose should be investigated immediately and be confirmed within three months after birth, the so-called 1-3-6 policy. Within six months postpartum an adequate intervention and hearing aid fitting should be introduced [44].

Three of eight participants reported that the Joint Committee guidelines concerning screening and diagnose had been followed. In one case the caregivers reported that the child was screened and not passed at birth but did not receive a hearing diagnose before 26 months. And only at an age of approximately 31 months was the child fitted with hearing aids for the first time.

In Norway there is a recommendation to follow the guidelines «National professional guidelines for newborn screening” (Nasjonal faglig retningslinje for screening av hørsel hos nyfødte) from “the Norwegian Directorate of Health» [45], and not a directive to follow the Joint Committee of Infant Hearing Screening, and adapt to the suggested 1-3-6 policy [44]. One thing to bear in mind is that this is only a recommendation and not a directive [45]. However, all parents that are offered newborn hearing screening at the hospital has an expectation about follow- up actions if their child does not pass. The majority of the participants in the present study reported that they were not pleased with their follow- up actions and have expressed that they were unsatisfied with the health care actions and information they got after screening.

4.2 Validity

The validity of the current study had some limitations concerning generalizability, sampling method, effect size, errors of measurement and the fact that there was only one recording per family. All these factors have been considered when conducting the research. When doing similar research in the future, there should be time to do more than one recording per family, which will strengthen the reliability of the measures. Considering the participants were young children, their condition of the recording- day is a contributing factor. Sampling method and size was a challenge but could have increased the generalizability of the study by collecting a bigger sample through random sampling [46]. The participants´ age was wide, and sex was not evenly distributed in the two groups (NH, HI). The caregivers´ socio-economic levels were narrow. All these factors were considered, but in some ways, they influenced the generalizability and the validity of the study.

4.3 Limitations and future perspective

The current study had limitations concerning the sample size, variation in the participating caregivers` educational level and limited validation material. However, the results indicate that LENA is a method that can be used also in a Norwegian context, and that LENA can contribute with new knowledge about caregiver gender differences in amount of language use, in typical and clinical groups. This should be further investigated in a broader group with families of different socio-economic status level, including to explore more qualitative aspects of interaction patterns in female and male caregivers.

5 Conclusion

The results showed that Norwegian female caregivers talked more to the children in the sample than male caregivers, regardless of the children’s hearing status. Children with hearing impairment were exposed to a higher amount of words than children with normal hearing. This result is encouraging because children with hearing impairment require a higher amount of language stimuli because of their reduced hearing level.

LIST OF ABBREVIATIONS

NH	Normal Hearing
HI	Hearing Impairment
LENA	Language Environment Analysis
DLP	Digital Language Processor
CI	Cochlear Implant
HA	Hearing Aids
CIs	Confidence Intervals
SD	Standard Deviation
SES	Socio-Economical status
ADEX	Advanced Data Extractor
ITS	Interpreted Time Segments

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6 Appendix

Appendix 1- Information letter for children with hearing impairment

Informasjon om deltakelse i forskningsprosjektet

“Ord gjør forskjell”

Dette er et informasjonsskriv om deltakelse i et forskningsprosjekt om barns hørsel- og talespråkmiljø, og dets påvirkning på tidlig språklig-, kommunikativ- og psykososial utvikling.

Bakgrunn og formål
Mange barn med nedsatt hørsel utvikler ikke et like rikt og omfattende ordforråd som barn med normal hørsel, til tross for at de oppfatter og forstår tale ved hjelp av hørselshjelpemiddel.

Vi ønsker derfor å undersøke om det er noe i barnets hørsel- og talespråkmiljø i tidlig alder, som påvirker ordforrådsutviklingen.

Prosjektet er et internasjonalt samarbeid mellom Universitetet i Oslo, Oslo Universitetssykehus, Karolinska Institutet, Sverige, Universitet i Split, Kroatia, Universitetet i Pisa, Italia og Ear Foundation i Nottingham, Storbritannia.
Hensikten med prosjektet er å sammenligne en gruppe barn i alderen 18-56 måneder (1,5- 5 år) som har nedsatt hørsel, uavhengig om de bruker høreapparat med en gruppe barn i samme alder som har normal hørsel.

Innad i gruppene vil vi se på sammenhengen mellom:

- Talespråkmiljø
- Ulike bakgrunnsfaktorer som for eksempel alder når barnet fikk høreapparat
- Barnets språklige nivå

- Kommunikative ferdigheter

Vi vil bruke en metode som heter Language Environment Analysis (LENA) (www.lenafoundation.org). Målingsmetoden innebærer at en måler hvor mange ord et barn får høre i løpet av en hel dag, hvor mange ytringer barnet selv gjør, skjermtid og turtakninger mellom barn og voksen. En får herved fram verdifull informasjon om barnets hørsels og lydmiljø og om kommunikasjonsmønsteret mellom barnet og omgivelsene.

Hvem kan delta i forskningsprosjektet?

Dette er kriteriene for deltakelse i forskningsprosjektet:

- Alder mellom 18-56 måneder ved prosjektstart
- Norsk talespråk som morsmål (Barnet og/ eller en av foreldrene har norsk talespråk som morsmål)
- Hørselstap (Uavhengig av grad, bilateralt, unilateralt, bruker høreapparat/BAHA/CI eller ikke bruker hørselstekniske hjelpemidler).
- Ingen andre kjente tilleggsdiagnoser

Hva innebærer deltakelse i studien?

Vi avtaler på forhånd et møte hjemme hos dere, eller på Universitetet i Oslo. Her kartlegges ditt /deres barns språklige utvikling, og i tillegg skal dere fylle ut noen spørreskjemaer som gir oss viktig bakgrunnsinformasjon om språk og andre faktorer som kan påvirke språkutvikling. Dere får låne en liten LENA- lydopptaker som skal registrere alle lyder i en periode på 12-16 timer i hjemmet. Lydopptakeren legges i en lomme på en vest som barnet skal bære. Når LENA- lydopptakeren leveres tilbake, er dere ferdig hos oss.

Hva skjer med informasjonen om deg?

LENAs avanserte dataprogram, registrerer:

1. Hvor mange ord personene rundt barnet ytrer
2. Hvor mange ord barnet ytrer
3. Antall turtakinger mellom barn og voksen
4. Skjermtid
5. Hvilket hørselsmiljø barnet oppholder seg i under innspillingsdagen

Hørselsmiljøet analyseres ved registrering av for eksempel hvor mange timer barnet hører elektronisk lyd fra TV eller radio eller om barnet oppholder seg i et miljø med tale eller støy. Det gjøres en stikkprøve på det 12-16 timers lange opptaket, hvor forskere tar ut 15 minutters opptak, og analyserer og skriver ned hva som blir sagt. Dette er for å kvalitetssikre at LENA-programmet har registrert korrekt antall ytringer. Utover dette vil ingen lydfiler bli avlyttet lyttet til, eller avspilles i sin helhet. Hvert opptak avkodes, og innspillingen på lydopptakeren slettes umiddelbart etter avkodingen.

Uvedkommende eller personer som ikke er ansatte i prosjektet, har ikke tilgang til det avkodede materialet. Det avkodede materialet anonymiseres og bevares atskilt fra samtykkeerklæring og andre eventuelle dokumenter hvor barnets identitet fremgår. Det avkodede materialet oppbevares i tråd med gjeldende regler for personvern ved Universitetet i Oslo, i låsbart brannsikkert skap ved Institutt for spesialpedagogikk, Universitet i Oslo. Samtykkeerklæringer oppbevares i atskilt låsbart brannsikkert skap ved Institutt for spesialpedagogikk, Universitet i Oslo. Alt materiale vil bli slettet og destruert den datoen som er avtalt med Regionale komiteer for medisinsk og helsefaglig forskningsetikk (REK).

Prosjektets resultater vil bli presentert i vitenskapelige artikler og eventuelt inngå i en eller flere masteroppgaver eller doktorgradsavhandlinger. Ved presentasjon av resultater, vil all informasjon som kan identifiseres som personopplysninger, anonymiseres.

Du/dere har rett til å søke om å få innsikt i/ ta del i informasjonen og få rettet eventuelle feilaktige personopplysninger. Ansvarlig for håndtering av personopplysningene er prosjektleder og førsteamanuensis Ulrika Löfkvist, ved Institutt for Spesialpedagogikk, Universitetet i Oslo.

Frivillig deltakelse

Deltakelsen er frivillig, og du kan når som helst trekke ditt samtykke uten å oppgi noen grunn.
Dersom du trekker deg, vil alle opplysninger om deg bli slettet.
Dersom du ønsker å delta eller har spørsmål til studien, ta kontakt med:

Nina Melsom Kristensen
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Universitetet i Oslo
Mail: ninamk@gmail.com
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Catharina Fallet Sundby
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Appendix 2- Information letter for children with normal hearing

Informasjon om deltakelse i forskningsprosjektet

“Ord gjør forskjell”

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Bakgrunn og formål

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Innad i gruppene vil vi se på sammenhengen mellom:

- Talespråkmiljø
- Ulike bakgrunnsfaktorer som for eksempel alder når barnet fikk høreapparat
- Barnets språklige nivå
- Kommunikative ferdigheter

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Hvem kan delta i forskningsprosjektet?

Dette er kriteriene for deltakelse i forskningsprosjektet:

- Alder mellom 18-56 måneder ved prosjektstart
- Norsk som morsmål (Barnet og/ eller en av foreldrene har norsk som morsmål)
- Normal hørsel
- Ingen andre kjente tilleggsdiagnoser

Hva innebærer deltakelse i studien?

Vi avtaler på forhånd et møte hjemme hos dere, eller på Universitetet i Oslo. Her kartlegges ditt /deres barns språklige utvikling, og i tillegg skal dere fylle ut noen spørreskjemaer som gir oss viktig bakgrunnsinformasjon om språk og andre faktorer som kan påvirke språkutvikling. Dere får låne en liten LENA- lydopptaker som skal registrere alle lyder i en periode på 12-16 timer i hjemmet. Lydopptakeren legges i en lomme på en vest som barnet skal bære. Når LENA- lydopptakeren leveres tilbake, er dere ferdig hos oss.

Hva skjer med informasjonen om deg?

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6. Hvor mange ord personene rundt barnet ytrer
7. Hvor mange ord barnet ytrer
8. Antall turtakinger mellom barn og voksen
9. Skjermtid
10. Hvilket hørselsmiljø barnet oppholder seg i under innspillingsdagen

Hørselsmiljøet analyseres ved registrering av for eksempel hvor mange timer barnet hører elektronisk lyd fra TV eller radio eller om barnet oppholder seg i et miljø med tale eller støy. Det gjøres en stikkprøve på det 12-16 timers lange opptaket, hvor forskere tar ut 15 minutters opptak, og analyserer og skriver ned hva som blir sagt. Dette er for å kvalitetssikre at LENA-programmet har registrert korrekt antall ytringer. Utover dette vil ingen lydfiler bli avlyttet

lyttet til, eller avspilles i sin helhet. Hvert opptak avkodes, og innspillingen på lydopptakeren slettes umiddelbart etter avkodingen.

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Du/dere har rett til å søke om å få innsikt i/ ta del i informasjonen og få rettet eventuelle feilaktige personopplysninger. Ansvarlig for håndtering av personopplysningene er prosjektleder og førsteamanuensis Ulrika Löfkvist, ved Institutt for Spesialpedagogikk, Universitetet i Oslo.

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Deltakelsen er frivillig, og du kan når som helst trekke ditt samtykke uten å oppgi noen grunn. Dersom du trekker deg, vil alle opplysninger om deg bli slettet.

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Telefon: +47 22 85 91 65

Appendix 3- Information letter regarding the LENA system and method

Informasjon om LENA- metoden (Language Environment Analysis)

Gjennom prosjektet ***"ord gjør forskjell"*** og bruk av **LENA-** metoden ønsker vi å analysere språk/ lydmiljøet hos barn 18- 48 måneder, samt undersøke betydningen av språkstimulering i tidlig alder (0- 3 år) og hvordan dette påvirker barnas fremtidige liv og læring. Spørsmålet vi stiller oss er:" hvordan *finner vi ut om barna får nok språkstimulering i ulike situasjoner gjennom dagen?".* Vi ønsker å måle dette gjennom å bruke **LENA** metoden i hjemmesituasjonen hos normalthørende barn, og sammenlikne med barn som bruker cochlea implantat (CI) og/ eller høreapparat.

LENA måler lydmiljøet gjennom en Digital Language Processor (DLP). DLPen ligger i en vest som barnet bærer gjennom en hel dag (12-16 timer) hjemme. Barnet bærer vesten hele dagen, og mens barnet sover ligger DLPen ved siden av. DLPen er enkel å bruke og har en på/ av- knapp og en innspillings- knapp (REC).

LENA- vest med en DLP

Stolpediagram over LENA- måling

LENA måler/ teller:

- Barnets egne ytringer
- antall dialogskifter
- Voksnes ytringer
- Skjerm/TV- tid

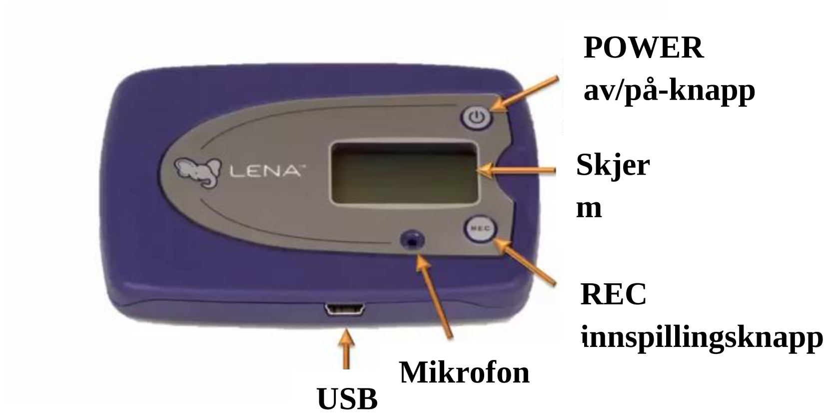
LENA teknologien måler barnets lydmiljø. Etter opptak blir dataene lagt inn i en programvare der de blir analysert og satt inn i et stolpediagram. Hver av stolpene representerer **LENA**s målinger. Gjennom disse målingene får vi frem verdifull informasjon om barnets lyd og hørselsmiljø og om kommunikasjonsmønsteret mellom barnet og omgivelsene.

Appendix 4- Digital Language Processor instructions

”Ord gjør en forskjell” - innspilling med LENA

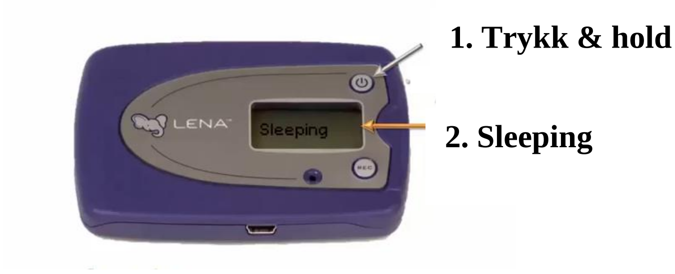
Ved innspilling: Pass på at spilleren er i gang **MINST 12-16 timer**, Dvs. under hele dagen! (Når barnet sover kan den ligge ved siden av).

Slik ser LENA-spilleren ut:



For å spille inn:

1. Sett i gang LENA gjennom å **trykke på POWER**, hold inne knappen et par sekunder.
2. Vent til det står **PAUSE** på skjermen



3. Trykk på **REC** i noen sekunder til det står **RECORDING** på skjermen. Innspillingen har nå begynt.

3. Trykk & hold

Recording

Klær

For å spille inn med LENA trengs et klesplagg som innspilleren kan være i. Vær nøye med å **sette i gang innspillingen før apparatet føres inn i klesplagget**.

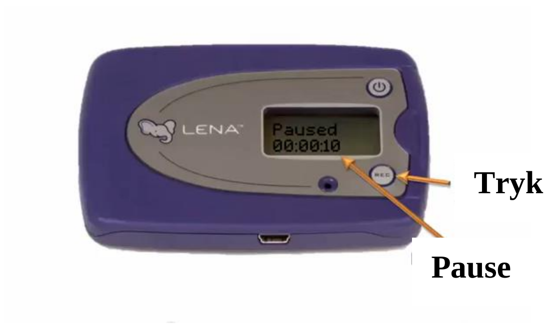
Apparatet skal alltid føres inn med **elefanten først** och **mikrofonen vendt utover**, fra barnet! Plagget tas på slik at innspilleren **plasseres på barnets bryst/mage**.

Elefanten skal inn i lommen først!

Mikrofon

Pause

Trykk på **REC** for å ta pause i innspillingen. Sett i gang innspillingen ved å trykke på **REC** igjen.



Trykk &

Pause

Avslutte innspillingen

Når dagen er slutt skal **12-16 timer** ha blitt spilt inn. Steng av spilleren ved å **trykke på POWER.** Hold inne knappen en stund.

Trykk & hold

Appendix 5- Activity journal

UiO : Universitetet i Oslo

” Ord gjør forskjell”- aktivitetsdagbok

Barnets navn: ____

Barnets fødselsdato:____

Dagens dato:____

Omsorgsperson 1: kjønn __________ Omsorgsperson 2 kjønn:______________

Klokke-slett	**Hvem har vært til stedet, sett ring rundt og skriv antall**	**Miljø** **Ute=U** **Inne=I**	**Aktivitet** **TV=T, Ipad=I, PC=P o.l**	**Øvrige aktiviteter** **F.eks lek, måltid, bondegårdsbesøk o.l**
6-7	Omsorgsperson: 1 2 Øvrige personer: Menn__kvinner__ barn__			
7-8	Omsorgsperson: 1 2 Øvrige personer:			

	Menn__kvinner__ barn__			
8-9	Omsorgsperson: 1 2 Øvrige personer: Menn__kvinner__ barn__			
9-10	Omsorgsperson: 1 2 Øvrige personer: Menn__kvinner__ barn__			
10-11	Omsorgsperson: 1 2 Øvrige personer: Menn__kvinner__ barn__			
11-12	Omsorgsperson: 1 2 Øvrige personer: Menn__kvinner__ barn__			
12-13	Omsorgsperson: 1 2 Øvrige personer: Menn__kvinner__ barn__			
13-14	Omsorgsperson: 1 2 Øvrige personer: Menn__kvinner__ barn__			

14-15	Omsorgsperson: 1 2 Øvrige personer: Menn__kvinner__ barn__			
15-16	Omsorgsperson: 1 2 Øvrige personer: Menn__kvinner__ barn__			
16-17	Omsorgsperson: 1 2 Øvrige personer: Menn__kvinner__ barn__			
17-18	Omsorgsperson: 1 2 Øvrige personer: Menn__kvinner__ barn__			
18-19	Omsorgsperson: 1 2 Øvrige personer: Menn__kvinner__ barn__			
19-20	Omsorgsperson: 1 2 Øvrige personer: Menn__kvinner__ barn__			
20-21	Omsorgsperson: 1 2			

	Øvrige personer: Menn__kvinner__ barn__			
21-22	Omsorgsperson: 1 2 Øvrige personer: Menn__kvinner__ barn__			

Appendix 6- Background information about caregivers

” *Ord gjør en forskjell”* – Foreldreskjema

Barnets navn: ____

Barnets fødselsdato: ____

Navn foresatt 1: ____

Navn foresatt 2: ____

Dato: ____

	Ja	**Nei**
Har barnet søsken?		
Om ja, oppgi alder og kjønn:		

	Foresatt 1	**Foresatt 2**
I hvilket land er du født?		

Hvis du ikke er født i Norge, hvor gammel var du når du kom hit?		

Hva er din høyeste fullførte utdanning?		
	Foresatt 1	**Foresatt 2**
Grunnskolen		
Videregående skole/fagbrev		
Uteksaminert fra høyskole/universitet, alternativt minst to års høyskoleutdanning		
Annen utdanning		

Hvilket språk snakker du hovedsakelig med ditt barn?		
	Foresatt 1	**Foresatt 2**
Alene med barnet		
Sammen med den andre foresatte		

Når ble hørselstapet oppdaget? (alder på barnet)				
Hvilken grad er hørselstapet?	Mildt	Moderat	Alvorlig	Svært alvorlig
Bruker barnet hørselstekniske hjelpemidler?	Ja		Nei	

Høreapparater		
Cochleaimplantat		

Hvor lenge har barnet brukt hørselshjelpemidler?	
Hvilken oppfølging har familien mottatt siden barnet fikk hørselstekniske hjelpemidler?	

Appendix 7- Consent form

Samtykke til deltakelse i forskningsprosjektet

Prosjekt: Ord gjør en forskjell – om barns hørsel- og talespråkmiljø, og dets påvirkning på tidlig språklig-, kommunikativ- og psykososial utvikling.

Jeg/vi har lest informasjonen om forskningsprosjektet og forstår at:

- Deltakelsen er frivillig
- Jeg/vi kan når som helst avbryte vår deltakelse uten ytterligere forklaring
- Ved behov kan jeg/vi kontakte ansvarlige for prosjektet for spørsmål.

Jeg/vi samtykker til å delta i forskningsprosjektet:

Sted og dato:

Foresattes signatur og navn i blokkbokstaver:

Sted og dato:

Foresattes signatur og navn i blokkbokstaver:

Appendix 8- Developmental Snapshot

Barnets navn/ID: ____ Barnets personnummer (11 siffer):______________________ Dato: ______________

Instruksjoner: - Ansatt i prosjektet gjennomgår spørreskjemaet sammen med foresatte i intervjuform - Sett strek under riktig svaralternativ: «Ja» eller «ikke enda» - Stopp etter fem påfølgende «Ikke enda-svar»	
1. Når du prater med barnet, forsøker han/hun å følge stemmen med blikket? *Eks. Snur barnet på hodet eller blikket for å lete etter/finne deg?*	Ja Ikke enda
2. Svarer barnet med stemmen når du smiler/ler til barnet eller tar kontakt med stemmen?	Ja Ikke enda
3. Er det forskjell i måten barnet uttrykker seg på basert på hva han/hun vil? *Eks. Endrer barnet uttrykksmåte når han/hun er trøtt eller sulten?*	Ja Ikke enda
4. Uttrykker barnet at det er fornøyd eller misfornøyd ved å bruke andre lyder enn gråt og latter? *Eks. Lyder som uttrykk for glede eller frustrasjon?*	Ja Ikke enda
5. Putter barnet leker eller andre gjenstander i munnen?	Ja Ikke enda
6. Ler barnet?	Ja Ikke enda
7. Eksperimenterer/leker barnet med stemmen og lager ulike lyder? *Eks. Produserer barnet lyse (høyfrekvente lyder), mørke/dype lyder, smatter/prompelyder*	Ja Ikke enda
8. Uttaler barnet to eller flere vokaler som for eksempel /a/ eller /å/?	Ja Ikke enda
9. Gjenkjenner barnet eget navn eller kallenavn? *Eks. Avbryter barnet aktiviteten og/eller ser på deg når du sier navnet?*	Ja Ikke enda
10. Benytter barnet stemmen (eller skriker) for å få din oppmerksomhet?	Ja Ikke enda
11. Kan barnet imitere lyder? *Eks. Kan barnet lage/forsøke og lage de samme lydene som deg?*	Ja Ikke enda
12. Kan barnet si gjentakende stavelser som «bababa» eller «dadada»?	Ja Ikke enda

13. Hvis du f.eks. sier «Ha det» eller «vil du komme opp», vil barnet vinke eller løfte armene mot deg?	Ja Ikke enda
14. Kan barnet kombinerer ulike språklyder i bablingen? *Det vil si at barnet varierer med både konsonanter og vokaler i bablingen som for eksempel «ba-da-ba», «a-ta-be», «a-me-ga».*	Ja Ikke enda
15. Formidler barnet ønsker med både stemme og kroppsspråk (peking/gester)? *Eks. peke på eller bevege seg mot ønsket mål samtidig som barnet bruker stemmen?*	Ja Ikke enda
16. Sier barnet andre ord enn «mamma» og «pappa»? *Forsøk på å si ordet regnes også som ord – eks. at barnet sier «ba» for ball eller «vovve» for hund.*	Ja Ikke enda
17. Forstår barnet hva du vil hvis du gir enkle instruksjoner? *Eks. Forstår barnet instruksjoner eller spørsmål som «gi meg skoene dine» eller «hvor er ballen?»?*	Ja Ikke enda
18. Kan barnet følge enkle instruksjoner? *Eks. Instruksjoner som «hent skoene dine»*	Ja Ikke enda
19. Kan barnet peke på riktig gjenstand hvis du for eksempel sier ”hvor er ballen?” eller ”har du sett lastebilen”? Forstår barnet lignende spørsmål?	Ja Ikke enda
20. Hører du på stemmen at barnet stiller spørsmål? *Det vil si at du hører på intonasjonen at det er et spørsmål fordi stemmeleiet går opp på slutten.*	Ja Ikke enda
21. Kan barnet peke på ulike kroppsdeler på seg selv? *Eksempelvis peke på nese, øyne, ører, hår.*	Ja Ikke enda
22. Kan barnet si minst ti forståelige ord? *Ordene trenger ikke være perfekte. Hvis barnet sier ”ba” for ”ball” hver gang regnes det som ett ord.*	Ja Ikke enda
23. Kan barnet peke på ting du benevner når dere leser en bok? *For eksempel at du ved lesing sier ”vis meg hvor katten er” – kan ditt barn da peke på korrekt bilde?*	Ja Ikke enda
24. Imiterer barnet ord som han/hun har hørt andre si?	Ja Ikke enda
25. Forstår barnet en todelt instruksjon? *For eksempel: ”Kan du hente skoene dine og sette dem på bordet?” eller ”Kan du hente jakken din og gi den til mormor?”*	Ja Ikke enda
26. Forstår barnet minst fire verb uten støtte av gester? *For eksempel: Forstår barnet ord som hoppe/kaste/sove osv. selv om du ikke gir noen visuelle ledetråder til ordets betydning?*	Ja Ikke enda
27. Forstår barnet spørsmål som hvem/hva/hvor?	Ja Ikke enda
28. Benevner barnet velkjente formål? *For eksempel: Forsøker å si ord som is/bleie/skje.*	Ja Ikke enda
29. Forsøker barnet å benevne bilder som du peker på i en bok? *Eks. Forsøker barnet å si «katt» hvis du peker på bildet av katten*	Ja Ikke enda
30. Forstår barnet preposisjoner som ”på”, ”i” og ”ut”?	Ja Ikke enda

31. Kan barnet sette sammen to ord til enkle fraser? *For eksempel: ”Vil ball” eller ”mamma sitte”*	Ja Ikke enda
32. Kan ditt barn minst 50 talte ord?	Ja Ikke enda
33. Forstår barnet begrepet en/ett? *For eksempel: Forstår barnet hva det skal gjøre hvis du peker på et antall klosser og sier ”Jeg vil ha EN kloss”?*	Ja Ikke enda
34. Kan ditt barn følge en tre-leddet oppfordring/instruksjon uten å bli distrahert? *For eksempel: ”Gå til rommet ditt, hent smokken og gi den til meg?”*	Ja Ikke enda
35. Bruker barnet ordene/personlige pronomen ”jeg”, ”meg” og ”du”?	Ja Ikke enda
36. Kan barnet noen farger? *For eksempel: Forstår barnet hva det betyr/klarer barnet å peke på riktig farge hvis du sier ”pek på den røde klossen”*	Ja Ikke enda
37. Har barnet begynt å bruke begreper for størrelser? *For eksempel: Sier barnet ord som ”stor” og ”liten”?*	Ja Ikke enda
38. Benytter barnet 4-ordsytringer?	Ja Ikke enda
39. Har barnet begynt å bruke flertallsendinger? *For eksempel: Sier barnet ”katter” for å markere at det er snakk om flere enn én katt?*	Ja Ikke enda
40. Kan barnet fortelle hva man gjør med ulike gjenstander? *For eksempel: Her er en tannbørste – hva gjør man med den?*	Ja Ikke enda
41. Kan barnet bøye verb? *For eksempel si hoppe/hopper/hoppet osv.*	Ja Ikke enda
42. Kan barnet si ordene ”en” og ”et”, det vil si anvende artikler? *For eksempel: Si ”en sang”, ”et eple” eller ”ballen”*	Ja Ikke enda
43. Benevner barnet de vanligste formene som sirkel, trekant, firkant og stjerne?	Ja Ikke enda
44. Forstår barnet begrep som ”minst”, ”mest” og/eller ”først”?	Ja Ikke enda
45. Forstår barnet begrep som ”lang”, ”kort”, ”høy” og/eller ”lav”?	Ja Ikke enda
46. Anvender barnet flertallspronomen som ”vi”, ”dem” og/eller ”oss”?	Ja Ikke enda
47. Anvender barnet verb i bøyd form? *For eksempel: ”hoppende”, ”har spilt”*	Ja Ikke enda
48. Kan barnet spontant si meninger som består av mer enn ti ord? *Eks. Fortelle sammenhengende med bruk av mer enn ti ord*	Ja Ikke enda
49. Kan barnet kategorisere formål? *For eksempel: Forstår barnet instruksjoner som ”si tre frukter” eller ”gi eksempel på tre ulike dyr”?*	Ja Ikke enda
50. Kan barnet gjenfortelle en historie eller hendelse med begynnelse, midt og en slutt?	Ja Ikke enda

For eksempel: Kan barnet fortelle en meningsbærende historie?	
51. Kan barnet beskrive formålet med to ord dersom du sier et substantiv? *For eksempel: ”Si to ord som beskriver en sykkel”.*	Ja Ikke enda
52. Spør barnet om ordets betydning for siden å benytte ordet i en meningssammenheng?	Ja Ikke enda

Appendix 9- Letter from Statped to caregivers of children with hearing impairment

Hei,

I forbindelse med en masteroppgave har vi fått en forespørsel fra to studenter til dere foreldre «angående rekruttering til et forskningsprosjekt som masteroppgaven inngår i».

Dette brevet er en utsending til alle i den aktuelle aldersgruppen, og at foresatte til barn som ikke innfrir kriteriene for studiet, kan se bort fra denne forespørselen.

Studentene heter: Catharina Fallet Sundby og Nina Melsom Kristensen, Masterstudenter i Audiopedagogikk ved Institutt for spesialpedagogikk, UiO.

Prosjekt heter "ord gjør forskjell" og ledes av Ulrika Löfkvist. Prosjektet går ut på å måle barns omgivelseslyder og språkmiljø i hjemmet ved bruk av en metode som heter Language Environment Analysis (LENA). Formålet med prosjektet er å undersøke om det er noe i barnets hørsel- og talespråklige miljø som påvirker ordforrådsutviklingen i tidlig alder.
Deltakelse i prosjektet er frivillig og selvfølgelig anonymisert.
Prosjektet er godkjent av regionale komiteer for medisinsk- og helsefaglig forskningsetikk (REK):

https://helseforskning.etikkom.no/prosjekterirek/prosjektregister/prosjekt?p_document_id=737608&p_parent_id=803161&_ikbLanguageCode=n

Studentene ønsker å få kontakt med foreldre til barn med nedsatt hørsel, uavhengig av grad, som bruker eller ikke bruker HA, CI eller BAHA. På vegne av studentene spør vi derfor om dere har mulighet til /ønsker å delta i dette prosjektet?

Frist for å melde sin interesse til studentene er mandag 4. februar 2019.

Vi legger ved informasjonsbrev om prosjektet og et skriv om LENA-metoden.

Ta kontakt med Eric Holm Andersen på e-post eric.holm.andersen@statped.no eller tlf nr. 911 22 591 hvis dere lurer på noe i forbindelse med denne forespørselen.

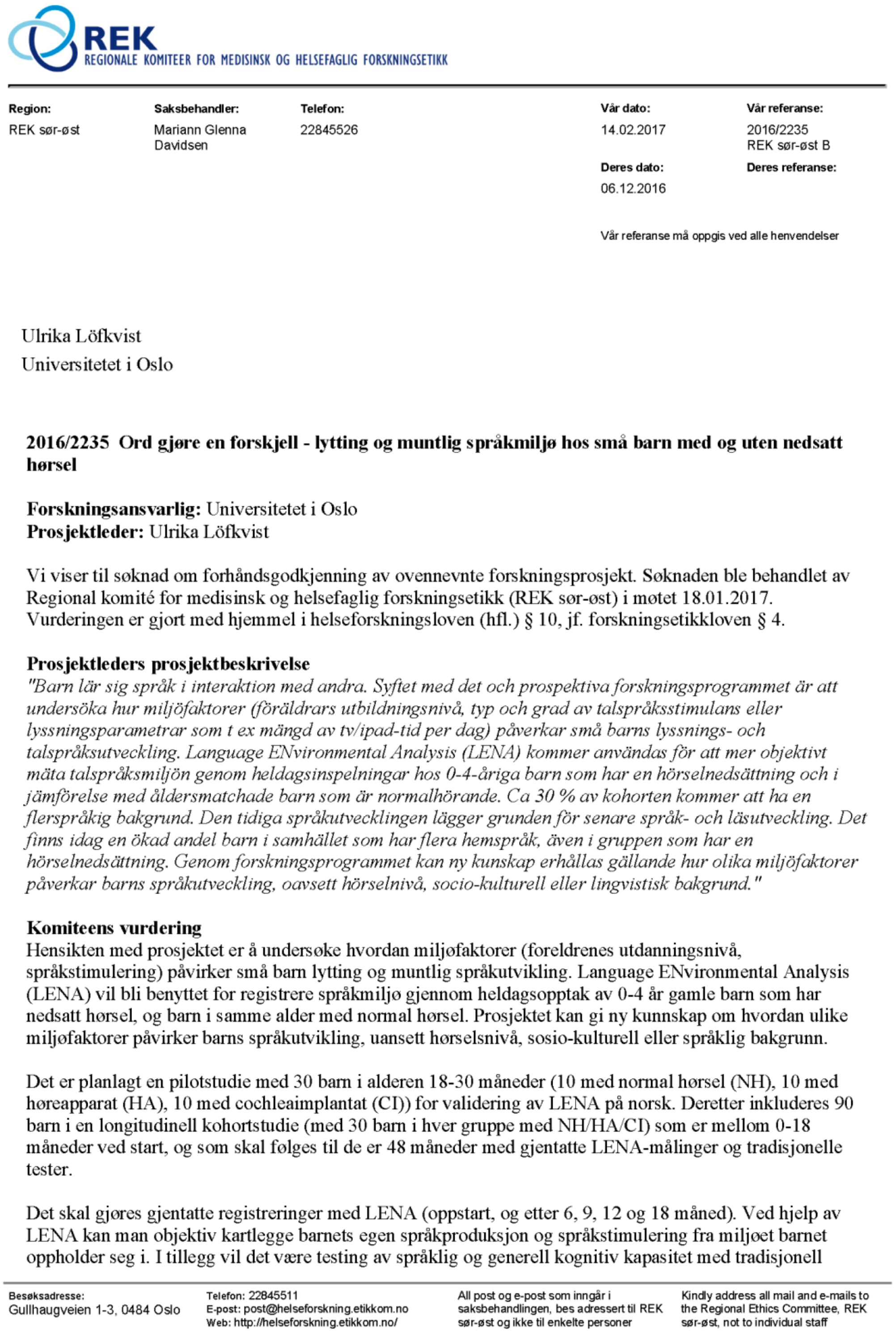
Hvis dere har spørsmål knyttet til prosjektet eller ønsker å delta i prosjektet, tar dere direkte kontakt med studentene.

Nina Melsom Kristensen
Masterstudent ved Institutt for spesialpedagogikk
Universitetet i Oslo
ninamk@gmail.com
Telefon: 906 96 872

Catharina Fallet Sundby
Masterstudent ved Institutt for spesialpedagogikk
Universitetet i Oslo
Mail: catharinafs93@gmail.com
Telefon: 955 58 447

Hilsen

Appendix 10- Application and approval from REK



REK
REGIONALE KOMITEER FOR MEDISINSK OG HELSEFAGLIG FORSKNINGSETIKK

Region:	Saksbehandler:	Telefon:	Vår dato:	Vår referanse:
REK sør-øst	Mariann Glenna Davidsen	22845526	14.02.2017	2016/2235 REK sør-øst B
			Deres dato:	Deres referanse:
			06.12.2016	

Vår referanse må oppgis ved alle henvendelser

Ulrika Löfkvist
Universitetet i Oslo

2016/2235 Ord gjøre en forskjell - lytting og muntlig språkmiljø hos små barn med og uten nedsatt hørsel

Forskningsansvarlig: Universitetet i Oslo
Prosjektleder: Ulrika Löfkvist

Vi viser til søknad om forhåndsgodkjenning av ovennevnte forskningsprosjekt. Søknaden ble behandlet av Regional komité for medisinsk og helsefaglig forskningsetikk (REK sør-øst) i møtet 18.01.2017. Vurderingen er gjort med hjemmel i helseforskningsloven (hfl.) § 10, jf. forskningsetikkloven § 4.

Prosjektleders prosjektbeskrivelse
"Barn lär sig språk i interaktion med andra. Syftet med det och prospektiva forskningsprogrammet är att undersöka hur miljöfaktorer (föräldrars utbildningsnivå, typ och grad av talspråksstimulans eller lyssningsparametrar som t ex mängd av tv/ipad-tid per dag) påverkar små barns lyssnings- och talspråksutveckling. Language ENvironmental Analysis (LENA) kommer användas för att mer objektivt mäta talspråksmiljön genom heldagsinspelningar hos 0-4-åriga barn som har en hörselnedsättning och i jämförelse med åldersmatchade barn som är normalhörande. Ca 30 % av kohorten kommer att ha en flerspråkig bakgrund. Den tidiga språkutvecklingen lägger grunden för senare språk- och läsutveckling. Det finns idag en ökad andel barn i samhället som har flera hemspråk, även i gruppen som har en hörselnedsättning. Genom forskningsprogrammet kan ny kunskap erhållas gällande hur olika miljöfaktorer påverkar barns språkutveckling, oavsett hörselnivå, socio-kulturell eller lingvistisk bakgrund."

Komiteens vurdering
Hensikten med prosjektet er å undersøke hvordan miljøfaktorer (foreldrenes utdanningsnivå, språkstimulering) påvirker små barn lytting og muntlig språkutvikling. Language ENvironmental Analysis (LENA) vil bli benyttet for registrere språkmiljø gjennom heldagsopptak av 0-4 år gamle barn som har nedsatt hørsel, og barn i samme alder med normal hørsel. Prosjektet kan gi ny kunnskap om hvordan ulike miljøfaktorer påvirker barns språkutvikling, uansett hørselsnivå, sosio-kulturell eller språklig bakgrunn.

Det er planlagt en pilotstudie med 30 barn i alderen 18-30 måneder (10 med normal hørsel (NH), 10 med høreapparat (HA), 10 med cochleaimplantat (CI)) for validering av LENA på norsk. Deretter inkluderes 90 barn i en longitudinell kohortstudie (med 30 barn i hver gruppe med NH/HA/CI) som er mellom 0-18 måneder ved start, og som skal følges til de er 48 måneder med gjentatte LENA-målinger og tradisjonelle tester.

Det skal gjøres gjentatte registreringer med LENA (oppstart, og etter 6, 9, 12 og 18 måned). Ved hjelp av LENA kan man objektiv kartlegge barnets egen språkproduksjon og språkstimulering fra miljøet barnet oppholder seg i. I tillegg vil det være testing av språklig og generell kognitiv kapasitet med tradisjonell metodikk på de samme tidsintervaller. Det er for øvrig ikke oppgitt antall ganger LENA vesten skal brukes.

Rekruttering/samtykke
Deltagerne skal rekrutteres via oppslag i barnehager, sykehus, helsestasjoner, Facebook og UiOs hjemmeside. Foreldre som ønsker å delta får info/samtykkeskriv tilsendt. Informasjons- og samtykkeskrivet må imidlertid renskrives, blant annet må det lukes ut setninger med blanding av svenske og norske ord.

Komiteen har ingen innvendinger til studien som sådan, men utifra det ovennevnte settes følgende vilkår for prosjektet:

1. Informasjon- og samtykkeskriv må renskrives, samt at det må legges til i informasjonsskrivet hvor hyppig LENA vesten skal brukes. Revidert skriv sendes komiteen for godkjenning.

Vedtak
Komiteen godkjenner prosjektet i henhold til helseforskningsloven § 9 og § 33 under forutsetning av at ovennevnte vilkår tas til følge. I tillegg til ovennevnte vilkår, er godkjenningen gitt under forutsetning av at prosjektet gjennomføres slik det er beskrevet i søknaden

Tillatelsen gjelder til 30.11.2022. Av dokumentasjonshensyn skal opplysningene likevel bevares inntil 30.11.2027. Opplysningene skal lagres avidentifisert, dvs. atskilt i en nøkkel- og en opplysningsfil. Opplysningene skal deretter slettes eller anonymiseres, senest innen et halvt år fra denne dato.

Forskningsprosjektets data skal oppbevares forsvarlig, se personopplysningsforskriften kapittel 2, og Helsedirektoratets veileder ”*Personvern og informasjonssikkerhet i forskningsprosjekter innenfor helse- og omsorgssektoren*”

Sluttmelding og søknad om prosjektendring
Prosjektleder skal sende sluttmelding til REK sør-øst på eget skjema, jf. hfl. § 12. Prosjektleder skal sende søknad om prosjektendring til REK sør-øst dersom det skal gjøres vesentlige endringer i forhold til de opplysninger som er gitt i søknaden, jf. hfl. § 11.

Klageadgang
Du kan klage på komiteens vedtak, jf. forvaltningslovens § 28 flg. Klagen sendes til REK sør-øst B. Klagefristen er tre uker fra du mottar dette brevet. Dersom vedtaket opprettholdes av REK sør-øst B, sendes klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag for endelig vurdering.

Komiteens avgjørelse var enstemmig.

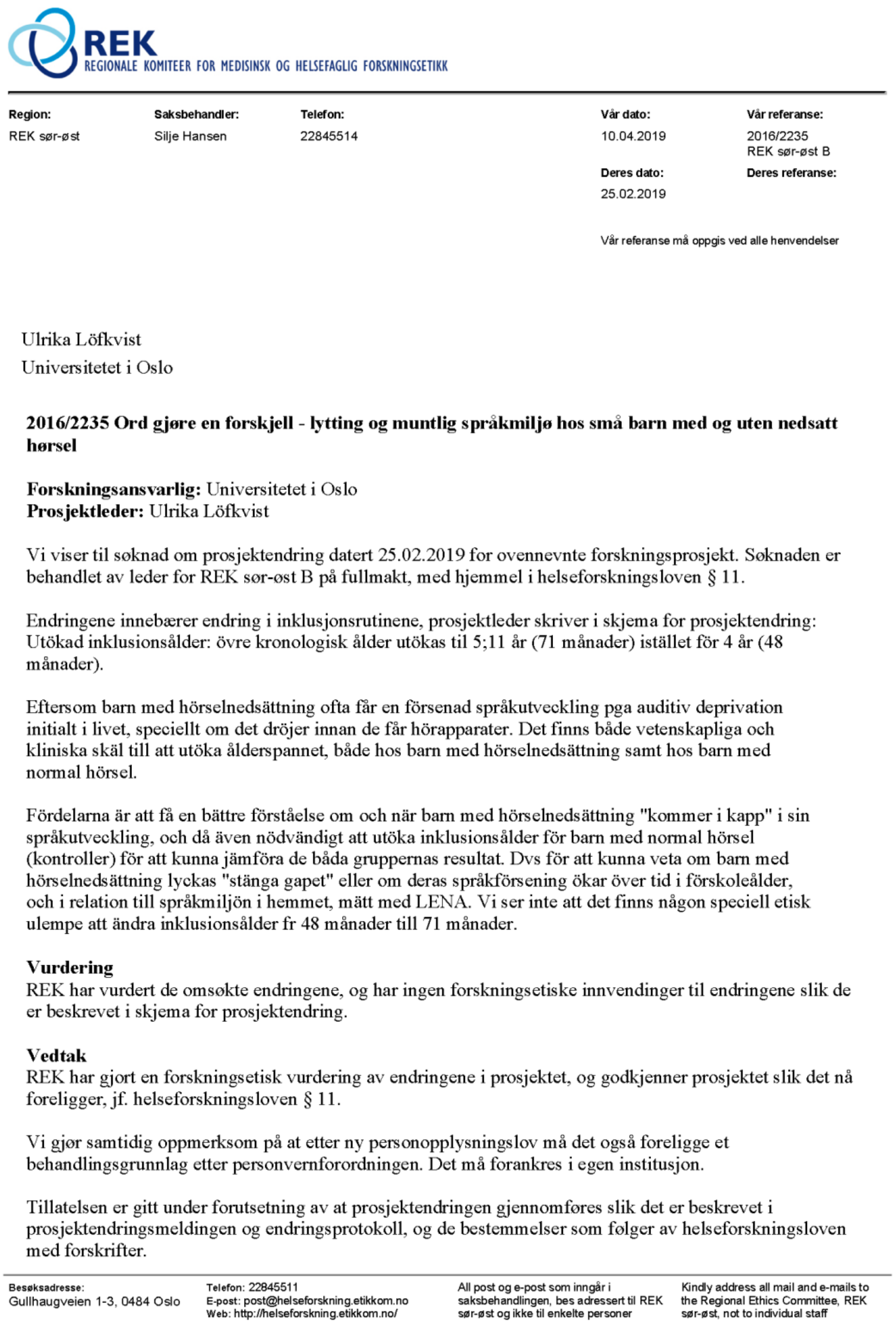
Med vennlig hilsen

Grete Dyb
professor, dr. med.
leder REK sør-øst B

Mariann Glenna Davidsen
rådgiver

Kopi til:
- Universitetet i Oslo ved øverste administrative ledelse

Appendix 11- approval of changes in age- criterion from REK



REK
REGIONALE KOMITEER FOR MEDISINSK OG HELSEFAGLIG FORSKNINGSETIKK

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REK sør-øst	Silje Hansen	22845514	10.04.2019	2016/2235 REK sør-øst B
			Deres dato:	Deres referanse:
			25.02.2019	

Vår referanse må oppgis ved alle henvendelser

Ulrika Löfkvist
Universitetet i Oslo

2016/2235 Ord gjøre en forskjell - lytting og muntlig språkmiljø hos små barn med og uten nedsatt hørsel

Forskningsansvarlig: Universitetet i Oslo
Prosjektleder: Ulrika Löfkvist

Vi viser til søknad om prosjektendring datert 25.02.2019 for ovennevnte forskningsprosjekt. Søknaden er behandlet av leder for REK sør-øst B på fullmakt, med hjemmel i helseforskningsloven § 11.

Endringene innebærer endring i inklusjonsrutinene, prosjektleder skriver i skjema for prosjektendring: Utökad inklusionsålder: övre kronologisk ålder utökas til 5;11 år (71 månader) istället för 4 år (48 månader).

Eftersom barn med hörselnedsättning ofta får en försenad språkutveckling pga auditiv deprivation initialt i livet, speciellt om det dröjer innan de får hörapparater. Det finns både vetenskapliga och kliniska skäl till att utöka ålderspannet, både hos barn med hörselnedsättning samt hos barn med normal hörsel.

Fördelarna är att få en bättre förståelse om och när barn med hörselnedsättning "kommer i kapp" i sin språkutveckling, och då även nödvändigt att utöka inklusionsålder för barn med normal hörsel (kontroller) för att kunna jämföra de båda gruppernas resultat. Dvs för att kunna veta om barn med hörselnedsättning lyckas "stänga gapet" eller om deras språkförsening ökar över tid i förskoleålder, och i relation till språkmiljön i hemmet, mätt med LENA. Vi ser inte att det finns någon speciell etisk ulempe att ändra inklusionsålder fr 48 månader till 71 månader.

Vurdering
REK har vurdert de omsøkte endringene, og har ingen forskningsetiske innvendinger til endringene slik de er beskrevet i skjema for prosjektendring.

Vedtak
REK har gjort en forskningsetisk vurdering av endringene i prosjektet, og godkjenner prosjektet slik det nå foreligger, jf. helseforskningsloven § 11.

Vi gjør samtidig oppmerksom på at etter ny personopplysningslov må det også foreligge et behandlingsgrunnlag etter personvernforordningen. Det må forankres i egen institusjon.

Tillatelsen er gitt under forutsetning av at prosjektendringen gjennomføres slik det er beskrevet i prosjektendringsmeldingen og endringsprotokoll, og de bestemmelser som følger av helseforskningsloven med forskrifter.

Klageadgang
REKs vedtak kan påklages, jf. forvaltningslovens § 28 flg. Eventuell klage sendes til REK sør-øst B. Klagefristen er tre uker fra mottak av dette brevet. Dersom vedtaket opprettholdes av REK sør-øst B, sendes klagen videre til Den nasjonale forskningsetiske komité for medisin og helsefag for endelig vurdering, jf. forskningsetikkloven § 10 og helseforskningsloven § 10.

Vi ber om at alle henvendelser sendes inn med korrekt skjema via vår saksportal: http://helseforskning.etikkom.no. Dersom det ikke finnes passende skjema kan henvendelsen rettes på e-post til: post@helseforskning.etikkom.no.

Vennligst oppgi vårt referansenummer i korrespondansen.

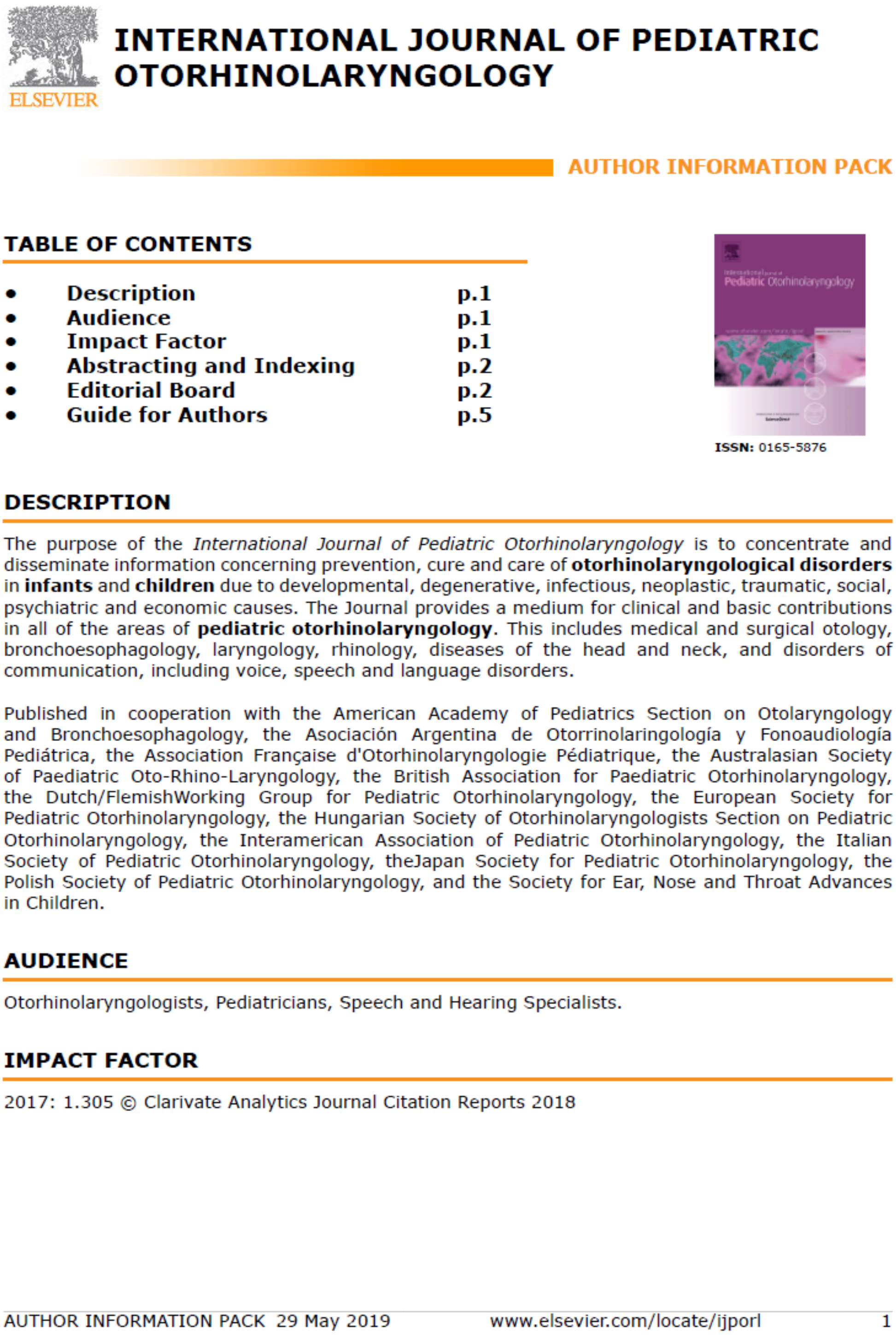
Med vennlig hilsen

Ragnhild Emblem
Professor, dr. med.
leder REK sør-øst B

Silje Hansen
førstekonsulent

Kopi til:
Universitetet i Oslo ved: postmottak@uio.no

Appendix 12- Author information pack from The International Journal of Pediatric Otorhinolaryngology



ELSEVIER

INTERNATIONAL JOURNAL OF PEDIATRIC OTORHINOLARYNGOLOGY

AUTHOR INFORMATION PACK

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ISSN: 0165-5876

DESCRIPTION

The purpose of the *International Journal of Pediatric Otorhinolaryngology* is to concentrate and disseminate information concerning prevention, cure and care of **otorhinolaryngological disorders** in **infants** and **children** due to developmental, degenerative, infectious, neoplastic, traumatic, social, psychiatric and economic causes. The Journal provides a medium for clinical and basic contributions in all of the areas of **pediatric otorhinolaryngology**. This includes medical and surgical otology, bronchoesophagology, laryngology, rhinology, diseases of the head and neck, and disorders of communication, including voice, speech and language disorders.

Published in cooperation with the American Academy of Pediatrics Section on Otolaryngology and Bronchoesophagology, the Asociación Argentina de Otorrinolaringología y Fonoaudiología Pediátrica, the Association Française d'Otorhinolaryngologie Pédiatrique, the Australasian Society of Paediatric Oto-Rhino-Laryngology, the British Association for Paediatric Otorhinolaryngology, the Dutch/FlemishWorking Group for Pediatric Otorhinolaryngology, the European Society for Pediatric Otorhinolaryngology, the Hungarian Society of Otorhinolaryngologists Section on Pediatric Otorhinolaryngology, the Interamerican Association of Pediatric Otorhinolaryngology, the Italian Society of Pediatric Otorhinolaryngology, theJapan Society for Pediatric Otorhinolaryngology, the Polish Society of Pediatric Otorhinolaryngology, and the Society for Ear, Nose and Throat Advances in Children.

AUDIENCE

Otorhinolaryngologists, Pediatricians, Speech and Hearing Specialists.

IMPACT FACTOR

2017: 1.305 © Clarivate Analytics Journal Citation Reports 2018

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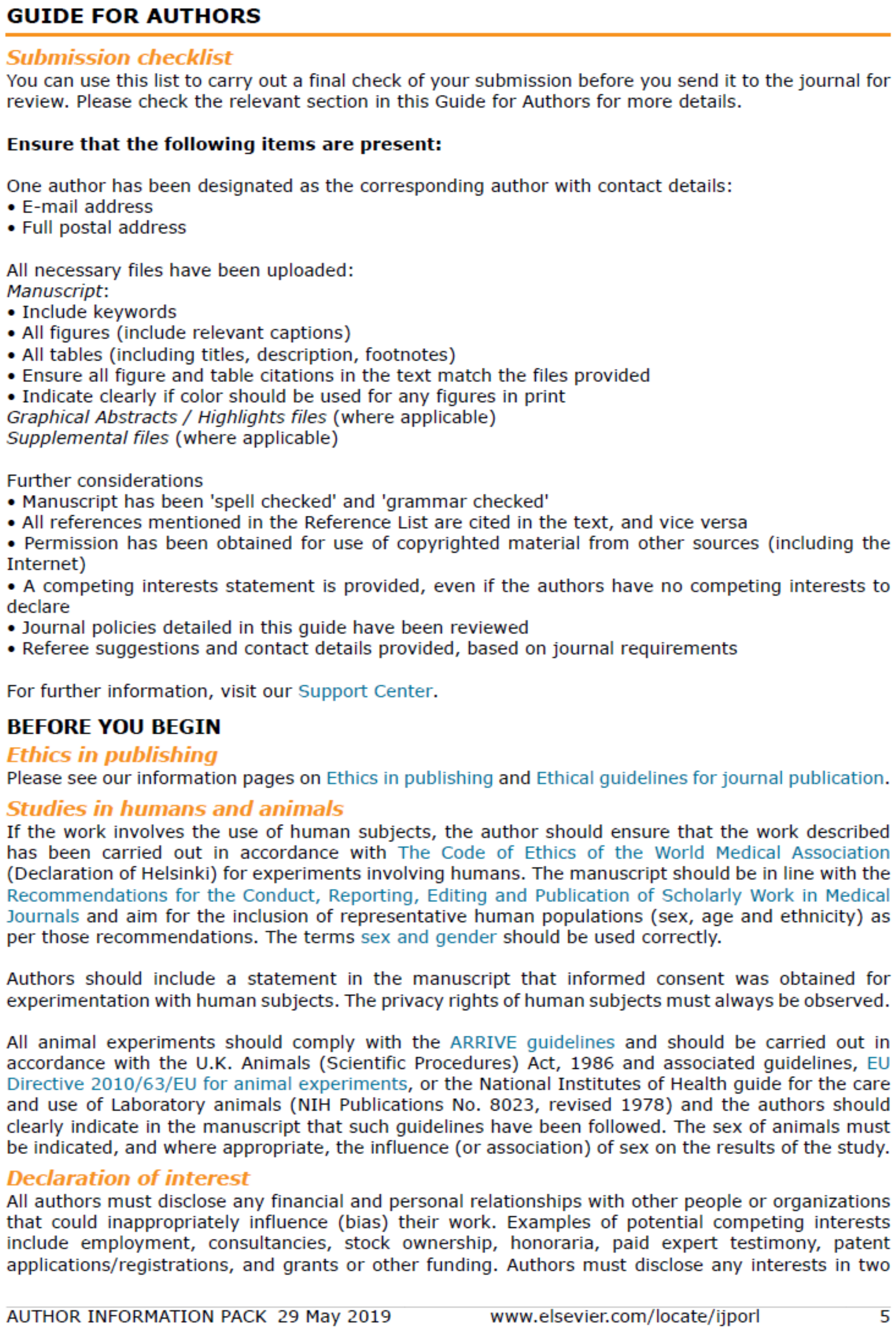

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[5] Cancer Research UK, Cancer statistics reports for the UK. http://www.cancerresearchuk.org/aboutcancer/statistics/cancerstatsreport/, 2003 (accessed 13 March 2003).
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