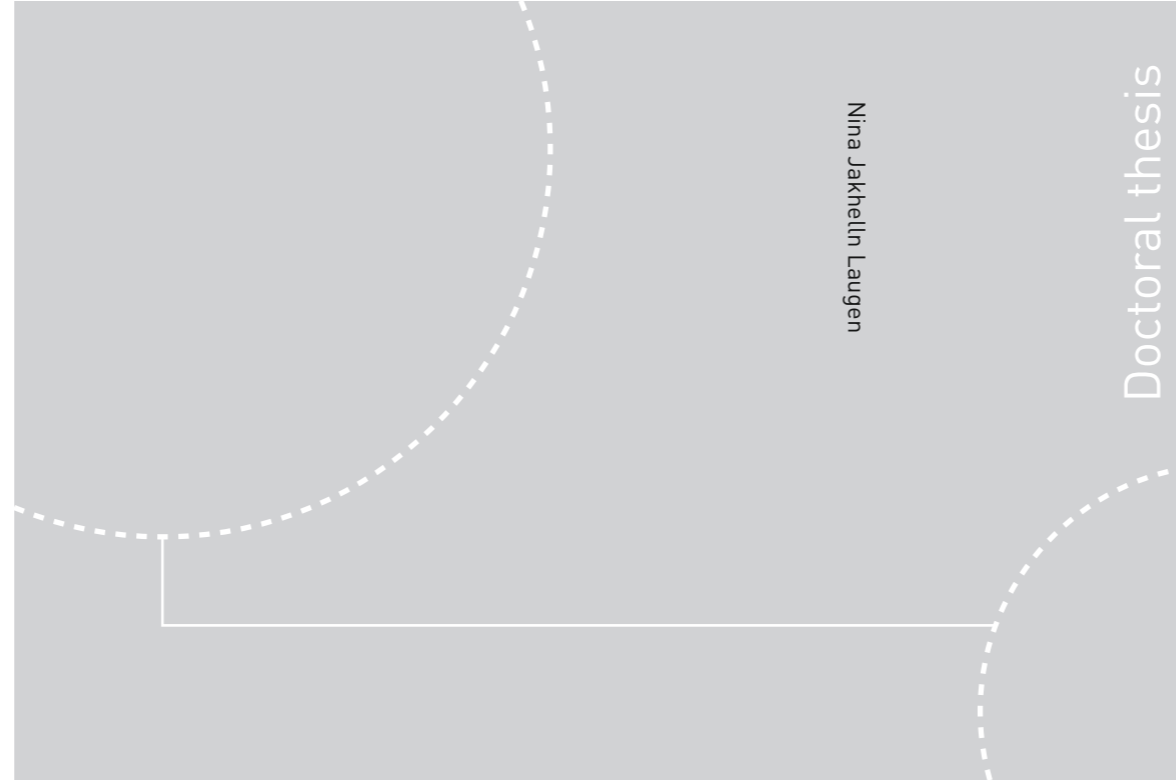


ISBN 978-82-326-2506-2 (printed ver.)
ISBN 978-82-326-2507-9 (electronic ver.)
ISSN 1503-8181



Doctoral theses at NTNU, 2017:217

Nina Jakhelln Laugen

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 **NTNU**
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NTNU
Norwegian University of Science and Technology
Thesis for the Degree of
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Department of Psychology

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Trondheim, August 2017

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Printed by NTNU Grafisk senter

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Sammendrag

Barn med hørselstap er i risiko for forsinket utvikling på flere områder. Tidlig diagnostisering og oppfølging har bidratt til bedre utviklingsbetingelser, men vi vet ikke like mye om barn med milde og moderate tap, som de med større tap. I tillegg vet vi mindre om psykososial utvikling enn vi vet om utvikling av språk og kommunikasjon, spesielt hos førskolebarn.

I denne studien ble 35 4-5-åringer med høreapparater inkludert. De fleste hadde milde eller moderate hørselstap og brukte hovedsakelig norsk tale, noen med tegnstøtte. Psykososial fungering, emosjonsforståelse, sosiale ferdigheter og talespråklig ordforråd ble kartlagt. En gruppe på 180 barn med normal hørsel, hentet fra den longitudinelle populasjonsstudien Tidlig trygg i Trondheim, utgjorde kontrollgruppen.

Barn med høreapparater viste flere tegn til psykososiale vansker enn barna med normal hørsel, spesielt gjaldt dette gutter. Barn som fikk sitt hørselstap oppdaget tidlig, hadde færre vansker. Selv om barn med høreapparater hadde svakere ordforråd enn barn med normal hørsel, var sammenhengen mellom ordforråd og psykososiale vansker svak.

Emosjonsforståelsen til barn med hørselstap var like god som barn med normal hørsel.

Foreldrene til barn med hørselstap var mer presise når de skulle anslå barnets emosjonsforståelse enn det foreldre til barn med normal hørsel var, og høyere presisjon predikerte bedre emosjonsforståelse hos barna. Sosiale ferdigheter hos barn med moderate og alvorlige tap var på linje med barn med normal hørsel, mens barn med milde eller ensidige tap var betydelig forsinket. Gode sosiale ferdigheter hadde sammenheng med tidlig høreapparattilpasning, men ikke med ordforråd.

Kort oppsummert tyder funnene på at barn med høreapparater er i risiko for vansker innenfor noen områder av psykososial utvikling, allerede i førskolealder. Språkferdigheter, i

form av ordforråd, kunne ikke forklare disse vanskene. Tidlig diagnose og intervensjon kan forebygge psykososiale vansker, også for de barna med milde eller ensidige tap.

Summary

Children who are deaf and hard of hearing are at risk for developing delays or difficulties in many areas. Early hearing detection and intervention have improved the developmental conditions for deaf and hard of hearing children as a group, but we know less about the hard of hearing children than we do about children with more severe degrees of hearing loss. Moreover, psychosocial development has received limited attention compared to language and communication, especially in preschool age.

Therefore, we investigated a group of 35 children aged 4-5 years, with hearing aids. The majority had mild or moderate hearing loss and all used spoken Norwegian as their main language, some supported with signs. Psychosocial functioning, emotion understanding and social skills were assessed, as well as spoken vocabulary. 180 children with typical hearing, derived from the longitudinal population study Trondheim Early Secure Study, were used as a comparison group.

Hard of hearing children showed more signs of psychosocial problems than children with typical hearing, especially boys. Low age at identification of the hearing loss predicted better psychosocial functioning, whereas degree of hearing loss and vocabulary scores did not. As for emotion understanding, hard of hearing children performed similarly as their peers with typical hearing. The parents of hard of hearing children were more accurate when estimating their child's emotion understanding; and this accuracy was associated with the child's actual performance. Social skills development was delayed in children with unilateral and mild bilateral loss, but not in the children with moderate to severe loss. Higher scores on social skills were associated with lower age at amplification, but not with vocabulary scores.

Taken together, our results suggest that hard of hearing children, even those with mild and unilateral hearing loss, are at risk for difficulties related to some areas of psychosocial development already in preschool age. These difficulties cannot be attributed to vocabulary

delays. Early detection and intervention may prevent adverse psychosocial development, even for children with mild or unilateral hearing loss.

Acknowledgements

The past three years have been a wonderful journey. I am grateful to all of you who have joined me, cheered from the sidelines and pushed me forward.

This thesis has its origin in Statped Midt. The questions leading to this research were born in meetings with parents, children and my colleagues in the department of hearing impairment. A big thanks goes to Anne Heian, Anne-Mari Nordnes Skagen, Anne Sollie, and Tove Leinum Østerlie for sharing knowledge and enthusiasm over the years – in meetings, projects and important hallway conversations. To my leaders Bjørn Bakken and Anne Bakken, thank you for letting me pursue my ideas and supporting me from the very beginning.

This project has been made possible by the Norwegian Extra Foundation for Health and Rehabilitation, in collaboration with The Norwegian Association of the Hard of Hearing (Hørselshemmedes Landsforbund, HLF).

Karl Jacobsen has followed the project from the start. He has provided the support I have needed, and at the same time given me autonomy to develop the project as my own. Our discussions have deepened my understanding of development and of psychology in general. Lars Wichstrøm has generously shared data from the Trondheim Early Secure Study, helped out with the statistics and provided valuable feedback all along. Carolien Rieffe has been a great guide in the field of hearing loss. Patrick Kermit was a valuable discussion partner early in the project, and Chris Aanonsen was helpful with suggestions in the last stage of writing. Fellow PhD students and everyone in the outpatient clinics at the department of Psychology, NTNU, have provided a supportive, warm and inspiring working environment.

I am grateful to all the families who in their busy everyday lives, found the time to invite me into their homes. Thank you for your generosity.

I am privileged to have a supportive family around me. I owe so much to my mother Nora who as a mother, grandmother and in her career has convinced generations of children that they are important and deserve to be heard. I am also thankful to my father Knut for encouraging me to always do my best, and for showing me how to enjoy the journey; whether in the mountains, academia, or in life. To my children Julie and Kristian, thank you for reminding me what's important, and for putting up with my temper in stressful times. To my husband Frode, thank you for your loving support. Whenever I'm feeling insecure, your confidence in me always convinces me to keep going.

Acronyms

dB	Decibel
DHH	Deaf and hard of hearing
HH	Hard of hearing
MSHL	Moderate or severe hearing loss
NTNU	Norges teknisk-naturvitenskapelige universitet
PPVT-III	Peabody picture vocabulary test – third edition
SDQ	Strengths and difficulties questionnaire
SSRS	Social skills rating system
TEC	Test of emotion comprehension
TH	Typical hearing
TROG-2	Test of reception of grammar, second edition
UMHL	Unilateral or mild bilateral hearing loss
WHO	World Health Organization

Clarification

Throughout this thesis, the term deaf and hard of hearing (DHH) refers to individuals who have any degree of hearing loss. Hard of hearing (HH) refers to individuals with mild to severe hearing loss (26-90 dB) including unilateral hearing loss (>26 dB in the affected ear), whereas deaf refers to individuals with profound loss. Where the terms deaf and HH are used in the sense of cultural identity, this is specified.

Although often categorized, degrees of hearing loss are continuous. Sometimes throughout the thesis there has been a need to discuss the degree of hearing loss in relative terms rather than the absolute categories; in such cases, “milder” and “more severe” degrees have been used. These do not necessarily refer to the categories mild and severe, rather descriptions along a continuum.

The candidate has planned the study in collaboration with her supervisors. The instruments were mainly the same as those used in the Trondheim Early Secure Study, from which the data on TH children origins. As for the HH children, the candidate was responsible for the recruitment and assessment of these. Moreover, the candidate is responsible for the data analysis. All three papers were written by the candidate, with suggestions and comments provided by the co-authors.

List of papers

- I. Laugen, N. J., Jacobsen, K. H., Rieffe, C., & Wichstrøm, L. (2016). Predictors of Psychosocial Outcomes in Hard-of-Hearing Preschool Children. *Journal of Deaf Studies and Deaf Education*, 21(3), 259-267. doi:10.1093/deafed/enw005

- II. Laugen, N. J., Jacobsen, K. H., Rieffe, C., & Wichstrøm, L. (2017). Emotion Understanding in Preschool Children with Mild-to-Severe Hearing Loss. *Journal of Deaf Studies and Deaf Education*, 22(2), 155-163. doi:10.1093/deafed/enw069

- III. Laugen, N. J., Jacobsen, K. H., Rieffe, C., & Wichstrøm, L. (2017). Social skills in preschool children with unilateral and mild bilateral hearing loss. *Deafness & Education International*, published ahead of print. doi:10.1080/14643154.2017.1344366

1. Introduction

1.1 Background for the thesis

Children who are deaf and hard of hearing (DHH) are at risk for language delays and psychosocial difficulties (Lederberg, Schick, & Spencer, 2013; Stevenson, Kreppner, Pimperton, Worsfold, & Kennedy, 2015). Traditionally, research and intervention programs have mostly included children with moderate to profound hearing loss, perhaps with a special interest in children with cochlear implants. However, during the past years there has been an increasing awareness of the children who are hard of hearing (HH); a growing body of literature suggests that they are at risk for language delays (Tomblin et al., 2015), although little is still known about psychosocial development.

Studies of school-age children and adolescents suggest that any degree of hearing loss represent a risk for psychosocial problems (Dammeyer, 2010; Hintermair, 2007); however, universal newborn hearing screening has changed the developmental conditions for HH children substantially, and to date we do not know enough about this new generation of early detected HH children; especially in preschool age. With this lack of knowledge, early intervention may fail to prevent adverse outcomes simply because of insecurity concerning what outcomes to prevent, and who may benefit from early intervention (Holstrum, Biernath, McKay, & Ross, 2009).

Against this backdrop, the present thesis investigates psychosocial functioning, emotion understanding and social skills in preschool HH children, compared to children with typical hearing (TH). The outcomes of HH children have important implications for early intervention services.

1.2 Children who are deaf or hard of hearing

Permanent childhood hearing loss can be congenital, such as those resulting from pre- and perinatal complications or genetic dispositions, or acquired at an early age. The hearing loss can also increase in severity over time. 1-2 per thousand children are diagnosed with a hearing loss as newborns (Caluraud et al., 2015; Vos, Lagasse, & Levêque, 2014), and the prevalence increases to 2-4 per thousand by the time of school entry (Russ et al., 2003; Watkin & Baldwin, 2011).

Based on average hearing threshold across different frequencies, hearing losses are commonly categorized as slight (16-25 dB), mild (26-40 dB), moderate (41-55 dB), moderately severe (56-70), severe (71-90 dB) or profound (>90 dB) (WHO, 2016). In general, slight and mild losses do not always require any amplification, and the severe and profound losses are often considered for cochlear implantation. The majority of DHH children are considered HH, with hearing losses ranging from mild to severe, often aided with regular hearing aids.

The terms may also refer to cultural identities. Whereas Deaf usually refers to belonging to the sign language culture and community, individuals who identify themselves as HH often use spoken language as their main language. In this thesis, the term HH refers to the audiological definition, including unaided hearing thresholds corresponding to mild to severe hearing loss, as well as unilateral hearing losses.

Despite technological advances regarding both cochlear implants and regular hearing aids, they do not provide the same access to auditory information as that of TH. Background noise, reverberation and distance are some of the factors affecting how the child perceives and understands the auditory information in its surroundings. Whereas the rapid advances of cochlear implant technology have spawned a large amount of research, there has until recently been a paucity of research regarding HH children.

1.3 The transactional model

As presented in the following sections, there is a considerable amount of studies reporting developmental outcomes in DHH children. Such outcomes are influenced not only by the audiological characteristics, but also the dispositions of the child, its parents, resources in the family's environment and cultural influences, as well as interactions between these. The transactional model of development (Sameroff, 2009) describes the mutual interactions between these factors over time, and provides a framework for understanding how a hearing loss could represent a risk for developing psychosocial difficulties.

Characteristics of the child, its environment and the interactions between those two shape the development of both the child and its environment (Sameroff, 2009). For example, how a child calms down is influenced by the parent's regulating behavior. Simultaneously, the parent's regulating behavior towards the child is influenced by how easy or difficult it is to calm the child. In addition, the temperament of the child determines how the child reacts to the parent's behavior. At any point in time, the characteristics of both the child and the parent are results of their former interactions, and over time, both are changing in the light of new experiences.

The presence of a hearing loss is likely to affect the interactions between the child and its environment. For example, a child who does not hear the parent calling his or her name, or who is not able to locate where the sound comes from, may not display an observable reaction. If the parent interprets the child's behavior as lack of interest, the parent may be less inclined to engage in the child's emotions or activities. The child, in turn, may adapt to the parent's lack of engagement by changing his or her expectations of future interactions. In a different scenario, the same behavior by the child (not responding to his or her name) could be interpreted as a result of the hearing loss, rather than lack of interest. The parent would perhaps adapt its communication to the child's needs by catching the child's visual attention

before repeating the name, rather than leaving the child alone. Whether the child interprets the parent as interested or not so interested, is likely to affect the child's initiatives towards the parent on a later occasion. Thus, over time, the sum of positive and negative transaction effects such as the ones described here, form the developmental outcomes of the DHH child as well as the behavior of the parents.

Development is fueled by increasing complexity both within the child and in the environment with which the child interacts (Sameroff, 2009; Taumoepeau & Ruffman, 2008). With a hearing loss, the child's access to the social world is limited, given that most children live in spoken language environments. Moreover, communication difficulties as a result of noise, distance and limited sign language skills are likely to reduce the complexity in the parents' responses to the child, as they try to reduce the chance of misunderstandings (Morgan et al., 2014). For example, parents might be using the words that are already familiar to the child rather than expanding the vocabulary with new words. Thus, whereas parents typically adjust the complexity in their actions towards the child according to their perceived level of development (Taumoepeau & Ruffman, 2008), DHH children are at risk for experiencing a gap between their cognitive and socio-emotional maturity and the complexity provided in their social world, which over time could limit their further cognitive and socio-emotional development.

The relationship between the hearing loss and the outcome is complex. Given the variability in individuals and all the different social contexts they encounter, the number of possible outcomes is infinite. The studies presented in this thesis investigate three areas of psychosocial development, aiming to contribute to the understanding of typical developmental outcomes in HH children. Paper I addresses emotional and behavioral difficulties, or psychosocial functioning; Papers II and III address two areas of competence that are important to psychosocial development, namely, emotion understanding and social skills,

respectively. Previous studies rarely address these areas of development specifically in the group of HH children; however, research concerning the population of DHH children in general provides an overview of the current state of knowledge, as will be presented in the following section.

1.4 Developmental outcomes in DHH children

1.4.1 Psychosocial functioning

Psychosocial functioning is a frequently used concept, yet a consistent definition is lacking (Ro & Clark, 2009). The term includes the presence or absence of emotional, social or behavioral problems, and is associated with terms like well-being, self-esteem and quality of life (Keilmann, Limberger, & Mann, 2007). DHH children are at risk for developing psychosocial difficulties, including emotional, social and behavioral problems; a recent review and meta-analysis reports substantially higher rates of emotional and behavioral problems in DHH children and adolescents than in children with TH (Stevenson et al., 2015).

Psychosocial problems in childhood are associated with later mental health problems in the TH population (Sveen, Berg-Nielsen, Lydersen, & Wichstrøm, 2013). In the DHH population, the incidence of depression and levels of anxiety are likely to be higher than the population average both in children and adults, although there are methodological challenges to some of these studies (Fellinger, Holzinger, & Pollard, 2012; Fellinger, Holzinger, Sattel, Laucht, & Goldberg, 2009; Theunissen et al., 2012; Øhre, von Tetchner, & Falkum, 2011). Thus, knowledge about the prevalence and distribution of psychosocial problems is of importance for early intervention planning.

A recent review of outcomes in children with unilateral and mild bilateral hearing loss (UMHL) reports increased level of behavioral problems (Winiger, Alexander, & Diefendorf, 2016); however, most of the studies included in the review that address psychosocial

outcomes are rather old, and generalizing these findings to the present generations of early identified children is difficult. More recent studies that include early identified HH children convey mixed findings regarding developmental outcomes; Topol, Girard, St. Pierre, Tucker, and Vohr (2011) reported more signs of withdrawal and internalizing symptoms, whereas Stika et al. (2015) found developmental outcomes to be within the normal range.

1.4.2 Emotion understanding

Emotions serve as signals to the social world (Campos, Mumme, Kermoian, & Campos, 1994), and hold important functions for social affiliation and distancing at an individual and group level (Fischer & Manstead, 2008). However, for emotion to hold this important function, it is vital not only to experience emotions, but also to understand the nature of one's own and others' emotions. A range of competences are required, from awareness of one's own emotions to strategies for emotion regulation (Saarni, Campos, Camras, & Witherington, 2006). One such competence, emotion understanding, refers to the explicit knowledge about emotions (Pons, De Rosnay, Andersen, & Cuisinier, 2010). The ability to identify emotions, and the understanding of relationships between emotions and its elicitors, facilitates the interpretation of one's social environment and thereby increases the chances of positive transactional effects.

As for DHH children, previous studies have provided mixed results regarding emotion understanding. Some have reported delays in DHH children in the understanding of other people's mental processes (Peterson, 2009), although this is not the case for DHH children who have deaf parents (Woolfe, Want, & Siegal, 2002). Delays in more specific understanding of emotions, such as the relationship between emotions and their triggers, have also been reported (Gray, Hosie, Russell, Scott, & Hunter, 2007). Preschool children, aged below 6 years, may have delays in emotion recognition (Wiefferink, Rieffe, Ketelaar, De Raeve, & Frijns, 2013), but older school-age children seem to catch up with their TH peers on

this component (Hopyan-Misakyan, Gordon, Dennis, & Papsin, 2009; Rieffe, 2012). Still, school-age children may have difficulties with more complex aspects of emotion understanding, such as knowledge concerning how emotions can be regulated (Rieffe, 2012). In contrast, other studies have reported similar levels of emotion understanding in DHH and TH children (Mancini et al., 2016).

The mixed results in emotion understanding research can be attributed to a range of circumstances. Firstly, emotion understanding is a broad concept including several different components (Pons, Harris, & de Rosnay, 2004). As studies focus on different aspects of emotion understanding, the findings are not easily comparable. Secondly, the participants differ regarding a range of attributes such as age, degree of hearing loss, age at detection and the context of language and service provision. Thirdly, the study of emotion understanding is complicated by the wide range of assessment methods. For example, the verbal loading in the different assessments vary; if children are given tasks that require complex language recognition and production, it is difficult to tell whether the results reflect language difficulties or emotion understanding difficulties.

1.4.3 Social skills

Development of social competence concerns the ability to engage successfully and effectively in social interactions across different contexts (Rose-Krasnor & Denham, 2009). Social skills represent the specific learned skills that enable such successful interactions in socially acceptable ways (Gresham & Elliott, 1990).

Given that most children who are HH grow up in a spoken language environment (Mitchell & Karchmer, 2004), the development of social skills is likely to be affected by the reduced access to sound. In fact, several studies have reported social skills difficulties among preschool children with severe and profound hearing loss (Hoffman, Quittner, & Cejas, 2015) as well as in studies including all degrees from mild to profound hearing loss (Meinzen-Derr

et al., 2014). In early detected children with cochlear implants, age-adequate social skills have been reported (Ketelaar, Rieffe, Wiefferink, & Frijns, 2013) although social interaction in larger settings might still be problematic (Martin, Bat-Chava, Lalwani, & Waltzman, 2011). Possibly, they might be less often invited to social interaction by their TH peers (DeLuzio & Girolametto, 2011), thus experiencing fewer learning opportunities compared to TH children.

Although any degree of hearing loss might represent a risk for developmental outcomes, it is likely to assume that more severe degrees of hearing loss represent a larger obstacle to the social world, compared to a milder hearing loss. However, even individuals with unilateral hearing loss report difficulties regarding access to social information (Wie, Pripp, & Tvette, 2010), and some have even reported less optimal outcomes for milder hearing loss than for children with more severe hearing loss (Wake, Hughes, Collins, & Poulakis, 2004). The effect of mild and unilateral hearing losses on social skills development is not yet established.

1.4.4 Summary

Existing literature suggests that DHH children are at risk for developing difficulties regarding psychosocial functioning, emotion understanding and social skills. However, as most literature is concerned with school age children, preschool children are less studied. Moreover, although HH children are sometimes included as a part of larger samples, they are rarely studied specifically. The resulting knowledge gap regarding preschool HH children may prevent the development of well-targeted early interventions. In worst case, the potential benefits of early detection and early intervention could be lost to this group. Therefore, the present study addresses psychosocial development in preschool HH children, aiming to investigate possible factors influencing their development in these areas.

1.5. Predictors of psychosocial development

Early intervention is a difficult task; one size does not fit all, and one specific intervention is likely to create different outcomes depending on the individual and its context (Sameroff & Fiese, 2000). However, awareness of factors associated with difficulties on a group level increases the possibilities of providing effective early intervention. Knowledge about malleable factors such as age at detection of the hearing loss and parents' contributions to the transactions should guide the planning and content of early intervention; whereas knowledge about non-malleable factors such as gender and degree of hearing loss can assist in targeting early intervention towards those individuals and families who are at risk.

In the present study, several possible predictors of psychosocial development were investigated, and these are presented in Papers I-III. However, some areas deserve a more thorough presentation and discussion. In order to gain knowledge about the development of HH children, and whether these children need the same or different type of support compared to deaf children, degree of hearing loss is an important variable that must be considered. Further, hearing loss is commonly associated with language delays and communication difficulties (Lederberg et al., 2013), and in general, early intervention is considered an important predictor of developmental outcomes (Korver et al., 2010). These factors are important to take into consideration when attempting to understand the mechanisms of psychosocial development in HH children.

1.5.1 Degree of hearing loss

Access to auditory information is important for social interaction in societies where spoken languages are used, which means that the impact of a milder hearing loss might differ from a more severe hearing loss. However, the relationship between the severity of a condition and its functional outcomes is not always straightforward (WHO, 2001). Mild

hearing losses can affect social interactions in qualitatively different ways than profound hearing losses do.

Any degree of hearing loss represents a risk for language delay (Lederberg et al., 2013). Still, there is substantial support for the relationship between degree of hearing loss and spoken language development; not surprisingly, increased severity of hearing loss is associated with more delays in spoken language (Ching et al., 2013a). However, it must be noted that this does not describe the full picture of language development. For example, sign language development is not related to degree of hearing loss, rather to other factors such as the sign language skills of the parents (Lu, Jones, & Morgan, 2016).

In some cases, children with mild and moderate hearing loss experience many of the same communication difficulties as children with severe or profound hearing loss (Winiger et al., 2016). For example, adverse listening conditions can reduce the access to social interactions for children with all degrees of hearing loss equally, regardless of language ability, in many situations. Likewise, for children who use sign language, access to social interactions depends on the sign language competence in their environment irrespective of the child's degree of hearing loss.

The terms “deaf” and “hard of hearing” are not only audiological terms; they also define different cultural identities. In the Deaf community where sign language is the main language, degree of hearing loss is not relevant for one's ability to communicate, because of the visual-gestural nature of sign languages. The hearing loss is not considered a disability, as it does not represent a barrier between the individual and the community. In contrast, for HH individuals who use spoken language, the access to communication is reduced (Wie et al., 2010). Whereas a more severe hearing loss can motivate parents to learn sign language and ease the child's access to the Deaf community, a milder hearing loss is less likely to trigger changes in the family's mode of communication.

For parents of a baby with a newly diagnosed hearing loss, whether the baby is considered “deaf” or “hard of hearing” could influence their interpretations and responses when interacting with the baby, for example in terms of the degree to which they expect the child to respond to auditory initiatives, and whether they interpret the baby’s gestures as communicative attempts. For a HH child, there might be a larger discrepancy between the expected functioning and the actual possibilities, whereas a deaf child is met with different expectations of participation and therefore also adjustment of the family or school environment in order to reduce the gap between functioning and possibilities. In short, the expectation of “normal behavior”, such as engaging in conversations even in noisy surroundings, may cause added stress for HH children, as they risk frequent experiences of shortcoming in social interactions (Moeller, 2007).

1.5.2 Early detection and intervention

Age at identification and access to support services may differ according to degree of hearing loss. Profound hearing loss is more likely than mild hearing loss to be detected early, due to observable signs in behavior and language development. This could result in earlier access to amplification and support. The lack of support in the first years of life has been considered a likely contributor to psychosocial difficulties observed in children with mild to moderate hearing loss (Moeller, 2007), and the implementation of universal newborn hearing screening was expected to enable earlier detection and intervention of even milder hearing losses. Indeed, the age at identification has been reduced dramatically, from 5 years to 0.8 years in children with UMHL (Fitzpatrick, Whittingham, & Durieux-Smith, 2014), however children with milder hearing loss tend to receive intervention services later than children with more severe hearing loss (Walker et al., 2014). This delay may be due to underestimating the need for intervention as professionals and parents observe that the child responds to some sound (Holte et al., 2012). Further, it may be due to lack of knowledge concerning the need

for early intervention, as the vast majority of research concerning the effect of early intervention addresses mainly children with severe and profound hearing loss (see for example Kasai, Fukushima, Omori, Sugaya, & Ojima, 2012; Yoshinaga-Itano, 2003). In particular, studies of psychosocial development in early identified children with mild to severe hearing loss are few and far between; although some studies do report better developmental outcomes in children with early identified UMHL (Porter, Sladen, Ampah, Rothpletz, & Bess, 2013) as well as in HH toddlers (Stika et al., 2015). In this thesis, age at detection and its relation to psychosocial functioning was studied in Paper I. In Paper III, focusing on children with UMHL, we studied how age at amplification was related to social skills and vocabulary.

1.5.3 Language

Developmental outcomes in one area, such as language development, affect other areas of development as well; often referred to as developmental cascades (Masten & Cicchetti, 2010). For example, internalizing behavior (Bornstein, Hahn, & Suwalsky, 2013), socioemotional competence (Harris, De Rosnay, & Pons, 2005) or cognitive development (Siegal & Surian, 2012) are all associated with language development in the TH population. Thus, efforts to reduce language delays in DHH children are likely to benefit their psychosocial development as well; this is mentioned as one of the main reasons for early detection and intervention for DHH children (Joint Committee of Infant Hearing, 2007).

However, although language ability is an important prerequisite which increases the possibilities of successful interactions, it may not be sufficient to protect against psychosocial difficulties in DHH children (Stevenson et al., 2011). Degree of hearing loss has frequently been reported as a predictor to language development, but not to psychosocial outcomes (Dammeyer, 2010; Fitzpatrick, Crawford, Ni, & Durieux-Smith, 2011); suggesting that

language development and psychosocial development follow different developmental paths, despite the often reported correlation between the two.

Language development includes several different aspects, such as receptive versus expressive language, as well as the different levels of vocabulary, grammar and syntax. Regarding development of mental state understanding in TH children, Harris et al. (2005) suggest that pragmatic language development is a stronger predictor than lexical or syntactic language. This emphasis on pragmatic language, that is, the knowledge and perspectives acquired through conversations with others, has also received attention in DHH research. For example, Yoshinaga-Itano (2015) demonstrated that DHH children with vocabulary scores within the normal range still had considerable delays in pragmatic language development, including how to apologize, make promises or to request more information. It is also likely that such delays impact future transactions in which the child engages, thereby contributing to psychosocial difficulties. In the same vein, Netten et al. (2015) suggest that as a predictor of social functioning, a rating of communicative abilities could be more accurate than vocabulary scores.

1.5.4 Parent-child interaction

The developmental impact of early parent-child communication is well documented (Laible & Song, 2006; Sroufe, 1995), and parents' expectations and perceptions of their child affect their contributions in the interaction. For example, parents' perception of their child's abilities, their adjustment of their initiatives towards the child according to the child's developmental level, as well as their use of mental-state language that accurately addresses the child's mental state are all suggested as predictors of the child's development (Kårstad, Wichstrøm, Reinfjell, Belsky, & Berg-Nielsen, 2015; Meins et al., 2002; Taumoepeau & Ruffman, 2008). As for DHH children, parents may experience elevated stress related to the child's hearing loss (Quittner et al., 2010), which could affect the child's

psychosocial development (Hintermair, 2006). Further, the child's hearing loss is likely to influence parent-child interaction patterns (Gale & Schick, 2009; Lam & Kitamura, 2010), as well as the quality and content of conversations (Morgan et al., 2014). Drawing from studies of TH children (Kårstad et al., 2015), it is likely that parents' perceptions of their child's abilities play an important role in parent-child interaction patterns as well as in the child's psychosocial development. In Paper II, parents' estimations of the child's ability and its relationship with the child's emotion understanding are investigated.

1.6 Aims of the study

The overall aim of this study was to examine the prevalence of difficulties regarding psychosocial functioning, emotion understanding and social skills. A second aim was to examine possible factors associated with such difficulties. Each of the developmental areas of psychosocial adjustment, emotion understanding and social skills are addressed in three different papers.

1.6.1 Paper I

The aim of Paper I was to estimate the prevalence of psychosocial difficulties in HH preschool children, and potential predictors of psychosocial functioning. Three research questions were posed:

- 1) Are HH 4-year olds at greater risk of psychosocial difficulties, compared to TH peers?
- 2) Are there gender differences in psychosocial adjustment, and if so, do gender patterns differ between HH and TH children?
- 3) To what extent do vocabulary, age at detection and degree of hearing loss predict psychosocial adjustment?

1.6.2 Paper II

The aim of Paper II was to examine the level of emotion understanding in HH children compared to TH children. Moreover, the role of parent attribution was addressed through an investigation of how accurately parents estimate the level of emotion understanding in their HH and TH children. The research questions that were formulated are:

- 1) Does the level of emotion understanding in HH preschool children differ from that of TH preschool children?

- 2) Do parents of HH children estimate their child's emotion understanding level differently than parents of TH children?
- 3) Is there an association between parental accuracy and the child's actual level of emotion understanding?

1.6.3 Paper III

The aim of Paper III was to examine social skills in subgroups of HH children. Parent-reported social skills in three groups were compared: Children with unilateral and mild bilateral hearing loss (UMHL), with moderate and severe hearing loss (MSHL) and with TH. The following research questions were formulated:

- 1) Do children with UMHL, MSHL and TH differ from each other in parent-reported social skills?
- 2) Are social skills associated with vocabulary or age at detection in children with UMHL and MSHL?

2. Method

The papers in this thesis are based on a cross-sectional study of psychosocial outcomes in a representative group of HH preschool children, and a representative group of TH children. Data were collected through parent reports and direct assessment of the children. The study was approved by the Regional Committee for Medical and Health Research Ethics, Central Norway.

2.1 Participants

The HH children were recruited in collaboration with audiology departments in hospitals throughout Norway; these are the units responsible for the assessment and diagnosis of hearing loss as well as the fitting of hearing aids. All 21 audiology departments serving children were invited, and 19 of these participated in the recruitment process. Two special education service providers also participated.

We included all children who had been fitted with one or two hearing aids, and who did not have a cochlear implant. This provided a sample of children with hearing losses ranging from unilateral and mild to severe. Further inclusion criteria were date of birth between October 2009, and March 2011, because the children would then be aged between 4 and 5 years of age at the time of assessment. Children were excluded from the study if there were known additional disabilities, or if spoken Norwegian was not used by the child and at least one parent. The latter criterion was necessary due to the instruments used in the study, which were only validated in spoken Norwegian.

In all, 97 children with one or two hearing aids were registered. Three were excluded because they did not speak Norwegian, and 13 were excluded due to additional disabilities. Two more were excluded as one had moved abroad and one did not have a hearing loss diagnosis anymore. Thus, 79 children were invited to the study by letters of invitation. 36

families responded and were included in the study; however, one child was later excluded because the language levels were not sufficient for administering the assessments.

The 35 families included in the study lived throughout Norway, from the southern parts to the northern parts of the country. 17 of the families lived in or near cities, and 18 lived in rural areas. Spoken Norwegian was the preferred language for all of the children, as reported by parents. Six children preferred to support spoken Norwegian with signs. Two children used sign language as a second language, and seven children grew up in families who used another spoken language in addition to spoken Norwegian. 30 of the children used their hearing aids most of the time.

The comparison group of TH children of the same age was drawn from a larger study, the Trondheim Early Secure Study (Wichstrøm et al., 2012). A community sample consisting of all children born in the city of Trondheim in 2003 and 2004 whose parents consented to take part in the study and who were proficient in Norwegian ($n = 2475$) were included and screened using Strengths and Difficulties Questionnaire (SDQ; Goodman, 2001). SDQ total difficulties scores were used to create four strata. Using a random number generator, a sample of 1250 children was selected, oversampling for children with high SDQ total difficulties scores by increasing the drawing probability in the higher score strata. In the present study, a sub-sample of 180 children was drawn from the sample of 1250. Using the same strata and the inverse drawing probabilities, 180 children were included, thus forming a representative sample with SDQ total difficulties score distribution identical to the original population of 2475 children. Due to missing data for some of the instruments, there is some variability in the size of the comparison group (Papers I – III).

Among the HH children, 25.7 % had been to a neonatal intensive care unit, whereas among the TH children, there were significantly fewer; only 9.9 %. There were no other significant differences regarding age, gender, gestation age, or parental education.

2.2 Instruments

2.2.1 The Strengths and Difficulties Questionnaire (SDQ)

SDQ (Goodman, 2001) is a screening tool for psychosocial adjustment. 25 items form five subscales, with five items in each; Emotional problems, peer problems, conduct problems, hyperactivity/inattention and prosocial behavior. The items are statements, such as “often loses temper”, that are rated 0 = not true, 1=somewhat true and 2= certainly true. The sum of the first four scales form the total difficulties score, with a range of 0-40. The SDQ is considered a valid screening instrument for psychiatric disorders in preschoolers (Sveen, Berg-Nielsen, Lydersen, & Wichstrøm, 2013).

Internal consistency on the total problems scale was $\alpha = .76$ and $.87$ for the TH and HH groups respectively, and $.80$ for the two groups combined. This fits well with other studies of TH and DHH populations, with coefficients ranging from $.79$ to $.83$ (Goodman, 2001; Hintermair, 2007). However, internal consistency was fairly low on some of the subscales (Paper I, table 2).

2.2.2 The Social Skills Rating System (SSRS)

SSRS (Gresham & Elliott, 1990) consists of 39 items, forming four subscales with 10 items in each (one item appears in two subscales); Cooperation, assertion, responsibility and prosocial behavior. The items are examples of social behaviors, such as “follows household rules”. The parent rates each item according to how often the behavior occurs (frequency scale), and how important the parent considers the behavior for the child’s development (importance scale). In our study, only the frequency scale was used.

Whereas the original SSRS uses a 3-point Likert scale, the Norwegian version has extended the frequency scale to 4 points (0 = never, 3 = very often) (Ogden, 2003). This version of SSRS has shown good validity (Gamst-Klaussen, Rasmussen, Svartdal, & Strømgren, 2016; Ogden, 2003). Data from SSRS are reported in both Papers I and III. As can

be seen in Paper I, the range of the subscales is 0-22.5, instead 0-30 which would reflect that each scale has 10 items ranging from 0 to 3. The recalculation of the subscales was performed for comparison purposes in another context; however, the transformation did not affect the distribution of the data.

Cronbach's alpha for the total score was .82 (TH), .84 (HH) and .89 (total), comparable to reports of other Norwegian studies (Ogden, 2003).

2.2.3 The Test of Emotion Comprehension (TEC)

TEC (Pons et al., 2004) is an assessment of emotion comprehension administered directly with the child. The child is presented with drawings where the face of the protagonist is left blank. There are different versions for boys and girls, with the gender of the protagonist matching the gender of the child being assessed; apart from gender, the drawings and stories are identical.

Each drawing is accompanied by a short story or description read aloud by the experimenter, and the child is requested to point to one of four facial expressions, to indicate which emotion he or she attributes to the protagonist.

TEC assesses 9 components of emotion understanding, divided into three developmental phases: (1) The external phase, characterized by the understanding of expressions of emotions and situational causes; (2) The mentalistic phase, where the child understands the distinction between expressed and felt emotions as well as the influence of desires and beliefs on emotions; and (3) the reflective phase, referring to the acknowledgement of conflicting emotions and the influence of norms and moral. The components and phases are described in Paper II, table 2.

TEC consists of 21 items, and the number of items within each component varies between one and five. Each component is scored as 1 = accomplished or 0 = not accomplished, resulting in a total score between 0 and 9.

Due to the dichotomous nature of the component scores, Cronbach's alpha was not suitable for calculating internal consistency. Instead, we used Armor's theta. High levels were achieved both for the children ($\theta = .81$) and for the parents' estimation ($\theta = .95$). Previous studies have reported high test-retest reliability (.83 with a three-month delay; Pons, Harris, & Doudin, 2002) and good concurrent validity (see Pons et al., 2014 for a review). TEC has been translated to a wide range of languages, and has also been used previously with DHH children in an Italian study (Mancini et al, 2016).

2.2.4 The Peabody Picture Vocabulary Test (PPVT-III)

PPVT-III (Dunn & Dunn, 1997) is a measure of the child's receptive vocabulary. The child is presented with four drawings, and is requested to point to the drawing corresponding to the target word (e.g., pointing to the drawing of a bus, when the test administrator says "bus"). The whole test consists of 10 blocks with 12 items in each, and in the case of 8 wrong answers in one block the testing is terminated. Cronbach's alpha in our sample ranged between .92 and .97 due to small variations in sample size in the different studies. These values fit well with the reported value for the standardization sample of the same age, which is .95(Williams & Wang, 1997). PPVT-III is widely used both in TH and DHH populations (Bennett, Gardner, & Rizzi, 2014; Betz, Eickhoff, & Sullivan, 2013).

2.2.5 Test of Reception of Grammar (TROG-2)

TROG-2 (Bishop, 2003) is a measure of the child's grammar comprehension. The child is asked to point to one of four drawings after hearing a sentence. Correctly selecting the drawing is dependent on the child's understanding of different grammatical components. The test consists of 80 items, divided into 20 blocks. For a block to be passed, all four items must be answered correctly. After five consecutive blocks that are not passed, the testing ends. Total scores are reported as total number of blocks passed, ranging from 0 to 20. Reliability scores between .87 and .95 are reported (Bishop, 2003; Lyster & Horn, 2009).

TROG-2 scores were not available for the TH group; still, we decided to administer this test to the HH children in order to get a more detailed measure of language development. However, as the scores of TROG were strongly correlated with PPVT-III in the HH group ($r = .76, p < .001$) PPVT-III was used as the only language measure in the analyses.

2.3 Procedure

Upon accepting the invitation for the study, the families of HH children were contacted by phone in order to arrange for a meeting. Most of the families were visited in their home, whereas some preferred to meet at the child's daycare or the facilities of a local service provider. The duration of each visit was 1.5-2.5 hours. Each family received a gift card containing 200 Norwegian kroner, and a small toy for the child.

During the visit, the child was assessed with the instruments PPVT-III, TROG-2 and TEC. Efforts were made in order to optimize testing conditions, for example by reducing background noise (TV, radio, dishwasher), placing the child facing away from windows for favorable lighting, as well as making sure the child was not distracted by family members or pets. Breaks were provided as needed. Parents were sometimes in the room during PPVT-III or TROG-2 assessments, but not during the TEC assessment.

During the assessment of the child, the parent filled out questionnaires; SDQ, SSRS and a general questionnaire including audiological and demographic information. The parent was also presented with TEC, using the same procedure as with the children; only parents were asked to provide the answers they assumed their child had provided. This enabled us to calculate a discrepancy score between the parents' estimation of the child emotion comprehension level, and the child's actual level, as described in Paper II.

The TH children were all examined at the outpatient clinic at the Department of Psychology, NTNU.

2.4 Ethical considerations

As this study included young children, special care was taken in order to prevent adverse experiences for the children or their families. The study was approved by the Regional Committee for Medical and Health Research Ethics, Central Norway. In the planning of the project, several issues were considered.

As the amount of research addressing DHH children is growing, parents may be contacted by several different institutions, asked to participate in projects. This is especially a concern in Norway, because of the small population. As families of DHH children often experience increased demands on the family, such as educational or medical appointments and applications for support, it was important to invite the families in a non-intrusive way, avoiding the impression that they were obliged to participate. The fact that parents had to contact the researcher in order to participate in the study, probably explains the rather low response rate; 36 of the 79 invited families accepted the invitation. However, this procedure ensured that the parents who did not wish to participate did not have to respond at all.

The parents gave their consent on behalf of the children; In addition, all assessments were conducted only if the child agreed to. In four cases, TROG-2 was not performed because the child no longer wished to participate.

Due to the small population of HH children in Norway, no information about each child is provided, in order to protect their privacy. Although withholding such information limits the possibility to assess the validity of the study, we hope to have provided sufficient information about the sample on a group level.

2.5 Statistical analysis

Statistical analyses were performed using the computer software IBM SPSS Statistics, versions 21 and 23. Prior to analysis, the dataset was examined for outliers, heteroscedasticity and non-normality using boxplots, skewness and kurtosis values, Levene's test and Kolmogorov-Smirnov test. Due to skewness and kurtosis, two variables were transformed using natural logarithms: SDQ and age at detection. In Paper III, non-parametrical tests were used because age at amplification and parents' education did not meet the assumptions of normality.

In order to examine whether there were any differences between the HH and the TH group regarding psychosocial adjustment, social skills, emotion comprehension, parental accuracy and vocabulary, independent samples t-tests were performed. Due to the increased risk of type 1 errors when multiple t-tests are performed, the t-statistics p-values were adjusted using false discovery rate (Benjamini & Hochberg, 1995, 2000).

In order to explore whether gender, age at detection or degree of hearing loss were associated with the outcomes, linear regression analyses and Pearson's correlations were performed.

In Paper 3, social skills and vocabulary were compared in three groups; children with TH, children with UMHL and children with MSHL. Analysis of variance (ANOVA) was used. Based on existing theoretical and empirical literature, we could not form clear hypotheses as to which groups would differ from each other. Thus, post-hoc tests were used in order to compare the three groups. Differences between the groups regarding parental education and age at amplification were investigated with the Kruskal-Wallis and Mann-Whitney tests. Associations between social skills, vocabulary, age at detection and parental education were calculated with Kendall's tau correlations.

The sample sizes in our study require special consideration. First, the HH group was rather small ($n = 35$). Moreover, in Paper III, this group was divided into UMHL and MSHL groups, further reducing the sample sizes. When performing linear regressions, a small sample size increases the risk of overfitting of the regression model, if the number of predictors included is larger than the dataset allows. This issue was particularly relevant in Paper I, when performing a regression analysis including the HH sample only. However, by using the adjusted R^2 in the interpretation of the results, the model is less likely to be distorted even with a large number of predictors, as demonstrated by Austin and Steyerberg (2015).

The groups of HH and TH children vary greatly in size, the TH group being substantially larger than the HH group in all the papers. For some analyses that are sensitive to such unequal sample size, measures were taken in order to reduce the adverse consequences. In Paper II, Welch's t was used instead of Student's t in all cases, even if Levene's test suggested that equal variances could be assumed (Zimmerman, 2004). Likewise, in the ANOVA procedure in Paper III, Hochberg's GT2 was chosen as post-hoc test because of its tolerance for unequal sample sizes.

3. Results

3.1 Paper I

In Paper I we compared the psychosocial functioning in 35 4-5-year olds who were HH to that of 180 TH children, using the parent ratings of psychosocial functioning (SDQ) and social skills (SSRS). The HH children had mild to severe degrees of hearing loss. Possible associations between psychosocial functioning in HH children and gender, age at detection of the hearing loss, vocabulary development, degree of hearing loss and risk factors such as prematurity, low birth weight and parents' education were investigated.

Children who were HH evidenced more psychosocial problems than the TH children, and this difference remained after controlling for gender, vocabulary, social skills and risk factors. The difference was most pronounced on the Hyperactivity subscale. In the HH group, boys were rated as having more problems than girls, whereas such gender difference was not evident in the TH group. Among the HH children, low age at detection of the hearing loss was associated with better psychosocial outcomes, whereas vocabulary, degree of hearing loss and risk factors were not. As for social skills, HH children were rated lower than TH children on one subscale (responsibility). No other significant differences between the groups or across gender were detected.

3.2 Paper II

We compared the level of emotion understanding in a group of 35 HH children aged 4-5 years, to that of 130 children with TH. Moreover, we investigated the parents' estimation of their child's level of emotion understanding. Children were assessed with the Test of Emotion Comprehension (TEC). Parents were presented with the same test and asked to guess what their child answered on each item. The correspondence between the child's level and the parent's estimation on each item provided an accuracy score.

HH children performed at the same level as TH children. Scores on emotion understanding were associated with higher parental accuracy and higher vocabulary scores. The TH and HH groups differed in parental accuracy; parents of HH children were more accurate in their estimation of the child's level of emotion understanding. This increased accuracy is likely to benefit the development of emotion understanding in HH children.

3.3 Paper III

In Paper III we examined whether there were any differences in social skills among children with UMHL, MSHL and TH. In addition, among the HH children, we investigated whether social skills were associated with vocabulary or the age at which the children received their hearing aid.

14 children with UMHL, 21 children with MSHL and 123 children with TH participated in the study. All the 35 children with UMHL or MSHL had hearing aids. Social skills and vocabulary were compared across the three groups. For the UMHL and MSHL groups combined, correlations between social skills, vocabulary, age at amplification and parents' education were calculated.

Children with UMHL were rated as having significantly lower social skills than children with TH, whereas children with MSHL received similar scores as children with TH. In contrast, children with UMHL and MSHL had comparable vocabulary scores, but considerably lower than the scores for TH children. The hearing losses of the children with UMHL were detected later than in children with MSHL, and they also received their hearing aids considerably later. Lower social skills were associated with the later age at amplification, but not with vocabulary scores or parents' education level.

4. Discussion

4.1 Psychosocial functioning

4.1.1 Group differences

The most striking difference between the groups is reported in Paper I, regarding psychosocial functioning. The number of reported difficulties was considerably higher in the HH group than in the TH group. The same conclusion was drawn in a recent systematic review and meta-analysis on emotional and behavioral difficulties in DHH children (Stevenson et al., 2015); however, the difference in our study was more profound (Hedge's $g = .87$) than the mean of the studies using SDQ included in the review ($g = .23$). Hence, our study suggests that HH preschool children have considerable risk for psychosocial difficulties, and the risk does not seem to be any less than for the DHH population in general.

Even with well-fitted hearing aids and competent adults in their social environment, HH children may still be confronted with challenges similar to those of deaf children. For example, the noise of large groups of children often makes it difficult for the HH child to access auditory information and to participate in play. They may also be more susceptible to fatigue during the day, leaving less energy for interacting with others. This vulnerability is likely to contribute to psychosocial difficulties such as peer problems, feelings of being lonely and anxiousness for new situations.

4.1.2 Gender differences

The results show a difference in psychosocial outcomes for boys and girls; HH boys seemed to struggle significantly more than HH girls. In contrast, in the TH group, the scores of boys and girls were similar.

Some studies of DHH children have reported equal outcomes in boys and girls (Manfred Hintermair, 2007; Van Eldik, 2005); however, other studies report differences. For example, in preschool children, boys have been reported as having lower psychosocial and

academic functioning than girls (Ching et al., 2013b; Leigh et al., 2015), whereas in adolescence, girls have been reported as having lower self-acceptance and advocacy than boys (Schick et al., 2013). These studies, along with the findings from our study, correspond well with the descriptions of the TH population, with boys having more difficulties in preschool age and girls having difficulties later on (Zahn-Waxler, Shirtcliff, & Marceau, 2008). A thorough discussion of gender differences in psychosocial functioning, including all possible interactions between biological and environmental contributors, is beyond the scope of this thesis.

So our findings fit well with gender patterns of the TH population in the preschool age, however the gender difference was apparent only in the HH group and not in the TH group. Possibly, the hearing loss represents an increased vulnerability to psychosocial difficulties for both boys and girls; only that this vulnerability is more likely to express itself in boys in preschool age and in girls later on. Thus, if the same sample were reassessed in 10 years, possibly the girls would exhibit more psychosocial difficulties.

Alternatively, the implications of the hearing loss might influence social interactions differently in boys and girls, thus causing different transactional effects. For example, shyness is considered more acceptable for girls than for boys, and boys tend to receive more negative responses to shyness than girls do (Doey, Coplan, & Kingsbury, 2014). A HH child is likely to withdraw from some social situations, for example due to noise; possibly, this behavior triggers more negative responses towards HH boys, whereas girls might meet more understanding. Over time, it is likely that such reactions manifest themselves differently in boys and girls.

4.1.3 Early intervention

It has been suggested that psychosocial difficulties of HH children could be related to later diagnosis and therefore underestimation of their support needs during the first years of

life, with an expectation of a better prognosis with the implementation of newborn hearing screening (Moeller, 2007). Our study suggests that even with screening, HH children are still at risk; but early detection does seem to be very important for this group.

In contrast to children with profound hearing loss, many HH children are likely to access some auditory information even before amplification. Especially during the first year of life, the communicative conditions appear quite favorable for most children, whether they have a hearing loss or not; the child interacts mainly with the parents at a short distance, and often in quiet surroundings at home. Moreover, the interaction is likely to include tactile and visual initiatives, and infant-directed speech (Walker-Andrews, 1997) which makes the communication more accessible for a HH child. So why does early intervention seem to be of such importance to HH children?

Evidently, one explanation is that the child, even with some residual hearing, misses important auditory information. Possibly, even when perceiving the more distinct sounds of speech, subtle sounds such as sighing and mumbling – which carry important social and emotional information – could be lost, and the child misses the opportunity to react to these signals from the parent. Difficulties to hear sounds from a distance can also prevent the child from being reassured that the parent is nearby. If the parents are not yet aware of the child's hearing loss, the lack of response from the child may be interpreted as lack of interest or ability, the child may be perceived as difficult to calm, or emotional attunement may prove more difficult. In contrast, a child who is fitted with hearing aids might respond more adequately in interactions. Moreover, for the parents, awareness of the hearing loss and knowledge about its consequences, resulting from early intervention, is likely to influence their interpretation of the child's behavior. They are also more likely to adjust their communication, auditory or visually, to fit the child's needs.

Thus, it is likely that the developmental conditions for a child before and after detection of the hearing loss are quite different, and longer periods of undetected hearing loss increase the chances of negative transaction effects that influence the developmental course over time.

4.2 Emotion understanding

4.2.1 Group differences

In contrast to psychosocial outcomes, TH and HH children performed similarly on emotion understanding, even though HH children had significantly lower vocabulary scores. The same result was reported in an Italian study of children with cochlear implants, aged 4-11 years (Mancini et al., 2016), using the same instrument (TEC). Interestingly, Mancini et al. (2016) report that vocabulary scores were associated with emotion understanding only for the more complex components of the TEC, which are usually acquired in school age, whereas the emotion understanding in the components normally acquired in preschool age were not significantly correlated with vocabulary. Possibly, emotion understanding at preschool age may to some degree be aided by visual and contextual cues as a compensation for language difficulties, whereas for the more complex components that develop later, these are no longer sufficient. Consequently, different aspects of language ability, such as vocabulary, become more important in peer interactions in later childhood. Thus, it is possible that although the children in our sample performed well on the TEC, they could be at risk of lagging behind their peers in emotion understanding as they grow older, if their vocabulary delays persist.

Our study contrasts a previous study on emotion understanding in preschool children with cochlear implants, who report difficulties in emotion recognition and attribution (Wiefferink et al., 2013). Whereas the TEC assesses 9 different components of emotion understanding and therefore have a limited number of items assessing each component, the

study of Wiefferink et al. (2013) studies two of these – recognition and attribution – in depth, which may have increased the possibilities of detecting differences.

4.2.2 Parents' accuracy

Previous studies of TH children report that parental accuracy, defined as the degree to which parents are able to correctly estimate their child's level of understanding, predicts their child's actual emotion understanding (Kårstad et al., 2015); similarly, our study found an association between these two measures in HH children as well. Interestingly, the parents of HH children were more accurate in their estimation of their child's emotion understanding than parents of TH children; though still overestimating, they overestimated to a lesser degree than parents of TH children. Possibly, the parents' awareness of their child's delayed language development may have led them to assume that emotion understanding skills were equally delayed, thus giving lower estimations than parents of TH children and thereby being closer to the child's actual performance. Alternatively, parents of HH children may be more aware than parents of TH children of their child's competence in general, as a result of their worries related to the child's hearing loss and the amount of feedback received by service providers in early intervention. In any case, it is possible that their increased accuracy is beneficial for their children's development of emotion understanding.

4.2.3 Emotion understanding and language

As proposed by Harris et al. (2005), pragmatic aspects of language – rather than vocabulary, syntax and grammar – may be significant in the development of emotion understanding. The quality and content of conversations has been suggested to play an important role in terms of introducing concepts related to mental states and other abstract phenomena, establishing relationships between mental states and external circumstances, as well as directing the child's attention towards events or emotions of specific importance (Thompson, 2006). Some studies suggest that DHH children engage in conversations with

less mental state content and fewer connected turns (Morgan et al., 2014); the child's hearing loss could represent an obstacle for well-connected conversations that are likely to contribute to the child's understanding, however this disadvantage could be moderated by their parents' ability to perceive their child's abilities more accurately and adjust their conversations accordingly. Thus, for HH children, it may be of particular importance to identify the parents who may need support in their understanding of their children. This should be reflected in early intervention services.

4.3 Social skills

4.3.1 Group differences

When comparing the HH group to the TH group, no significant differences in social skills emerged. However, when dividing the HH group into groups of children with UMHL or MSHL, it became apparent that the children with UMHL were rated by their parents as having significantly lower social skills than TH children, whereas the children with MSHL were rated similarly to the TH children. The similar scores between children with MSHL and TH contrast the findings of previous studies including predominantly children with moderate to profound hearing loss, who report a delay in social skills development (Hoffman et al., 2015; Meitzen-Derr et al., 2014). However, one study has also reported social skills at par with TH children among early detected children with cochlear implants (Ketelaar et al., 2013). This fits well with the scores of the children with MSHL, who were also early detected and early amplified. In contrast, children with UMHL received their amplification considerably later.

Although social skills have not previously been studied in children with UMHL specifically, some studies have reported lower ratings of health-related quality of life and lower self-confidence (Keilmann et al., 2007; Wake et al., 2004; Winiger et al., 2016) which suggests that children with UMHL may be at risk also in related areas such as social

functioning. However, it is not likely that the audiological difference between MSHL and UMHL directly puts children with UMHL at greater risk; rather, as children with UMHL have better access to spoken language than children with MSHL and most children grow up in families who use spoken language as their main language (Mitchell & Karchmer, 2004), one would expect that better auditory access gave children with UMHL an advantage in their development of social skills. Still, despite better auditory access, UMHL may change the child's developmental conditions in ways that put them at risk. For example, their needs for support are likely to be underestimated, and could explain the later detection and thus later access to intervention services, including amplification (Fitzpatrick, Durieux-Smith, & Whittingham, 2010). Late amplification, and probably also late intervention in general, is likely to contribute to the delays in social skills development in children with UMHL in our study.

The past decades' advances regarding early detection and intervention for DHH children have predominantly been concerned with moderate to profound hearing loss. Uncertainty about the benefits of early intervention for children with UMHL, combined with less reliable screening results for this group, has caused many screening programs to target only hearing losses exceeding 40 dB, and are thus failing to detect the children with UMHL (Korver et al., 2013; Schnell-Inderst et al., 2006). Our results suggest that there might be important benefits associated with early detection and intervention, such as amplification, in children with UMHL.

4.3.2 Access to different types of social interactions

Even for mild hearing losses, the transactions between parents and children could be altered if the child misses important subtle sounds and the parents misunderstand their child's responses. Parents' awareness of the hearing loss may alter their perception of the child and their responses and initiatives towards the child. Still, why was the effect of degree of hearing

loss observed only in social skills outcomes, and not in vocabulary, psychosocial functioning or emotion understanding?

Although all individual development happens in interaction with the environment, the development of social skills might be especially relying on the interaction in larger social contexts. Through vicarious listening, children experience how others cope with social tasks, and they receive feedback on their own behavior. In contrast, vocabulary acquisition, psychosocial functioning and early emotion understanding may benefit from dyadic interaction as well. For children with UMHL, access to larger social settings may be restricted due to adverse listening conditions, whereas interaction in more intimate settings such as with one parent is still accessible due to proximity and favorable listening conditions. Deprivation of interaction with the extended environment during the first year of life, if the hearing loss is undetected, could possibly affect the development of auditory attention towards distal sounds, and thereby continue to limit the child's interactions even after amplification.

Further research is needed in order to verify the impact of early intervention for children with UMHL, as well as clarifying what aspects of early intervention are effective for this particular group. Still, our findings suggest that even with limited impact on vocabulary development, early intervention could significantly improve social skills development.

4.4 Language and communication

One of the primary aims of early hearing detection and intervention is the promotion of language development (Joint Committee of Infant Hearing, 2007), although other areas such as family well-being and development-promoting family interactions have gained more attention in recent years (Moeller, Carr, Seaver, Stredler-Brown, & Holzinger, 2013).

Arguably, the importance of language should not be ignored, as language provides the means to make sense of past and future events, provide continuity across contexts and make sense of

one's social environment (Harris, 2008); however, our study did not provide solid support for a strong relationship between vocabulary development and psychosocial development. Only emotion understanding was associated with the vocabulary score, and even with vocabulary delays, the HH children as a group still performed at level with TH children. Both gender and age at detection contributed more to psychosocial functioning than vocabulary scores (Paper I), and vocabulary was not associated with social skills (Paper III).

4.4.1 Language measurement

In our study, only one language measure was included in the analyses, namely, the PPVT-III (Dunn & Dunn, 1997) which is an assessment of the child's receptive vocabulary. A test of receptive grammar (TROG-2; Bishop, 2003) was also administered to the HH children, but as this measure was very highly correlated with the scores on PPVT-III and missing in the TH group, only PPVT-III was used in the analyses. Comparisons of the PPVT-III with more general measures of verbal ability have reported moderate to high correlations (For a review, see Williams & Wang, 1997); still, it must be kept in mind that our study does not assess the full range of language abilities. In particular, it must be noted that only the vocabulary of spoken Norwegian is assessed. Even though all children were reported to prefer spoken Norwegian to other languages, the PPVT-III gives an incomplete picture of language ability for the 7 children who grew up in an oral bilingual home, and the 6 children who used sign language as a second language, or signs as support to spoken language.

4.4.2 The relationship between language and psychosocial development

It is commonly assumed that when supporting language, such as vocabulary development, a benefit in psychosocial development follows (Joint Committee of Infant Hearing, 2007). However, it is also possible that a common factor is associated with both vocabulary and psychosocial problems. For example, HH children are likely to spend more cognitive resources when listening, especially in noise (Arlinger, Lunner, Lyxell, & Pichora-

Fuller, 2009); thus, less capacity would be available for other tasks, likely to affect both vocabulary and psychosocial development.

Another possibility is that a certain level of vocabulary skills may be necessary for a child's psychosocial development, but that the impact diminishes after reaching this level. Considering the relationship between degree of hearing loss and language difficulties (Lederberg et al., 2013), and the fact that the vast majority of our HH sample had mild and moderate hearing loss, their vocabulary abilities may have been sufficient for preschool age, even though they were still delayed compared to TH children. However, as linguistic demands in social interactions may become higher in later childhood with increased complexity in the interactions, the associations between vocabulary and psychosocial development could strengthen over time.

4.4.3 Communication and parent-child interactions

The lacking association between vocabulary and psychosocial development in our study fits well with the increasing body of research that addresses the pragmatic aspects of language, or communication competence (Goberis et al., 2012; Harris et al., 2005). Even though the vocabulary skills of the HH children may have been sufficient, although delayed, there is a possibility that they still had considerable difficulties in other communication aspects, such as pragmatic language (Yoshinaga-Itano, 2015), which may have contributed to the psychosocial difficulties. As our study did not include data to investigate communication abilities other than vocabulary, no conclusions can be drawn on this issue. It is possible that whereas vocabulary acquisition may be more readily attainable for children with mild and moderate hearing loss than for children with more severe degrees of hearing loss, the acquisition of pragmatic language skills could be lagging behind as such learning would typically happen in social settings where the auditory conditions are not optimal. Moreover, with a satisfactory level of vocabulary, they may be expected to cope with more complex

social situations than they are capable of. This mismatch between abilities and expectations is likely to produce negative transactional effects, as the risk of misunderstandings and experiences of inadequacy might increase.

With TH children, parents tend to adjust the complexity of their language according to their perceptions of their child's ability (Taumoepeau & Ruffman, 2006). Our study revealed that parents of HH children had lower estimations of the child's emotion understanding, than parents of TH children (Paper II). This finding fits well with studies that report less mental state content in parents' conversations with DHH children than is the case for TH children (Morgan et al., 2014) The lower mental state content could actually be adaptive, as long as it reflects the child's developmental level and the child is not underestimated. In fact, our study suggests that the lower expectations of parents of HH children are more precise than the expectations of parents of TH children, who overestimated their children's level considerably. Such increased accuracy is likely to be beneficial for children's emotion understanding development (Kårstad et al., 2015).

4.5 Implications for early intervention and future research

Early intervention aims to prevent negative outcomes and promote positive development. However, one positive or negative event does not cause the same outcomes in all individuals, and many different events can result in the same outcome (Cicchetti & Rogosch, 1996). Early intervention aiming to prevent adverse outcomes in an at-risk group may appear futile, as the effect of any intervention will depend on each individual and its specific context. But even with considerable individual variation, some outcomes are more likely than others (Cicchetti & Rogosch, 1996), and many prevention programs operating at a selective level have proven effective (Fagan & Benedini, 2016). In DHH populations, the effectiveness of early detection accompanied by early intervention is well documented. Still,

the documented effects have mainly concerned language and academic outcomes, and only to a limited degree psychosocial development (see for example Ching et al., 2013b).

Some uncertainty exists as to who might benefit from early intervention. As the majority of outcome studies include children with moderate to profound hearing loss (Fitzpatrick, Durieux-Smith, Gaboury, Coyle, & Whittingham, 2015), the degree to which children with UMHL benefit from early intervention is less clear. Uncertainty regarding the effect of amplification or other interventions could cause a delay in service provision (Fitzpatrick et al., 2010), and is also reflected on a systems level, in terms of eligibility to services (Holstrum et al., 2009). Moreover, it is not clear which elements of early intervention are effective; the effect of early amplification and consistent use of hearing aids has been investigated (Tomblin, Oleson, Ambrose, Walker, & Moeller, 2014), but other parts of intervention such as family support are less frequently evaluated. Moreover, evaluating the different aspects of early intervention separately may prove difficult, as the effects of different intervention are likely to interact with each other as well.

Thus, three questions regarding early intervention appear: (1) Does early intervention promote psychosocial development in HH children? (2) Is early detection mainly beneficial for children with moderate to profound hearing loss, or should children with UMHL also be included in EDHI programs? And finally, (3) what elements in early intervention are effective? Our findings on psychosocial development in HH children do not provide answers to all these questions; however, some aspects of early intervention that appear in our study serve as useful background for a discussion of these issues.

In Paper I, age at detection was used in the analyses, and in Paper III, age at amplification was used. The two variables were strongly correlated, and it is reasonable to assume that both measures serve as an indication of age at intervention in general, as amplification often co-occurs with other types of intervention.

4.5.1 Early intervention and psychosocial outcomes

Our study provides support for the association between early intervention and psychosocial outcomes; high age at detection was the most important predictor of the occurrence of psychosocial problems. Assuming that early intervention promotes language development (Stevenson et al., 2011), one could argue that the psychosocial outcomes were resulting from better language ability in the early detected children. However, as vocabulary scores contributed very little to the psychosocial outcomes in our study, this explanation seems less likely. Rather, our results suggest that psychosocial functioning benefits from early intervention independently of its effect on vocabulary. This assumption is strengthened by the results on social skills in children with MSHL (early detected) and UMHL (late detected); whereas these groups differed significantly in their ratings on social skills, their vocabulary scores were very similar. Possibly, early intervention may have limited effect on vocabulary scores of children with UMHL as they already benefit from their residual hearing, but the effect on social skills could be quite substantial. This hypothesis underscores the importance of considering a multitude of developmental outcomes in the planning and evaluation of early intervention programs.

Due to the limitations of the cross-sectional design, causal relationships between early intervention and psychosocial outcomes cannot be assumed from our study. Other variables such as degree of hearing loss could influence both the timing of intervention and psychosocial outcomes. In our study, degree of hearing loss was related to age at detection and age at amplification, but not to psychosocial functioning; however it should be kept in mind that other factors, not included in our study, could confound our results. For example, socioeconomic or health-related challenges may slow down the diagnostic process and age at amplification if families do not show on the appointments, and are also likely to affect psychosocial development. Future longitudinal studies are needed to clarify these issues

further; however with the current state of knowledge, the possibility of early intervention promoting psychosocial functioning and social skills should not be discarded.

4.5.2 Early intervention for children with UMHL

Previous research has suggested that HH children who are late identified might be at risk for psychosocial difficulties, and it was assumed that early detection as a result of newborn hearing screening would alleviate this risk (Moeller, 2007). However, even though newborn hearing screening has reduced the age at detection considerably, children with UMHL are still diagnosed later than more severe losses (Fitzpatrick et al., 2010). These findings were replicated in our study, as reported in Paper III.

The service provision and support provided to children with UMHL have been characterized by uncertainty among both professionals and parents, and great variability in terms of access, scope and content of early intervention (Fitzpatrick et al., 2016; Holstrum, Gaffney, Gravel, Oyler, & Ross, 2008). Many factors are likely to contribute to this uncertainty and variability; for example, the practical issues of hearing aid use for babies could put some stress on parents, and if the hearing loss is mild they may not appreciate the importance of hearing aid use. Also for professionals, the benefits of amplification of UMHL is less certain, thus they may be hesitant to recommend hearing aids, and be less persistent to parents concerning the amount of use. Likewise, the need for the family to receive other types of support such as information about hearing loss, communication counselling and meeting other parents of children with hearing loss may not seem as necessary, as a mild or unilateral hearing loss has fewer consequences for the language development than a severe or profound hearing loss has. Moreover, service providers may prioritize children with the most profound hearing losses, in the case of limited resources.

Our study suggests that children with UMHL do benefit from early intervention. Although most children with UMHL benefit from their residual hearing and therefore have

better access to verbal communication than children with moderate to profound losses even before the hearing loss is diagnosed, early detection and intervention is likely to affect their development in several ways. Naturally, early amplification improves their access to verbal communication in a wider range of contexts, thus providing more opportunities for interactions with their parents and others. This could be especially important in terms of social competence, which may warrant experiences not only in the parent-child dyad, but also in larger social contexts, for example listening to other family members' conversations or participating in play with a group of children. Possibly, early amplification may help babies to direct their attention towards these situations, thus affecting their interest and ability to participate as they grow older.

With early intervention, the interactions between the child and the environment could increase not only in quantity, but also in quality. The limitations of a unilateral or mild bilateral hearing loss are not as obvious as with moderate to profound hearing losses, as the child functions quite well in many communication settings. Knowledge about the limitations helps the parents in interpreting their child's behavior. For example, if the child withdraws in the presence of background noise or does not calm down by the voice of the parent in another room, it could be interpreted by the parents as consequences of the hearing loss rather than personal attributes such as shyness or anxiousness. The different interpretations are likely to trigger quite different responses from the parent, and over time, create positive or negative transaction effects that shape the development of the child.

4.5.3 Content in early intervention

Early intervention includes not only amplification; the family is typically offered support such as support in development of spoken and/or sign language, parent workshops and special education. Although our study did not collect data concerning these services, it is likely to assume that the timing of such interventions correspond relatively well with age at

amplification. Although our study supports the notion that early intervention promotes psychosocial development and is also important for children with UMHL, it is still unclear what parts of early intervention that promotes development, and whether children with different degrees of hearing loss benefit from the same types of intervention. For example, it is likely that children with severe loss would need more support in their language development than a child with mild hearing loss. In contrast, for children with mild and unilateral hearing loss, there might be a stronger need to help parents interpret the behavior of the child, as the limitations related to the hearing loss could be more subtle than in the case of more severe losses, and easily misinterpreted.

On the other hand, although the aims of early intervention differ according to what negative outcomes one wants to prevent, the interventions do not necessarily need to be different. The strong effect of early intervention as demonstrated in Paper I and III are likely the result of early intervention aiming to promote language and communication development, rather than specific interventions addressing psychosocial difficulties or social skills. These effects could in part be mediated by language development, as better language ability is likely to promote psychosocial development as well, but it is also likely that early intervention promotes language development and psychosocial development simultaneously, independent of each other, as demonstrated by the lacking association between vocabulary scores and psychosocial functioning.

4.6 Strengths and limitations

Our study has some strengths, as well as some limitations that must be kept in mind when interpreting our findings. One of the strengths is the narrow age range, enabling a study of this age group specifically without confounding factors related to school enrollment and changes in the attributes of psychosocial difficulties with increasing age.

However, the narrow age range resulted in a very small HH sample, including only 35 children. In Paper III, this group is split in two, resulting in even smaller groups. Moreover, our study was cross-sectional, which prevents us from drawing conclusions about causality. Future studies with larger sample sizes and longitudinal design are needed to strengthen and elaborate the findings presented in our study.

The HH participants were recruited from all over Norway, and are assumed to represent the population of Norwegian HH children, coming from both urban and rural areas and from different regions. Whereas samples that are recruited from service institutions may be biased as in an overrepresentation of children who have difficulties and therefore seek help, our study recruited from audiology departments. Thus, all hearing aid users aged 4-5 years in Norway were included regardless of degree of contact with other service providers. However, some aspects concerning bias should be considered. For example, the response rate was rather low; 36 of 79 families, and we do not have any information about the families who did not accept the invitation to the study. In order to participate, parents had to actively contact the researcher by phone, email or post; thus, non-participation could simply be due to a slip of mind or indecision, rather than refusal. Alternatively, it is possible that families with extra stressors, such as economic or health-related burdens, were reluctant to participate, especially as the study involved a home visit. Still, there were no significant differences between the HH and TH group regarding sociodemographic variables such as parents' education and work situation, which gives some indication of the representability of the HH sample.

Another possible source of bias is that only children wearing hearing aids are included. In children with UMHL, the effect of hearing aids is subject to uncertainty, and it is possible that children are more likely to receive hearing aids if they seem to struggle in some developmental area or if their parents have concerns, thus causing a selection bias (Lieu &

Dewan, 2010). The same mechanisms are possible also for the children with severe hearing loss, as some receive cochlear implants (thus not included in our study) and some wear hearing aids. Therefore, it must be kept in mind that the presented findings concern children with hearing aids only.

It is estimated that 30-40 % of children with hearing loss have additional disabilities (Picard, 2004). In the recruitment process of our study, children with known conditions other than the hearing loss were excluded, in order to reduce the number of confounding factors. However, some difficulties may not yet have been diagnosed in preschool age; for example, autism spectrum disorders are often diagnosed later in DHH children than in TH children, as the symptoms could be misinterpreted as being hearing loss related (Szarkowski, Flynn, & Clark, 2014). The risk of additional conditions is partly associated with the etiology of the hearing loss (Picard, 2004), however as the cause of hearing loss was unknown in the majority of the participants, we were not able to control for this variable.

Some aspects of the data collection also deserve some attention. Receptive vocabulary was used as the only language measure. Thus, it is possible that other parts of language development, such as syntactic understanding or expressive language ability, may have confounded the results. Moreover, 6 children used some signs to support their Norwegian; two of whom also used full sign language in addition to spoken Norwegian – in addition, seven children lived in oral bilingual homes (spoken Norwegian and one additional spoken language). Thus, some children may have had a larger vocabulary than what was measured, in other languages. Although receptive Norwegian vocabulary provides an indication of language ability, it does not show the whole range of language abilities.

The parent reports used in the study, SDQ and SSRS, have evidenced good psychometric properties. Moreover, they are frequently used in both TH and HH populations (Antia, Jones, Luckner, Kreimeyer, & Reed, 2011; Fraley, Roisman, & Haltigan, 2013;

Stevenson et al., 2015; Sveen et al., 2013), facilitating comparisons across studies. However, parent ratings could be inaccurate, perhaps especially in the DHH population as some behaviors could be attributed to the hearing loss rather than to an emotional or social problem. Multi-rater assessment has been recommended in studies of DHH children and adolescents (van Gent, Goedhart, A., & Treffers, 2007); however, this was not possible in the present study.

5. Conclusions

HH preschool children show more signs of psychosocial problems than TH children. The difference could not be attributed to lower vocabulary score or degree of hearing loss. Rather, children who were detected at an early age seemed to have better functioning than children who were detected late. Whereas the benefit of early detection is well known for children with severe and profound hearing loss, our results show that even children with unilateral, mild and moderate hearing losses are at risk for adverse development if the hearing loss is not diagnosed within the first year. Our findings that social skills development was delayed in late detected children with unilateral and mild bilateral hearing loss supports this conclusion. Moreover, detection and diagnosis of mild and unilateral hearing loss seems to happen at a much later age than for more severe hearing losses. The newly published national guidelines for assessment and management for children with suspected hearing impairments (Helsedirektoratet, 2016), stating that babies with congenital hearing loss should be diagnosed within 3 months of age, are valuable contributions in the process of lowering the age at diagnosis. However, the challenges concerning identification of mild hearing losses are not yet overcome, which means that these children are still at risk for late detection. Given the described benefit of early detection even for milder hearing losses, efforts to improve screening and diagnostic tools for these losses are important.

The psychosocial functioning and social skills scores were not associated with the vocabulary scores. This serves as an important reminder that vocabulary, and possibly other measures of language and communication, do not tell the whole story about HH children; in fact, even with similar vocabulary ability, children may differ in their psychosocial functioning and social skills. The monitoring of the developmental process of the child in a wider sense than language and communication ability may prevent adverse development in HH children. Much of the support provided to families intended to promote language

development are also likely to promote other areas of development, as suggested by the better estimation accuracy in parents of HH children. These areas of development are of great importance, and should not be considered fortunate side effects of language promoting intervention; rather, aiming to promote the development of the whole child should be explicitly stated in early intervention programs.

6. References

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7. Papers I-III



Paper I

Laugen, N. J., Jacobsen, K. H., Rieffe, C., & Wichstrøm, L. (2016).

Predictors of Psychosocial Outcomes in Hard-of-Hearing Preschool Children.

Journal of Deaf Studies and Deaf Education, 21(3), 259-267.

doi:10.1093/deafed/enw005

EMPIRICAL MANUSCRIPT

Predictors of Psychosocial Outcomes in Hard-of-Hearing Preschool Children

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Abstract

Children with hearing loss are at risk for developing psychosocial problems. Children with mild to severe hearing loss are less frequently subject to research, in particular in preschool, and we therefore know less about the risk in this particular group. To address this, we compared psychosocial functioning in thirty-five 4–5-year olds with hearing aids to that of 180 typically hearing children. Parent ratings of psychosocial functioning and social skills, as well as scores of receptive vocabulary, were obtained. Children with hearing loss evidenced more psychosocial problems than hearing agemates. Female gender and early detection of hearing loss predicted better psychosocial functioning among children with hearing loss, whereas vocabulary and degree of hearing loss did not. Early intervention addressing psychosocial functioning is warranted for children with all degrees of hearing loss, including mild and moderate. Gender differences should be investigated in future research.

Children who are deaf and hard of hearing (DHH) are at risk for psychosocial problems (Fellinger, Holzinger, Sattel, & Laucht, 2008; Moeller, 2007). Identifying the prevalence of psychosocial problems and their potential causes are vital to prevent and ameliorate these. Research has often addressed children with cochlear implants (Hogan, Shipley, Strazdins, Purcell, & Baker, 2011), but we know comparatively less about the psychosocial development of hard-of-hearing (HH) children; that is, children with mild to severe hearing loss (25–89 dB) who often use spoken language as their main language and who benefit from hearing aids rather than cochlear implants. By many, this group has been described as “historically underserved” (Holte et al., 2012, p. 163). This lack of knowledge even concerns basic information such as gender differences in psychosocial problems, as outcomes about this particular group are rarely reported separately in DHH research.

Psychosocial adjustment includes emotional, social, and behavioral aspects. Development within these areas is associated with one’s mental health, which is defined by WHO as “a state of well-being in which every individual realizes his or her

own potential” (WHO, 2014). There is a substantial continuity in psychosocial difficulties from preschool years to middle childhood and adolescence (Luby, Gaffrey, Tillman, April, & Belden, 2014), thus emphasizing the importance of early intervention in this area. Even so, most research has been directed towards middle childhood and adolescence. It is therefore especially important to study preschoolers to provide a knowledge base to build early interventions upon. Specifically, there is a considerable lack of knowledge about (a) the prevalence of psychosocial problems and (b) its relation to degree of hearing loss, gender, and other potential risk and protective factors in HH preschool children. The overarching aim of this study is therefore to provide such information.

Degree of Hearing Loss

The majority of the DHH population has mild to moderate hearing loss. The share varies due to different samples and definitions, but numbers between 55% and 70% are reported (Caluraud et al., 2015; Russ et al., 2003; Wake, Poulakis, Hughes, Carey-Sargeant,

& Rickards, 2005). Although some aspects of deafness are applicable regardless of degree, for example, the inability to follow a conversation in noisy surroundings, there are important differences between milder and more profound hearing loss. HH children have to some degree access to language very early in life; in contrast, children with profound loss have no access to language until cochlear implantation or hearing aid fitting, unless their parents are familiar with sign language. On the other hand, HH children may be at risk for not receiving timely intervention. Firstly, they may be diagnosed later than deaf children, as the hearing loss is not as easily observable. Secondly, intervention can be delayed as parents may be less aware of the need for such if the hearing loss is mild or moderate (Walker et al., 2014). Thus, different degrees of hearing loss may affect psychosocial development through different mechanisms.

Psychosocial Problems in HH Children

Several studies have documented increased prevalence of psychosocial problems in DHH children. However, as demonstrated in a recent review (Stevenson, Kreppner, Pimperton, Worsfold, & Kennedy, 2015), very few studies include preschool children. Though language problems tend to be more severe in children with profound hearing loss than in HH children (Fitzpatrick, Crawford, Ni, & Durieux-Smith, 2011), the association between degree of hearing loss and psychosocial problems is less clear. Whereas one study reports little relationship between degree of hearing loss and prevalence of diagnosable mental health problems (Fellinger, Holzinger, Sattel, Laucht, & Goldberg, 2009), another study suggests that higher degree of hearing loss predicted psychosocial adjustment problems in elementary, secondary, and high school students (Polat, 2003). To complicate further, HH children may even suffer more than those with profound hearing loss; in a study by Wake, Hughes, Collins, and Poulakis (2004), parents of 7- to 8-year-old children with milder hearing loss reported lower health-related quality of life for their children, as compared to parents of children with more severe losses. Thus, there is no clear lesson to be learned from studies of DHH children regarding the psychosocial adjustment in HH children. Heterogeneity regarding age range and degree of hearing loss may explain some of the inconsistencies in previous research (Moeller, 2007). In the present study, we therefore included only HH children in a narrow age range.

Psychosocial Problems in Preschool Age

Studies demonstrate lower social competence and more behavior problems in deaf or cochlear implanted preschool children, compared to children with typical hearing (TH) (Barker et al., 2009; Hoffman, Quittner, & Cejas, 2015; Wiefferink, Rieffe, Ketelaar, & Frijns, 2012). Although older research suggests similar difficulties for HH children (Prior, Glazner, Sanson, & Debelle, 1988), newer research on infants and toddlers has been inconclusive. To illustrate, Stika et al. (2015) recently found that early identified HH children displayed social competence scores comparable to TH peers at the age of 12–18 months. In contrast, Topol, Girard, St. Pierre, Tucker, and Vohr (2011) found more symptoms of withdrawal and internalizing problems in children aged 18–24 months. Notably, the symptoms were more prevalent among children with mild or unilateral hearing loss compared to those with moderate to profound hearing loss, which the authors suggested could be related to lacking amplification in the mild/unilateral hearing loss group. However, a study on preschoolers with hearing loss ranging from mild to profound found social skills to be within the normal range, and

that degree of hearing loss did not predict outcomes (Leigh et al., 2015). In sum, it seems that although many HH children may have social skills comparable to TH children, other areas may still be problematic. There is a need for a closer description of the different areas of development that may be at risk.

Gender Differences

Several studies of the general population have documented gender differences in the prevalence and clinical manifestations of mental health problems (Luby et al., 2009; Tanidir et al., 2015; Zahn-Waxler, Shirtcliff, & Marceau, 2008). Girls and boys show differences in their social development from an early age; boys seem to have less impulse control and be more confronting and aggressive, both physically and verbally, especially during preschool years (Zahn-Waxler et al., 2008). Preschool girls, on the other hand, tend to be more cooperative and exhibit more prosocial behavior. As the presence of a hearing loss affects the child's interaction with their social environment, and this interaction differs between boys and girls, it is reasonable to ask if and how gender differences interact with the effects of the hearing loss.

Very few studies have investigated gender differences in psychosocial outcomes for DHH children. To our knowledge, no differences between genders have been documented in school-age children and adolescents (Hintermair, 2007; Van Eldik, 2005; Van Eldik, Treffers, Veerman, & Verhulst, 2004). As for preschool children, one study reports a slight gender difference in 3-year-old DHH children; girls performed better than boys on social and self-help skills, as reported by parents (Leigh et al., 2015).

Age at Detection

The importance of early detection and early intervention with regard to language development is well documented for children with severe and profound hearing loss, with special attention to children who receive a cochlear implant (Geers & Nicholas, 2013; Yoshinaga-Itano, 2003). However, the relationship between psychosocial development and early intervention is still unclear; Stevenson et al. (2011) did not find any relationship between behavior problems at age 5–12 years and age at detection, whereas Korver et al. (2010) found a relationship between early detection and several developmental outcomes, including social development and quality of life, in 3–5-year olds.

When a profound hearing loss is diagnosed, decisions need to be made regarding interventions like cochlear implantation, sign language programs, and auditory-verbal therapy. However, for HH children, intervention needs may not be as obvious. For example, parents and local service providers may doubt the diagnosis, as they observe that the baby responds to loud sounds. This could cause a delay of service provision, even when the hearing loss is detected early through universal newborn hearing screening (Holte et al., 2012; Walker et al., 2014).

Given the potential effect of early intervention for HH children, and the lack of knowledge concerning the extent and predictors of psychosocial problems on which to base such interventions, we collected data from children with hearing loss ranging from unilateral/mild to severe. The majority had mild or moderate hearing loss. We asked (a) whether HH 4-year olds are at greater risk for psychosocial problems and poor social competence compared to TH children, (b) whether gender differences in psychosocial adjustment and social competence are different in HH children compared to TH children, and (c) to what extent receptive vocabulary, age at detection, and degree of hearing loss predict psychosocial problems among HH preschool children.

Method

Participants

All audiology departments in Norway were asked to assist in the work of family recruitment. Of all 21 departments that serve children, 19 agreed to participate. Two special education providers were also recruiting participants. In all, 79 letters of invitation were distributed to families all over Norway, and 36 families accepted the invitation. Inclusion criteria were: age 4–5 years at the time of assessment, use of hearing aid in one or both ears, spoken Norwegian being one of the languages used by the child and at least one parent, no cochlear implantations, and no additional diagnoses. One child was excluded from the study due to insufficient spoken language.

Of the 35 HH children who were included, 7 reported genetic reasons and 2 reported birth complications as the cause of hearing loss. The majority did not know the cause of hearing loss. The families lived throughout Norway, 17 lived in rural areas and 18 in or near cities. Six children preferred sign supported Norwegian and the remaining preferred spoken Norwegian. Further details about participants are described in Table 1. We have no data on the families who did not reply.

The control (TH) group was drawn from an existing community sample, reported in Wichstrom et al. (2012). These children had previously been assessed with all the instruments used in this study. From the original sample of 1,250, 180 were drawn from the community sample to act as a control group. Because the original sample was screen stratified according to psychosocial problems, we drew comparatively more children from the strata with no or low psychosocial problems and fewer children high on psychosocial problems. The proportion drawn from each sample was factored by the inverse of the initial drawing probability when the larger community sample was created (see figure 1 in Wichstrom et al., 2012). Using a random number generator when drawing within each stratum, the effect was henceforth that our control group formed a representative sample of TH children. None of the 180 TH children had parent-reported hearing loss. There were no significant differences between the HH and TH group regarding age, gender, mothers' education, or prematurity. A larger proportion of HH children had a history of neonatal intensive care unit (NICU) stay (25.0% vs. 7.8%, Fisher's exact $p = .022$; see Table 1). None of the children had any additional disabilities as reported by parents.

Procedure

The families of the HH children were seen at home, in the child's daycare or in the facilities of a local service provider, by a clinical psychologist experienced in working with children with hearing loss. In 9 cases, both parents were present, only fathers in 2 cases, and only mothers in the remaining 24 cases. Parents filled out a questionnaire concerning the child's psychosocial functioning, social competence as well as on demographic and health information while the child's receptive vocabulary was assessed by the psychologist. Care was taken to minimize visual and auditory noise during the assessment. Signing was used to support communication with some of the children; however, the language assessment was conducted in spoken Norwegian only, without sign support. The TH children were examined at the University. The study was approved by the Regional Committee for Medical and Health Research Ethics.

Measures

The Strengths and Difficulties Questionnaire (SDQ; Goodman, Ford, Simmons, Gatward, & Meltzer, 2000) is a screening tool for psychosocial adjustment, including four subscales for difficulties (emotional problems, peer problems, conduct problems, and hyperactivity/inattention) and one subscale for strengths (prosocial behavior). The 25 items are rated 0 = not true, 1 = somewhat true, and 2 = certainly true. The scores of the four difficulties subscales are also added for a total difficulties score, with a range of 0–20. The SDQ also proves to be an excellent screening instrument for psychiatric disorders in preschoolers (Sveen, Berg-Nielsen, Lydersen, & Wichstrøm, 2013).

Internal consistency for the total problems scale, reported in Cronbach's α coefficients, range from .79 to .83 both in TH and DHH samples (Goodman, 2001; Hintermaier, 2007). In this study, as can be seen in Table 2, internal consistency was fairly low for some subscales.

The Social Skills Rating System (SSRS; Gresham & Elliott, 1990) provides a parent-reported assessment of a range of social skills. The 39 items are examples of social behaviors, like ability to make friends or to follow household rules, and are rated by parents on a 4-point frequency scale (how often does the behavior occur) and a 3-point importance scale (how important is the behavior for the child's development). In addition to the total score, four subscales are available: Cooperation, assertion, responsibility, and prosocial behavior.

The Peabody Picture Vocabulary Test, 3rd version (PPVT-III; L. M. Dunn & D. M. Dunn, 1997) is a measure of the child's receptive vocabulary. The child is presented with four drawings and is requested to point to the drawing corresponding to the target word (e.g., pointing to the drawing of a bus, when the test administrator says "bus"). The whole test consists of 10 blocks with 12 items in each, and in the case of 8 wrong answers in one block, the testing is terminated.

Age at detection, measured in months, was obtained through parents' reports. Age at first hearing aid fitting was also reported

Table 1. Demographic profile of participants

	TH (n = 180)	HH (n = 35)
Age, mean (SD) months	55.0 (3.4)	56.7 (6.2)
Boys	55.0 (3.3)	58.5 (6.3)
Girls	55.0 (3.5)	55.1 (5.9)
Male gender, no (%)	94 (52.2)	16 (45.7)
Missing	3 (1.7)	
Gestation age	39.4 (2.9)	39.5 (2.7)
NICU stay, no (%)	14 (7.8)*	9 (25.7)*
Missing	39 (21.7)	
Maternal education >12 years, no (%)	104 (75.9)	28 (80.0)
Missing	43 (23.9)	
Degree of hearing loss, no (%)		
Unilateral ^a		4 (11.4)
Mild (26–40 dB)		10 (28.6)
Moderate (41–55 dB)		15 (42.9)
Moderately severe (56–70 dB)		4 (11.4)
Severe (71–90 dB)		2 (5.6)
Age at detection, months (SD)		15.8 (15.8)
Age at amplification, months (SD)		22.8 (17.4)

Note. HH = hard of hearing; NICU = neonatal intensive care unit; TH = typical hearing.

^aDegree of unilateral hearing loss ranged from mild to profound.

* $p < .05$.

Table 2. Psychometric properties, means, and intergroup differences

Variable	Range	α	TH	HH	t	p	P_{bh}	95% CI	g
Strengths and difficulties									
Emotion	0–10	.67	1.42 (1.59)	2.31 (2.11)	2.76	.006	.014	0.09, 0.54	0.53
Hyperactivity	0–10	.79	2.46 (2.00)	4.26 (2.53)	4.03	.000	.000	0.24, 0.68	0.86
Conduct	0–10	.44	1.03 (1.07)	1.49 (1.34)	1.96	.051	.077	–0.00, .038	0.41
Peer	0–10	.55	0.82 (1.28)	1.52 (1.65)	2.86	.005	.014	0.10, 0.51	0.52
Prosocial	0–10	.56	8.38 (1.43)	8.14 (1.67)	–0.99	.323	.352	–0.09, 0.03	0.16
Total problems	0–40	.80	5.72 (4.06)	9.58 (5.97)	3.90	.000	.000	0.23, 0.70	0.87
Social skills									
Cooperation	0–22.5	.70	11.32 (2.27)	11.20 (3.15)	0.25	.804	.804	–1.07, 0.83	0.05
Assertion	0–22.5	.75	13.59 (2.67)	12.73 (3.31)	–1.59	.113	.151	–1.93, 0.21	0.30
Responsibility	0–22.5	.67	11.00 (2.59)	9.42 (3.19)	–3.01	.003	.012	–2.61, –0.54	0.58
Self-control	0–22.5	.83	13.57 (2.96)	12.94 (3.05)	–1.10	.272	.326	–1.76, 0.50	0.21
Total score	0–90	.82	49.58 (8.40)	46.15 (10.51)	–1.99	.048	.077	–6.84, 0.28	0.38
Vocabulary	0–120	.92	63.59 (19.85)	54.09 (22.32)	–2.45	.016	.032	–17.18, –1.83	0.47

Note. SDs are in parentheses. CI = confidence interval; HH = hard of hearing; TH = typical hearing. g = Hedge's g ; P_{bh} = p values corrected for multiple comparisons, by false discovery rate.

and included in preliminary analyses; however, as age at detection and age at first hearing aid fitting are interdependent and indeed were highly correlated, $r = .88$, $p < .01$, only age at detection is reported here.

Degree of hearing loss was reported by parents for each ear separately, using the categories normal (<25 dB), mild (26–40 dB), moderate (41–55 dB), moderately severe (56–70 dB), severe (71–90), and profound (>90 dB). In some cases where the parents were not sure of their child's degree of hearing loss, they contacted the audiology department for clarification. Hearing loss in best ear was used in the analyses.

A measure of risk factors was constructed as a sum of three variables: Whether or not the child had been admitted to a NICU, whether or not the child had been premature (born in gestation week 36 or earlier), and whether the mother had 12 years or less of education. This resulted in a scale ranging from 0 to 3.

Statistical Analyses

All statistical analyses were performed using the computer software IBM SPSS Statistics, version 21. The data set was examined for normality, outliers, and influential cases. By indication of skewness and kurtosis, data were transformed into natural logarithms for the SDQ scores as well as age at detection. However, for presentation purposes, means and SD are reported from nontransformed data.

Differences in psychosocial outcomes between the HH and TH group, as well as gender differences within each group, were tested using independent samples t tests. In order to compensate for multiple comparisons, we corrected p values with false discovery rate as described by Benjamini and Hochberg (1995; 2000). Due to the small sample size, Hedge's g was used to estimate effect size, which was used along with t tests for interpretation. To analyze multivariate associations with SDQ total problems score, a multiple regression analysis was conducted, including group, gender, vocabulary, social skills, and risk factors as covariates. To test whether any gender differences between the HH and TH groups were significantly stronger in one of the groups, a series of linear regressions were conducted for all subscales of SDQ and SSRS, including age, group, gender, and the group*gender product as independent variables. To address the question of potential predictors of psychosocial development in HH children, a hierarchical regression analysis was performed

on the HH group with SDQ total problems score as the dependent variable. Based on previous research, we included age at detection, degree of hearing loss, vocabulary, and risk factors as independent variables. We also included gender, based on the findings in the present study. As the number of predictors was rather large for the small sample size, adjusted R^2 was used in the interpretation of the results, as recommended by Austin and Steyerberg (2015).

Results

Prevalence of Psychosocial Problems

Table 2 presents means, intergroup differences, and psychometric properties for the TH and HH groups. Corrected p values are marked P_{bh} . As portrayed in the Table 2, independent samples t tests and Hedge's g estimates revealed that HH children evidenced more emotional, hyperactivity, and peer problems than TH children. The difference in hyperactivity was most pronounced—HH children scoring about 1 SD above TH children. The higher problem scores among HH children were also reflected in a higher total score on the SDQ. In a multiple linear regression analysis controlling for gender, vocabulary, social skills, and risk factors, the presence of hearing loss still remained a significant predictor of psychosocial problems, $B = .35$, $\beta = .23$, $p = .002$, 95% confidence interval (CI): 0.13, 0.57. As for social skills subscales, the responsibility scale was the only one reaching significance. The receptive vocabulary score of HH children was about half a SD below that of TH children.

Gender Differences

As presented in Table 3, there were no gender differences for any of the measures in the TH group. For the HH group, the difference between boys and girls was significant for SDQ hyperactivity and total problems. Regression analyses controlling for age revealed a significant interaction effect between group and gender regarding SDQ total problems score, $B = .61$, $\beta = .26$, $p = .012$, 95% CI: 0.14–1.08, as well as the hyperactivity subscale, $B = .58$, $\beta = .26$, $p = .014$, 95% CI: 0.12–1.05, confirming that the gender difference was significantly stronger in the HH group than in the TH group. The gender difference in the HH group remained significant when controlling for confounding factors, as presented in Table 4.

Table 3. Gender differences in psychosocial problems, social skills, and language

Variable	TH					HH				
	Boys	Girls	<i>p</i>	<i>P_{bh}</i>	<i>g</i>	Boys	Girls	<i>p</i>	<i>P_{bh}</i>	<i>g</i>
Strengths and difficulties										
Emotion	1.54 (1.72)	1.27 (1.41)	.375	.996	0.17	3.00 (2.61)	1.74 (1.41)	.175	.334	0.60
Hyperactivity	2.52 (2.19)	2.35 (1.78)	.996	.996	0.08	5.56 (2.00)	3.16 (2.43)	.002	.024	1.04
Conduct	1.14 (1.12)	0.89 (0.99)	.095	.996	0.23	1.88 (1.36)	1.16 (1.26)	.079	.237	0.54
Peer	0.69 (1.09)	0.88 (1.37)	.322	.996	0.15	1.88 (1.71)	1.22 (1.58)	.195	.334	0.39
Prosocial	8.26 (1.42)	8.53 (1.42)	.230	.996	0.19	8.19 (1.87)	8.11 (1.52)	.981	.981	0.05
Total problems	5.89 (4.45)	5.39 (3.37)	.843	.996	0.13	12.31 (5.79)	7.28 (5.22)	.006	.036	0.90
Social skills										
Cooperation	11.25 (2.10)	11.38 (2.43)	.764	.996	0.06	11.08 (3.28)	11.31 (3.12)	.837	.913	0.07
Assertion	13.67 (2.78)	13.51 (2.58)	.743	.996	0.06	13.45 (3.90)	12.13 (2.68)	.242	.363	0.39
Responsibility	11.08 (2.50)	10.92 (2.69)	.728	.996	0.06	10.22 (3.21)	8.74 (3.09)	.176	.334	0.46
Self-control	13.54 (2.98)	13.60 (2.97)	.910	.996	0.02	12.48 (3.46)	13.33 (2.70)	.423	.564	0.27
Total score	49.54 (8.33)	49.62 (8.53)	.960	.996	0.01	47.22 (11.48)	45.18 (9.80)	.579	.695	0.19
Vocabulary	64.33 (18.90)	62.88 (20.84)	.679	.996	.07	61.88 (16.15)	47.53 (24.99)	.057	.228	0.66

Note. SDs are in parentheses. HH = hard of hearing; TH = typical hearing. *g* = Hedge's *g*; *P_{bh}* = *p* values corrected for multiple comparisons, by false discovery rate.

Table 4. Hierarchical linear regression analyses predicting SDQ total problems scores in hard-of-hearing children (*n* = 35)

Variable	Step 1		Step 2		Step 3		95% CI
	β	<i>p</i>	β	<i>p</i>	β	<i>p</i>	
Age at detection	.59	.001	.49	.003	.49	.003	0.07, 0.32
Degree of HL	.07	.671	-.01	.923	-.02	.889	-0.18, 0.21
Gender			-.43	.008	-.44	.008	-0.97, -0.16
Vocabulary			-.26	.079	-.26	.084	-0.02, 0.00
Risk factors					-.09	.528	-0.33, 0.17
<i>R</i> ²	.33		.50		.51		
ΔR^2	.33		.17		.01		
Adjusted <i>R</i> ²	.28		.42		.41		
ΔF	7.05		4.56		0.41		
<i>p</i> ΔF	.003		.020		.528		

Note. CI = confidence interval; HL = hearing loss; SDQ = Strengths and Difficulties Questionnaire. Risk factors = prematurity, intensive care unit stay, low maternal education.

Predictors of Psychosocial Problems

To detect possible predictors of psychosocial problems among HH children, a hierarchical regression analysis was conducted in the HH group with the SDQ total problems score as the dependent variable. As can be seen in Table 4, Step 2 in the regression including four variables revealed that young age at detection and female gender predicted better outcomes, whereas degree of hearing loss and vocabulary did not. Including risk factors in Step 3 did not change the model significantly. Adjusted *R*² in Step 2 and 3 indicate rather large effect sizes (Cohen, 1992).

Discussion

Due to the lack of research on which to base early interventions among HH children with hearing aids, we raised three issues when comparing the psychosocial functioning of HH preschoolers with hearing aids to that of TH peers.

Are HH Preschool Children at Risk for Psychosocial Difficulties?

The HH preschoolers in our study evidenced considerably more psychosocial problems than TH children—a difference that remained significant even after controlling for a range of

covariates. Such a difference is in line with the robust finding from adolescent and adult populations that hearing loss of any degree is associated with more psychosocial and mental health problems (Fellinger, Holzinger, & Pollard, 2012; Hintermair, 2007). Our study adds two important findings: Firstly, psychosocial difficulties seem to appear as early as in preschool age, which has important implications for early intervention planning. Secondly, the finding that psychosocial problems are apparent even after controlling for receptive vocabulary suggests that although language plays an important role in psychosocial functioning (Stevenson, McCann, Watkin, Worsfold, & Kennedy, 2010), additional mechanisms significantly affect development in HH children. This finding is supported by Netten et al. (2015) who found communication abilities, but not vocabulary or syntax skills, to be related to psychosocial functioning in preschool children with hearing loss. Thus, psychosocial development should be addressed also in the children who perform well on traditional language measures.

Compared to SDQ scores, the difference between HH and TH children was less pronounced for social skills. Our findings contrast those of Hoffman et al. (2015), who found a difference in social competence between preschool children with and without hearing loss. However, whereas their sample consisted of children with profound hearing loss, our study includes mild to severe degrees of hearing loss, with the majority in the mild/

moderate categories. Similar to our study, Antia, Jones, Luckner, Kreimeyer, and Reed (2011) included school-age children with all degrees of hearing loss and found social skills in DHH children to be comparable to those of TH children. However, importantly, the authors note that even with adequate social skills, one may lack close relationships; thus, skills and well-being must be considered separately, as demonstrated in our study by the discrepant findings in psychosocial functioning and social skills.

Is There a Gender Difference?

Parents of HH boys report significantly more problems compared to HH girls. Although in contrast to the majority of previous research (Dammeyer, 2010; Polat, 2003; Van Eldik, 2005), our finding seems robust, as it remains even after controlling for a variety of possibly confounding factors. Moreover, the HH group differed significantly from the TH group, which did not exhibit the same gender pattern. One main difference between previous studies and the present is that our study concerns younger children. Possibly, gender differences may be more pronounced in early childhood. From our study, it is not possible to pinpoint the exact mechanisms behind these early gender differences, but some hypotheses may be proposed. Boys in the HH group were on average 3 months older than girls and could exhibit more problems than girls because of an older age. However, this possible explanation was not borne out because when age was entered into the regression analysis, the results remained the same.

Rutter, Caspi, and Moffitt (2003) suggested that boys are more vulnerable to early-onset diagnoses, like attention-deficit/hyperactivity disorder and conduct disorder, whereas girls are more vulnerable to disorders that normally appear later, such as anxiety and mood disorders. Possibly, the effect of hearing loss is more evident in boys early on because it manifests in disorders with an early debut, whereas the effect of hearing loss become evident among girls at a later stage in development, that is, the preadolescent and adolescent years, when the prevalence of anxiety and depression increases. Hence, such a gender difference in the effect of hearing loss might weaken or vanish at later stages.

Another possibility, following the logic of transactional theories of development (Sameroff, 2009), is that the social surroundings react to boys and girls differently, meaning that boys and girls may experience different social environments even when being in the same family or same day care facility. For example, although boys and girls may not differ in the prevalence of shyness, boys seem to be met with more negative reactions when acting shyly than girls do (Doey, Coplan, & Kingsbury, 2014). Thus, boys could be met with less understanding for their hearing-related difficulties as compared with girls, whose withdrawal behavior may be more accepted, resulting in a more emotionally supportive environment.

In the same vein, boys and girls may receive different amounts of support from service providers (Walker et al., 2014). Preschoolers with behavioral disorders more often receive professional help than preschoolers with emotional disorders (Wichstrom, Belsky, Jozefiak, Sourander, & Berg-Nielsen, 2014). Behavioral problems are the typical problems among HH boys. Moreover, boys are more prone to receive help than girls over and above their more often occurring behavioral problems. However, for DHH children, language development is a main concern, and interventions are most often targeted towards minimizing language delay. Hence, psychosocial difficulties in preschool children are likely to be attributed to language difficulties. If psychosocial difficulties prompt language interventions, this could

explain why boys in our study exhibit psychosocial problems but perform fairly well regarding receptive vocabulary.

Predictors of Psychosocial Problems in the HH Group

In the HH group, age at detection was a significant predictor of psychosocial outcomes; earlier diagnosis of hearing loss predicted fewer psychosocial problems. It is well appreciated that early detection—leading to early intervention—is a major predictor of language outcomes (Ching et al., 2013). The same relationship seems to apply to psychosocial development, regardless of degree of hearing loss. Our findings support the findings of Korver et al. (2010) who found that early detection had a positive effect on a range of developmental outcomes for all degrees of hearing loss but stand in contrast to Stevenson et al. (2011) who reported an effect of early detection on language development, but not on the degree of behavior problems. However, the latter study did not address differences concerning the very first months of life, as early detection was defined to be before the age of 9 months. In sum, it is possible that hearing loss detection in the first months of life has an impact on psychosocial development.

Regarding children with profound hearing loss, it is easy to see the importance of early detection both for language and psychosocial development. Strongly reduced access to sound is likely to affect parent-child interaction unless parents are familiar with sign language. However, for HH children, the advantage of early detection is not as obvious.

Babies spend a lot of their time awake close to their caregivers, and usually in quiet surroundings; these are good listening conditions, thus reducing the adverse effect of the hearing loss. Moreover, parent-child interaction includes to a large degree visual and physical elements like movement, gaze, and facial expression, as well as easily audible sound patterns. Under such conditions, one could assume that the early parent-child interaction would not be much different if the child has a mild or moderate hearing loss compared to TH, and that early detection would not be as crucial for these as for children with profound hearing loss; however, our findings suggest the contrary. Possibly, there are confounding factors accounting for this effect, not yet investigated. For example, subtle auditory cues such as sighing and mumbling hold information about emotional states but may be inaccessible for HH children. This could lead to a different reaction pattern, which again could affect the parent-child interaction despite the child's access to clearer sounds such as speech. Alternatively, the auditory environment is not as favorable for babies as one could assume. In addition, the effect of early detection could also be the effect of the family meeting a professional and receiving guidance in parent-child communication, meaning that the effect could also have been seen in TH children if they had received the same kind of support. Further research is warranted in this field.

In the HH group, degree of hearing loss did not predict psychosocial outcomes. The findings fit well with previous research on older children and adolescents, pointing to the same degree of difficulties regardless of degree of hearing loss (Dammeyer, 2010; Fellingner et al., 2008). In other words, even a mild to severe hearing loss is a risk factor for psychosocial difficulties and adverse mental health, and our findings suggest that this risk is considerable even in preschool age.

The relationship between receptive vocabulary and psychosocial outcomes was not significant in our study. This contrasts for example the findings reported by Stevenson et al. (2010), who report that language ability predicts behavioral problems. However, a related study reports that early age at detection predicted better

language ability, but not better psychosocial outcomes (Stevenson et al., 2011); despite the association between language and behavior, language is not sufficient to remove the risk of psychosocial difficulties. Our study seems to fit well with this conclusion.

Even though comparable in severity, psychosocial difficulties in HH children may be qualitatively different from what is reported for children with profound hearing loss. Whereas profound hearing loss causes an obvious disadvantage of accessing less auditory information, HH children may experience other difficulties, in terms of service access (Holte et al., 2012), or expectations from their surroundings. If their language progresses satisfactorily, their psychosocial needs could be underestimated. Parents and teachers may expect similar behavior as from hearing peers, whereas deaf children more readily are compared with other deaf children. HH individuals risk falling between the deaf community and the hearing community, thus being in a marginalized position (Fellinger et al., 2008).

Limitations

This study has several limitations. The group of HH children ($N = 35$) was relatively small, and we may have been unable to detect some differences between HH and TH children. The regression analysis presented in Table 4 includes a large number of predictors, considering the small sample size, causing a risk of overfitting of the model. However, in linear regression as opposed to logistic regression, very few subjects per variable are necessary to achieve accurate estimation of regression coefficients, and with minimal bias in adjusted R^2 (Austin and Steyerberg, 2015). Thus, we are confident that our results are reliable, even though a larger sample would provide more detailed information on intragroup differences.

We do not have any knowledge of the families who did not reply to the invitation, thus we do not know the representability of the sample. We did not obtain data on the amount or type of follow-up the families received, and further research is needed to explore if there are any differences in interventions in relation to gender and degree of hearing loss.

Another limitation is the fact that information regarding level of hearing loss was derived from the parents instead of the child's medical records. However, the fact that our findings coincide with other studies that indeed derived the degree of hearing loss from medical files suggests that the parents were relatively good in providing this kind of information about their child.

Internal consistency for the SDQ subscales are fairly low, conduct problems subscale as low as $\alpha = .44$. The levels are quite similar to the levels reported by Hintermair (2007) in his discussion of psychometric properties of SDQ in a DHH sample; he presents levels of Cronbach's α for the conduct problems subscale ranging from .46 to .65. Likewise, in TH populations, internal consistency levels for conduct and peer problems subscales are reported to be lower than for the other subscales (.57 and .63; Goodman, 2001). Nevertheless, the findings related to the subscales of the SDQ must be interpreted with this fact in mind; there is a possibility of HH children having more behavioral problems than TH children which we were not able to detect due to a combination of moderate statistical power and low reliability.

Conclusion

Our results show that preschool HH children are at risk for psychosocial problems. This must be taken into consideration in early intervention planning. Boys and girls may react to risk factors in different ways; HH boys seem to have higher psychosocial

difficulties, whereas HH girls show a slight tendency towards having more severe language delays at the age of 4.

Early detection of the hearing loss predicts better psychosocial outcomes, whereas degree of hearing loss does not affect outcomes. Screening and early intervention services must therefore be aware of the importance of early intervention even for milder hearing losses, and the importance of taking psychosocial development into account alongside with intervention targeted towards language development.

Funding

Norwegian Extra Foundation for Health and Rehabilitation (2013/2/0251).

Conflicts of Interest

No conflicts of interest were reported.

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Paper II

Laugen, N. J., Jacobsen, K. H., Rieffe, C., & Wichstrøm, L. (2017). Emotion Understanding in Preschool Children with Mild-to-Severe Hearing Loss. *Journal of Deaf Studies and Deaf Education*, 22(2), 155-163.

doi:10.1093/deafed/enw069

EMPIRICAL MANUSCRIPT

Emotion Understanding in Preschool Children with Mild-to-Severe Hearing Loss

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Abstract

Deaf and hard of hearing school-aged children are at risk for delayed development of emotion understanding; however, little is known about this during the preschool years. We compared the level of emotion understanding in a group of 35 4–5-year-old children who use hearing aids to that of 130 children with typical hearing. Moreover, we investigated the parents' perception of their child's level of emotion understanding. Children were assessed with the Test of Emotion Comprehension. Parents were presented with the same test and asked to guess what their child answered on each item. The results showed that children with hearing loss performed at the same level as typically hearing children, despite having lower vocabulary scores. Parents of children with hearing loss were more accurate in their estimations of their child's competence, and higher accuracy was associated with better emotion understanding. These findings may have implications for early intervention planning.

Emotion understanding refers to knowledge about the nature of one's own and others' emotions, as well as their causes and regulation processes (Pons, Harris, & De Rosnay, 2004). Such knowledge allows us to understand social processes and is thus an important prerequisite for psychosocial and cognitive development (Denham et al., 2012; Rieffe & De Rooij, 2012; Rosnay, Harris, & Pons, 2008). Some research indicates that children who are deaf or hard of hearing (DHH) have delays in emotion understanding, such as emotion attribution from situational cues (Gray, Hosie, Russell, Scott, & Hunter, 2007) and understanding causes of emotions (Rieffe, Terwogt, & Smit, 2003), whereas findings are more mixed regarding emotion recognition (Ketelaar, Rieffe, Wiefferink, & Frijns, 2013; Wiefferink, Rieffe, Ketelaar, De Raeve, & Frijns, 2013).

Recently, there has been increased interest regarding children with mild-to-severe hearing loss (25–89 dB) who use hearing aids (HA) rather than cochlear implants (CI) and who often use spoken language as their main mode of communication. For example, the Outcomes of Children with Hearing Loss

project (Moeller & Tomblin, 2015) has provided increased knowledge concerning language and audiological outcomes in this group of children. However, little is known about the development of emotion understanding before the age of 6. Therefore, the first aim of our study was to investigate the development of emotion understanding in a group of preschool children who use HA and have unaided hearing loss ranging from mild to severe, compared to that of typically hearing (TH) children.

The association between language development and emotion understanding is well known (Harris, De Rosnay, & Pons, 2005), and DHH children's language difficulties have been suggested to contribute to their delayed emotion understanding (Dyck, Farrugia, Shochet, & Holmes-Brown, 2004). However, less attention has been paid to the role of parents. Because parents' estimations of their child's ability have been found to affect emotion understanding in TH children (Kårstad, Wichstrøm, Reinfjell, Belsky, & Berg-Nielsen, 2015), the second aim of our study was to investigate how parents of children with HA estimate their children's level of emotion understanding compared to parents of TH children.

Received May 3, 2016; revisions received September 30, 2016; editorial decision October 7, 2016; accepted October 15, 2016

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Emotion Understanding

As part of the wider concept of emotion competence (Saarni, Campos, Camras, & Witherington, 2006), emotion understanding refers to knowledge about the nature of emotions, as well as their causes and regulation processes (Pons et al., 2004). Emotion understanding is quite different from emotion experience. For example, a child could experience a complex emotion such as guilt as young as preschool age but not be able to understand the underlying processes related to norms and morals until school age (Harris, 2008).

Emotion understanding develops gradually throughout childhood. Pons et al. (2004) suggest three developmental phases. Around the age of 5, most children are able to identify emotion expressions, situational causes of emotions and reminders that may activate emotions. Around the age of 7, the subjective role of desires and beliefs is acknowledged, as well as the difference between expressed and felt emotions. In the third phase, around 9–11 years, an understanding of more complex processes emerges, such as the possibility of experiencing conflicting emotions, cognitive regulation of emotion and how different perspectives can trigger different emotions.

Emotion Understanding in Children with Hearing Loss

As emotion understanding requires an understanding of mental processes in others, theory of mind development is also involved. Emotion understanding and theory of mind are closely associated, although empirical research suggests that they should be considered separately (Cutting & Dunn, 1999). A large body of evidence has shown that DHH children are at risk for delayed development of theory of mind (Peterson, 2009), which may affect emotion understanding development as well. In fact, DHH research does suggest a delay in the development of emotion understanding. For example, in a study of children and adolescents between 6 and 18 years of age, children with mild-to-profound hearing loss showed a delay in their understanding of the relationship between emotions and their causes compared to TH children (Dyck et al., 2004). However, when the DHH children were compared to a group of TH children matched for verbal ability, the difference disappeared, suggesting that the delay in emotion understanding was related to their delayed language development. In two other studies, deaf children aged 6–12 years performed comparably to TH children on emotion attribution, but the deaf children had a less mature understanding of the causes of emotions and less sophisticated strategies for communicating anger (Rieffe & Terwogt, 2000, 2006). Language level was not considered in these two studies, but the authors suggest that the difficulties in explaining causes of emotions could be related to communication problems and less participation in conversations with mental state content.

Several studies have reported that the aspects of emotion understanding that are developed early, such as emotion recognition, are comparable in DHH and TH children (Hopyan-Misakyan, Gordon, Dennis, & Papsin, 2009; Netten et al., 2015; Rieffe, 2012). However, many of these studies include school-age children. Because emotion recognition is normally acquired at a younger age, a possible delay may not have been detected because the DHH children could have caught up with the TH children by the time of the assessment. Potentially delayed development of emotion recognition is more likely to be present at ages 4–5, when children are normally in the process of acquiring these skills.

Relatively few studies have addressed emotion understanding in preschool children, but some suggest a delay in emotion

recognition in preschool children with CI (Wiefferink et al., 2013), as well as more difficulties perceiving emotions through facial expressions or prosodic cues in preschool children with moderate-to-profound hearing loss (Most & Michaelis, 2012). In contrast, a study of Israeli kindergarteners did not report differences in emotion understanding between TH children, children with CI and deaf children of deaf parents (Ziv, Most, & Cohen, 2013). Additionally, in a sample of children with CI, the parent-reported ability of their child to read others' emotions was at the same level as that reported by parents of TH children (Ketelaar et al., 2013).

In summary, the heterogeneity of these studies in terms of participants and results indicates a need for further research to clarify who might be at risk for emotion understanding difficulties at the preschool age. For example, few attempts have been made to investigate whether the degree of hearing loss affects emotion understanding. One study reported that children with profound hearing loss had more difficulties than children with mild-to-severe hearing loss (Most & Michaelis, 2012), and the importance of language also suggests that children with milder hearing loss may not have as large of a disadvantage in their emotion understanding development (Dyck et al., 2004). However, DHH children's lower performance on nonverbal tasks (Wiefferink et al., 2013) suggests that DHH children may be at risk even if they have good language outcomes.

Parents' Estimation Accuracy

Literature on development in TH children provides sound theoretical and empirical support for the importance of parents' contribution to their children's emotional and cognitive development (Sameroff, 2009; Sroufe, 1995). In typically developing children, studies suggest that maternal input, specifically the amount of mental state references in their conversations with their child, predicts the child's later emotion understanding (De Rosnay, Pons, Harris, & Morrell, 2004; Taumoepeau & Ruffman, 2006, 2008). In their conversations, mothers also typically adjust their mental state talk according to their child's development, introducing more complexity as the child grows (Taumoepeau & Ruffman, 2006). These observations fit well with the notion of the zone of proximal development (ZPD), which is a term introduced by Vygotsky (1962) and later adopted by Valsiner (1997). The ZPD is defined as the gap between the child's level of knowledge and the level that the child can understand with support from an adult. By adjusting the complexity of interaction to fit the child's ZPD, the adult supports the child's development. To adjust their level of conversation, parents depend on their own appraisal of their child's developmental level. Thus, parents who are more aware of their child's level of understanding may be more likely to adjust their contributions to fit the child's ZPD. Accordingly, children with parents who accurately estimate their child's level of emotion understanding advance more in their emotion understanding than children with less accurate parents (Kårstad et al., 2015).

In the case of DHH children, several studies suggest that parent-child interactions in dyads with DHH children differ from the interaction patterns observed in dyads with TH children (Gale & Schick, 2009; Lam & Kitamura, 2010). Specifically, parents of DHH children have been reported to include less mental state talk in their conversation with their children (Morgan et al., 2014). Given some DHH children's language delays and these differences in the parent-child interaction, it is appropriate to investigate whether parents' accuracy in appraising their DHH child's competence differs from that of parents of TH children. It is possible that due to the discrepancy between some DHH children's language level and chronological age, parents'

estimations of their DHH children could be less accurate than those of parents of TH children. Alternatively, an increased concern for their child's development could also contribute to an increased awareness and accuracy in parents' estimations of DHH children. Regardless, knowledge about the accuracy of parents with DHH children in estimating their child's emotion understanding may prove to be important if interventions to increase emotion understanding are considered. To our knowledge, our study is the first to investigate these issues.

The Present Study

The aim of the present study is twofold. First, we investigated whether the level of emotion understanding in a sample of 35 preschool children with mild-to-severe hearing loss, fitted with HA, was lower than that in a group of TH children drawn from a representative community sample. Because language is known to be an important predictor of emotion understanding in TH children (Harris et al., 2005; Pons, Lawson, Harris, & De Rosnay, 2003) and DHH children are at risk for language delays (Tuller & Delage, 2014), we included vocabulary in our analysis as a control variable to be able to separate the contributions of hearing loss and vocabulary. Second, we examined whether parents of children with HA have different perceptions of their child's level of emotion understanding compared to parents of TH children. In line with findings in the TH group (Kårstad et al., 2015), we predicted that increased accuracy of parents' estimations would be associated with increased level of emotion understanding in both groups.

Method

Participants

Data from the children with HA were collected as part of a larger study on psychosocial development in children with hearing loss (Laugen, Jacobsen, Rieffe, & Wichstrøm, 2016). Families were recruited via letters of invitation that were distributed from 19 audiology departments and 2 special education providers. The inclusion criteria were as follows: age 4–5 years at the time of the assessment, use of HA in one or both ears, the child and at least one parent speak Norwegian, no CI, and no known additional diagnoses. In total, 79 letters of invitation were distributed. Of the 79 families, 36 agreed to participate. One child was excluded due to language difficulties. We do not have any information about the 43 families who did not accept the invitation; thus, the possibility of a selection bias is present. However, the final sample of 35 children did not differ significantly from the TH group regarding parents' education and work situation. The families were evenly distributed throughout Norway. None of the children had any additional diagnoses, such as intellectual disabilities or autism, as reported by the parents.

Seven families reported genetic reasons and two reported birth complications as the cause of the hearing loss. The majority did not know the cause of the hearing loss. All children spoke Norwegian, but six of them preferred to use signs to support their spoken Norwegian. Two of these six children used sign language in addition to speaking Norwegian, but sign language was not their preferred language according to parent reports.

The group of TH children was drawn from an existing community sample that was collected for a larger study. The recruitment procedure is described in Wichstrøm et al. (2012). Although the size of the original community sample would allow for a matched samples design, this approach was not chosen due to the limited number of variables available in our data

set and thus the possibility of unobserved confounding factors (Arceneaux, Gerber, & Green, 2006, 2010). Rather, the group was drawn from the community sample using a random number generator. Because the original sample of 1,250 had an overrepresentation of children with psychosocial problems, we drew more children who had low or no psychosocial problems and fewer who had many psychosocial problems using the inverse of the drawing probability that was used when creating the original sample. Thus, our group of 180 TH children formed a sample that was representative of the TH population. Of these 180 children, data on emotion understanding were available for 130. These were included in our study. Findings concerning emotion understanding and parents' estimations in this longitudinal cohort study have been published elsewhere (Kårstad, Kvello, Wichstrøm, & Berg-Nielsen, 2013; Kårstad et al., 2015). Demographic information of all participants is described in Table 1. There were no significant differences between the HA and TH groups regarding age, gender, parents' education or prematurity. A larger proportion of children with HA had a history of NICU stay ($p = .024$), and children with HA had significantly lower vocabulary scores ($p = .016$).

Instruments

The Test of Emotion Comprehension (TEC; Pons et al., 2004) assesses nine components of emotion understanding that are divided into three developmental phases: (a) the external phase, characterized by the understanding of expressions of emotions and situational causes; (b) the mentalistic phase, where the child understands the distinction between expressed and felt emotions, as well as the influence of desires and beliefs on emotions, and (c) the reflective phase, referring to the acknowledgment of conflicting emotions and the influence of norms and morals. The components and phases are described in Table 2. The test consists of a book with drawings, and the protagonist's face is left blank. The drawing is accompanied by a short story that is read aloud by the experimenter, and the child is asked to

Table 1 Demographic profile of participants

	TH (n = 130)	HA (n = 35)
Age, mean (SD) months	55.1 (3.4)	56.7 (6.2)
Boys	55.3 (3.4)	58.5 (6.3)
Girls	55.0 (3.5)	55.1 (5.9)
Male gender, no (%)	63 (48.5)	16 (45.7)
Gestation age, mean (SD) weeks	39.4 (2.9)	39.5 (2.7)
NICU stay, no (%)	13 (10.0)*	9 (25.7)*
Parents' education		
Both parents > 12 years, no (%)	71 (54.6)	18 (51.4)
One parent >12 years, no (%)	38 (29.2)	13 (37.1)
Vocabulary	63.6 (19.9)*	54.1 (22.3)*
Degree of hearing loss (unaided), no (%)		
Unilateral ^a		4 (11.4)
Mild (26–40 dB)		10 (28.6)
Moderate (41–55 dB)		15 (42.9)
Moderately severe (56–70 dB)		4 (11.4)
Severe (71–90 dB)		2 (5.6)
Age at detection, months (SD)		15.8 (15.8)
Age at amplification, months (SD)		22.8 (17.4)

* $p < .05$.

^aUnilateral losses range from mild to profound.

Note. TH = typically hearing children; HA = children with hearing aids; NICU = neonatal intensive care unit.

Table 2 Overview of the components of emotion understanding measured by the TEC

Phase	Component	Description	Example item
External	Recognition	Recognize emotions from external cues (e.g., facial expression)	"Can you point at the angry face?" (Component: Recognition)
	External cause	How external causes affect emotions	
Mental	Reminder	How memory of past events affects emotions	"The rabbit eats a carrot. It doesn't see the fox hiding behind the bushes. How do you think the rabbit feels?" (Component: Belief)
	Desire	How people's emotions depend on what they want or prefer	
	Belief	How people's emotions depend on what they think or know	
Reflective	Hiding	The possible discrepancy between expressed and felt emotion	"The boy is sad because his rabbit died. What can he do to stop being sad?" (Component: Regulation)
	Regulation	Strategies for emotion regulation	
	Mixed	The possibility of experiencing multiple emotions concurrently	
	Morality	How morals affect emotions	

attribute an emotion to the story protagonist. The child is asked to choose between four drawings of facial expressions, each representing one of five emotions: "happy," "sad," "angry," "afraid," or "just all right." The items are scored as correct or not correct. Due to the dichotomous nature of the item responses, Cronbach's alpha was not suitable for the reliability analysis. Rather, Armor's theta was used as a measure of internal consistency. High levels were achieved both for the children ($\theta = 0.81$) and for the parents' estimation ($\theta = 0.95$). Previous studies have reported high test-retest reliability (0.83 with a 3-month delay; Pons, Harris, & Doudin, 2002) and good concurrent validity (see Pons et al., 2014 for a review). The TEC has been translated to a wide range of languages and was also used previously with DHH children in an Italian study (Mancini et al., 2016).

For vocabulary, we used the Peabody Picture Vocabulary Test (PPVT-III; Dunn & Dunn, 1997). In this test, the child is presented with four drawings per item and is asked to point to the drawing corresponding to the target word pronounced by the experimenter. The PPVT-III consists of 10 blocks with 12 items in each, and the test is terminated if 8 wrong answers are given in one block. Cronbach's alpha in our sample was 0.96. The PPVT-III has been subject to a range of validation studies, yielding moderate-to-high correlations with other vocabulary measures and measures of verbal ability, and it is considered suitable for DHH individuals (Williams & Wang, 1997).

Demographic data were obtained through parent reports. Parents' education was measured by an 11-point scale, where 1 = not completed elementary school and 11 = PhD. The mean of both parents' education was used in the analysis. If only one parent's education was reported, then that parent's level of education was used. Age at detection refers to the age of the child when the parents were informed about the hearing loss. Degree of hearing loss was measured on a 6-point scale using the categories of normal (<25 dB), mild (26–40 dB), moderate (41–55 dB), moderately severe (56–70 dB), severe (71–90), and profound (>90 dB). The parents provided reports for each ear separately, and hearing level in the best ear was used in the analysis.

Procedure

The children with HA were visited at home, daycare, or a local service provider, based on the family's preferences, by a clinical psychologist experienced in working with deaf children. The parents filled out a questionnaire regarding demographic and audiological information while the psychologist tested the

child's vocabulary and emotion comprehension level. When necessary, measures were taken prior to the assessment to ensure good auditory and optical conditions, such as turning off the dishwasher or turning on lights.

When the TEC was administered, the parent was in another room. Spoken Norwegian was mainly used in the assessment and was supported by signs as required. The psychologist's facial expression was kept neutral to avoid giving away additional emotion cues, which could have made the tasks easier. When the PPVT-III was conducted, no sign support was provided. To measure the parent's ability to estimate their child's emotion comprehension, the TEC was administered to the parent while the child was in another room. The parents were instructed to provide the answer they thought their child had provided.

The TH children were examined at NTNU, the Norwegian University of Science and Technology. The study was approved by the Regional Committee for Medical and Health Research Ethics Mid Norway.

Statistical Analysis

The data were inspected for normality and outliers. Values of skewness and kurtosis were acceptable for the PPVT-III and TEC in both the TH and HA groups, with z values ranging from 0.55 to 1.65 (skewness) and from 0.10 to 1.20 (kurtosis). We used independent sample t tests to investigate the differences between the TH and HA groups in terms of emotion comprehension, parent ratings, and parent-child discrepancy. To control for random significance that may result from multiple t tests, the statistics were corrected using the false discovery rate, as described by Benjamini and Hochberg (1995, 2000). Due to unequal sample sizes, Welch's unpaired t test was used for all comparisons, as recommended by Zimmerman (2004). Due to the small sample size of the HA group, Hedge's g was used to calculate the effect size. Because of the correlation between the presence of hearing loss and vocabulary difficulties, we performed two linear regression analyses to control for vocabulary scores on children's TEC outcomes and parental accuracy outcomes.

Parent-child discrepancy was defined as the difference between the child's score and the parent's estimation, converted into absolute values. This score was calculated for each of the three phases, as well as for the total score. If the parent's estimation of the child's level was identical to the child's actual

level, they received a discrepancy score of 0. Higher scores indicate higher discrepancy, which implies lower accuracy. For clarity, the findings will be discussed in terms of accuracy rather than discrepancy.

Results

Emotion Understanding in Children with HA and TH Children

Means and intergroup differences for the children and parents, as well as discrepancy scores, are displayed in Table 3. Overall emotion understanding scores in children with HA did not differ from the scores of TH children, as both groups attained a total mean score close to three out of nine correct components. Better vocabulary and higher parental accuracy were both associated with emotion understanding. When vocabulary and parental accuracy were controlled for, the difference between the groups remained non-significant (Table 4).

Parent's Estimation of their Child's Emotion Understanding

The parent's estimation of their child's performance on the TEC and their estimation discrepancy are presented in Table 3. Parents in both groups overestimated their child's emotion competence. The children's scores were approximately 3, whereas the parents' estimations were close to 5 in the HA group and above 6 in the TH group. Effect sizes were medium to high. The discrepancy between the parent and child scores was significantly lower in the HA group than in the TH group (Table 3), indicating that parents of children with HA were better at estimating their child's performance level than parents of TH children. Table 5 shows that parental accuracy is associated with both the child's TEC score and the vocabulary score. However, even when these covariates are controlled for, the group difference remains.

Discussion

In the present study, we examined whether mild-to-severe hearing loss in children with HA affects emotion understanding

in preschool children and whether parents of these children assess their child's level of emotion understanding differently than parents of TH children. We therefore compared the level of emotion understanding among 4-year-old children with HA to that of TH 4-year-old children drawn from a representative community sample. We found that the level of emotion understanding did not differ between the groups but that parents of children with HA had greater accuracy in estimating their child's emotion understanding than parents of TH children.

Emotion Understanding in Children with HA and TH Children

In our study, both children with HA and TH children reached a mean score close to 3 out of 9 points. Because the TEC was developed to assess emotion understanding in children between 3 and 11 years of age, we expected that the majority of the items would be too difficult for both the TH and HA groups. Our scores fit well with the level found in a representative British sample of 20 children with a mean age of 4.8 (Pons et al., 2003) and with the Norwegian norms based on 926 children with a mean age of 4.4 years (Kårstad et al., 2015).

The finding that children with HA perform comparably to TH children on emotion understanding is similar to the studies of Ketelaar et al. (2013) and Ziv et al. (2013), but it contrasts the findings of Wiefferink et al. (2013), who reported that preschool children with CI have more difficulties with emotion discrimination, identification, and attribution compared to TH children. Our study includes children with HA and considerably milder unaided hearing loss than participants in the study by Wiefferink et al. (2013). It is possible that the children's better access to sound, especially in the early years, could contribute to an enhanced understanding of emotions.

At the preschool age, emotion recognition is one of the main emotion competences to be learned. Whereas our study did not find any difference between the TH and HA group, Most and Michaelis (2012) found that 4–7-year-old children with moderate-to-profound hearing loss were outperformed by TH children when presented with tasks of emotion perception using visual and auditory nonverbal cues. However, while their study focused more specifically on perceptual processes, our study included

Table 3 Psychometric properties and mean scores on the TEC

	Range	Mean scores (SD)		T	p	P _{bh}	Hedge's g
		TH (n = 130)	HA (n = 35)				
Emotion comprehension: child							
External	0–3	1.63 (1.00)	1.71 (0.93)	–0.46	.640	.706	0.084
Mental	0–3	0.85 (0.77)	0.91 (0.87)	0.387	.719	.719	–0.075
Reflective	0–3	0.60 (0.69)	0.36 (0.55)	–2.13	.037	.088	0.360
Total score	0–9	3.08 (1.50)	2.94 (1.53)	–0.47	.647	.706	0.092
Emotion comprehension: parent							
External	0–3	2.54 (0.65)	2.20 (0.68)	–2.73	.010	.030	0.515
Mental	0–3	2.27 (0.71)	1.89 (1.02)	–2.08	.044	.088	0.482
Reflective	0–3	1.64 (0.89)	1.09 (0.89)	–3.26	.002	.012	0.617
Total score	0–9	6.45 (1.52)	5.17 (1.84)	3.77	.000	.000	0.801
Parent–child discrepancy							
External	0–3	0.89 (1.11)	0.49 (1.17)	1.89	.074	.123	0.359
Mental	0–3	1.42 (0.92)	1.0 (1.28)	1.78	.082	.123	0.413
Reflective	0–3	1.04 (1.11)	0.70 (1.10)	1.58	.119	.159	0.308
Total score	0–9	3.35 (1.78)	2.23 (2.18)	3.13	.008	.030	0.594

Note. TH = typically hearing children; HA = children with hearing aids. P_{bh} = p values corrected for multiple comparisons, by false discovery rate.

Table 4 Predictors of emotion comprehension

Variable	B	β	p	95% CI
Group	-0.28	-0.08	.075	[-0.70, 0.13]
Vocabulary	0.03	0.46	.000	[0.03, 0.04]
Discrepancy	-0.41	-0.53	.000	[-0.50, -0.32]
Model fit	Adjusted R ² = 0.53			

Note. CI = confidence interval. Group = dummy variable for typically hearing children (0) or children with hearing aids (1).

Table 5 Predictors of parental accuracy

Variable	B	β	p	95% CI
Group	-1.05	-0.23	.000	[-1.63, -0.47]
Vocabulary	0.02	0.22	.003	[0.01, 0.03]
Child's TEC score	-0.87	-0.67	.000	[-1.05, -0.69]
Model fit	Adjusted R ² = 0.39			

Note. CI = confidence interval. Group = dummy variable for typically hearing children (0) or children with hearing aids (1). TEC = Test of Emotion Comprehension.

additional aspects of emotion understanding, such as understanding the relationship between situational context and emotions. The children in our study may have benefited from additional information in the verbal instructions and short stories provided, which may have contributed to the age-appropriate performance in our study.

In line with the literature on TH children, our study confirms the importance of vocabulary development as a predictor of emotion understanding (De Rosnay & Harris, 2002). However, although children with HA performed significantly lower on the vocabulary measure, they still performed similar to TH children on emotion understanding. It must be noted that only a small part of the children's language abilities were measured (spoken language vocabulary). Although the majority of the HA group used spoken language only, two of the children also used sign language and some used signs as support for their spoken Norwegian. Thus, their total language ability could be different from what is reflected in the PPVT-III score. Additionally, the age-appropriate level of emotion understanding that we found could be due to the nature of emotion understanding in the preschool age, which primarily focuses on emotion recognition. Unlike the aspects of emotion understanding that develop later, emotion recognition may be less dependent on language, as visual and contextual cues are likely to assist in the recognition of emotion expressions. It is possible that language may have a greater impact on emotion understanding in later childhood, when the acquisition of less visible aspects of emotion understanding is relevant, such as hidden emotions and the impact of one's beliefs versus desires.

Parents' Estimation of their Child's Emotion Understanding

In both groups, parents clearly overestimated their child's emotion understanding ability. On average, parents of TH children estimated that their child would score 6.5 out of 9 points, which is the expected score of TH 8-9 year olds, whereas parents of children with HA estimated an average score of 5.2, which is expected for TH 6-7 year olds (Pons et al., 2003). Parents' tendency to overestimate their child's abilities has been demonstrated

within other areas of development, such as level of intelligence (Chamorro-Premuzic, Arteché, Furnham, & Trickot, 2009).

For the TH group, the parents' overestimation of their child's abilities was not unexpected, as this was reported in the larger study from which our TH group was drawn (Kårstad et al., 2013). It is interesting that parents of children with HA think that their children perform at a lower level than parents of TH children, even though this is not the case. As a result, parents of children with HA present more accurate estimates of their child's emotion understanding than parents in the TH group. It is possible that parents of children with HA are more aware of their child's competence because they are more concerned about their child's development, or it could be the result of more feedback about their child's competence in the context of family-centered interventions related to the child's hearing loss. These parents may also have estimated their children's emotion understanding as lower than the estimation of parents of TH children because of their children's language delays, as suggested by the significant contribution of vocabulary scores to parental accuracy. However, even when controlling for vocabulary scores, parents of children with HA remained significantly more accurate than parents of TH children.

Underestimating a child's level of understanding could be a disadvantage for the child, as parents would refrain from introducing new concepts and perspectives. In contrast, overestimation of the child's abilities could promote the child's development if the parent thereby addresses the child at a slightly higher level than their current level of understanding, or in other words, within the ZPD. However, if the discrepancy between the parent's estimation and the child's actual level is too high, the parent's initiatives in interactions with the child risk falling outside the ZPD and will be too difficult for the child to understand.

As predicted, better parental accuracy was associated with higher emotion understanding scores for children in both groups. Thus, in the HA group, the parents' increased accuracy compared to the TH group may have increased their child's emotion understanding, making up for their disadvantage in vocabulary development. It is possible that the increased accuracy of parents of children with HA, which caused them to be within the ZPD more often, could partly explain why children with HA were at the same level as TH children in emotion understanding, despite their significantly lower vocabulary scores.

The role of parental accuracy and its relevance for adjustment according to the child's ZPD is likely to change as the child grows older. While parents are the primary interaction partners of preschool children and thus have a vital role in the child's social and cognitive development, the peer group gradually becomes more important as the child reaches school age. Because peers normally cannot be expected to be equally aware of the child's developmental level or special communication needs due to their hearing loss, children with HA may not benefit from the adaptations of their parents to the same degree as when they are younger. Hence, a disparity between children with HA and TH children in emotion understanding may emerge in middle childhood, as indicated by Dyck et al. (2004) and Rieffe (2012).

Because our study is cross-sectional, we cannot infer any causal relationships between the parents' accuracy and the child's emotion understanding. However, our findings fit well with the findings of Kårstad et al. (2015), who reported that parents' accuracy at estimating the child's emotion understanding at age 4 predicted the child's emotion understanding level at age 6. If future research confirms the same relationship in children with HA, this has important implications for the services

provided to these children and their families. The families' ability to perceive their child's developmental level is an important area for intervention that deserves a more explicit focus to detect families who may need assistance in this respect.

Although the limitations of representability, as discussed below, must be kept in mind, we believe that our findings are likely to be representative for the population of children with HA in Norway. Caution is needed when generalizing the results to populations in other countries, as emotion comprehension and the parents' awareness thereof are likely to differ between cultures (Molina, Bulgarelli, Henning, & Aschersleben, 2014).

Future research is needed to assess whether children with CI and their parents follow the same pattern as the children with HA in our study. Although children with CI and HA are similar in many respects, there are also important differences, for example, regarding early auditory experience and service provision. This may lead to a different development of emotion understanding.

Limitations

As mentioned, our study is cross-sectional, and we are thus unable to provide any causal explanations for the relationship between children's emotion understanding and their parents' estimation accuracy. Moreover, our findings need to be interpreted with caution because the HA group only consisted of 35 children. Nonetheless, we achieved satisfactory effect sizes for the total scores.

Some aspects about the study design must also be noted. We do not know whether our sample of children with HA is a representative one because we do not have any information about the non-respondents. As participation in the study included a home visit, families with additional social problems may have been reluctant to participate. However, our HA group did not differ significantly from the TH group on relevant measures such as parent education and work situation.

Two of the children used sign language as well as spoken Norwegian, and parents reported that the preferred language was spoken Norwegian supported by signs. Because this information was collected from parent reports, there is a possibility that the children could actually prefer sign language, but the parents' lack of sign language skills obscured this preference in everyday life. Moreover, we did not assess these children's sign language skills or the sign vocabulary in the children who used signs to support spoken language. Thus, it must be considered that our measure of receptive vocabulary in spoken Norwegian represents just a small part of language development, and future research should address sign language or signing skills as well to obtain a fuller picture of language abilities.

None of the children included in the study had any known additional diagnoses, but some difficulties may not yet have been diagnosed. For example, autism spectrum disorders are often diagnosed later in DHH children compared to TH children (Szarkowski, Flynn, & Clark, 2014). Our results must be interpreted with the possibility of undiagnosed difficulties in mind.

The TEC has been used in the DHH population in only one other study of which we are aware (Mancini et al., 2016), and there is little knowledge about the appropriateness of using this test with DHH children. The TEC has a high verbal loading, as the child is required to listen to a short story or description before providing an answer. Furthermore, because the testing was performed in the families' homes, the auditory conditions could have varied, although measures were taken to prevent

this. Thus, the children with HA may have had more difficulties than TH children in understanding the task and may have perceived the task to be more energy consuming. However, as the HA children scored quite similar to TH children, we believe that these challenges did not significantly affect the scores.

Conclusion

The emotion understanding of children with HA and TH children did not differ at age 4. Although parents of children with HA overestimate their child's emotion understanding, their estimations were more accurate than parents of TH children. This increased accuracy is likely to benefit the development of emotion understanding in children with HA. Future research should explore the potential benefits of interventions aimed at increasing the accuracy of less proficient parents.

Funding

This work was supported by the Norwegian Extra Foundation for Health and Rehabilitation [2013/2/0251].

Conflicts of Interest

The authors have no conflicts of interest to report.

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Paper III

Laugen, N. J., Jacobsen, K. H., Rieffe, C., & Wichstrøm, L. (2017). Social skills in preschool children with unilateral and mild bilateral hearing loss.

Deafness & Education International, published ahead of print.

doi:10.1080/14643154.2017.1344366

Social skills in preschool children with unilateral and mild bilateral hearing loss

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Social skills in preschool children with unilateral and mild bilateral hearing loss

Abstract

Hearing loss may represent a risk for developing social skills difficulties; however, little is known about the potential risk resulting from unilateral or mild bilateral hearing loss (UMHL). We compared the social skills of 14 children with UMHL and 21 children with moderate to severe hearing loss (MSHL) with those of 123 children with typical hearing (TH). All the children were 4-5 years old, and all the children with hearing loss used hearing aids. Associations between social skills and age at amplification and vocabulary skills were examined. The children with UMHL had lower social skills than the TH children, whereas the children with MSHL received scores similar to those of the TH children. The children with UMHL were detected and amplified later than the children with MSHL. Early amplification was associated with better social skills but not with better vocabulary. The results suggest that despite a limited effect on vocabulary development, early intervention is likely to promote social skills development in children with UMHL.

Keywords: unilateral; mild; social skills; preschool; minimal hearing loss; age at amplification

Background

Social skills are learned behaviors that enable individuals to interact effectively with others and maintain successful relationships in a socially accepted manner (Gresham and Elliott 1990). Such skills are a vital part of the development of social competence (Rose-Krasnor 1997; Rose-Krasnor and Denham 2009, 171) and are associated with better mental health (Lee, Hankin, and Mermelstein 2010; Wichstrøm, Belsky and Berg-Nielsen 2013). Thus, promoting social skills development in at-risk groups is of vital importance.

Children who are deaf or hard of hearing (DHH) are at greater risk for developmental delays and difficulties than their peers with typical hearing (TH). This risk is often attributed to their language delays (Hoffman, Quittner and Cejas 2015; Stevenson et al. 2010). Even mild bilateral (26-40 dB in the best ear) and unilateral losses (< 25 dB in the best ear, \geq 25 dB in the other) may carry an increased risk of maladaptive development (Tharpe 2008; Winiger, Alexander and Diefendorf 2016). Still, many outcomes in children with mild hearing loss remain unexplored, particularly those associated with social and emotional development. Indeed, although children with unilateral and mild bilateral hearing loss (UMHL) are included in some studies, their social skills have not been investigated specifically. This lack of knowledge renders the provision of well-targeted, effective interventions difficult (Holstrum et al. 2009). As social skills acquisition is a vital developmental task in the preschool years (Rose-Krasnor and Denham 2009, 162), the present study explores these skills in 4-year-old children with UMHL.

Hearing loss and social skills

In general, DHH children exhibit lower social competence, including social skills, than TH children. For example, Hoffman, Quittner and Cejas (2015) reported significantly lower social competence in children with severe to profound hearing loss compared with children with TH. The same conclusion was reached in studies of children with cochlear implants (Wiefferink et al. 2012) and mild to profound hearing loss (Meinzen-Derr et al. 2014). However, exceptions do exist; age-appropriate social skills have been reported among students with mild to profound hearing loss (Antia et al. 2011; Laugen et al. 2016) and in children with cochlear implants (Ketelaar et al. 2013). Even so, the social skills of children with UMHL have not yet been investigated.

Outcomes in children with unilateral and mild bilateral hearing loss

Research on children with UMHL has mainly focused on language and academic skills and conveys mixed findings: whereas some studies report outcomes for children with UMHL that are comparable to those of TH children (Fitzpatrick et al. 2015; Niedzielski et al. 2006; Wake et al. 2006), others report difficulties among children with UMHL (Lieu et al. 2010; McFadden and Pittman 2008). A recent review identified many areas in which UMHL children may suffer compared with their TH peers; however, there is great variability within the group, and risk factors have not yet been sufficiently investigated (Winiger, Alexander, and Diefendorf 2016).

It could be argued that children with UMHL may experience fewer difficulties than children with moderate to profound loss because they have better auditory access. However, the severity of a condition and its outcomes are not always related (WHO 2001), and in some ways, children with UMHL may be subject to the same adverse conditions as the DHH population in general. Background noise, which is quite common in a child's everyday surroundings, may reduce access to social information and opportunities for social interactions, even in cases of a unilateral loss (Wie, Pripp, and Tvette 2010). Studies have shown that degree of hearing loss did not predict social functioning, mental health, or quality of life (Fellinger et al. 2008; Netten et al. 2015), suggesting that a less severe hearing loss does not necessarily imply fewer difficulties.

Some studies have found that children with UMHL may actually be worse off in some respects than children with moderate to profound hearing loss: Wake et al. (2004) reported that children with mild hearing loss had lower health-related quality of life than those with profound loss, whereas Keilmann, Limberger, and Mann (2007) found lower self-confidence among children with UMHL than among those with more severe hearing loss. Similar results have been reported for class performance (Most 2004).

In sum, there are good reasons to investigate the development of children with UMHL because milder hearing loss does not necessarily imply a milder impact and because such knowledge is important for service planning.

Early hearing detection and intervention

UMHL is not as easily detected as moderate to severe hearing loss (MSHL). Traditionally, children with UMHL have received intervention, including amplification, at a much later age. In addition, the services provided to children with UMHL may vary greatly in content and extent (Holstrum et al. 2008) compared with, for example, children with cochlear implants, who typically enter specific programs. With the implementation of universal newborn hearing screening in many countries, the age at detection has been dramatically reduced for children with UMHL, although the time between detection and amplification may vary from 0 to 6 years (Fitzpatrick, Whittingham and Durieux-Smith 2014). As hearing aid fitting often takes place in parallel with other types of intervention, such as parent support, a delay in amplification could reflect a delayed onset of intervention in general. Late detection and intervention could compromise the development of social skills, as suggested by some studies (Hoffman, Quittner, and Cejas 2015; Martin et al. 2011) but contradicted by others (Bat-Chava, Martin, and Imperatore 2014; Ketelaar et al. 2013; Meinzen-Derr et al. 2014). However, this issue has not previously been addressed in the UMHL population specifically.

How social skills relate to language development

There is general agreement regarding the reciprocal relationship between language and social skills: Language ability facilitates social interaction, and social interaction promotes language development (Cochet and Byrne 2016). In the DHH population, language delay is frequently mentioned as a contributor to difficulties in many areas, including social skills (Hoffman,

Quittner and Cejas 2015; Stevenson et al. 2010). Even very small language delays can have a significant impact on the development of social competence (Meinzen-Derr et al. 2014).

This relationship between language and social skills easily translates into an understanding of social skills problems as secondary to language problems, suggesting that if language delays are minimized, the risk of social skills problems is also reduced. However, it is possible that language and social skills development are affected by the hearing loss directly or via a mediating factor. For example, Tuller and Delage (2014) suggested that the effects of language delays in children with mild to moderate hearing loss might be mediated through by a hearing loss-related compromise of working memory. In support of this hypothesis, others have reported that children with UMHL expend more cognitive resources when listening or multitasking compared with TH children (Dokovic et al. 2014; McFadden and Pittman 2008). If more cognitive capacity being directed toward other tasks, such as listening, social skills development is likely to be affected.

The present study

Our aim was to examine the extent to which children with UMHL are at risk for social skills difficulties compared with TH children and children with MSHL. We expected that children with UMHL would have more social skills difficulties than children with TH; however, we did not form a specific hypothesis regarding whether they would struggle more or less than children with MSHL. As children with UMHL and MSHL are likely to differ regarding vocabulary and age at amplification, we also explored how these factors were associated with social skills. Because parental education level has been reported to predict developmental outcomes in DHH children in general (Ching et al. 2013; Porter et al. 2013), this variable was also included.

Method

Participants

For the UMHL and MSHL groups, participants were included if they were 4-5 years old, they used a hearing aid in one or both ears, and spoken Norwegian was used by the child and at least one parent. Children with additional diagnoses and children with cochlear implants were not included. Families were recruited via invitation letters distributed by two special education providers and by 19 of the 21 audiology departments that serve children in Norway. In all, 79 letters to families throughout Norway were distributed, and 36 families agreed to participate. One of the children was excluded due to language difficulties. Of the 35 participating children, 30 used their hearing aids most of the time according to their parents. Fourteen children were in the UMHL group, and 21 were in the MSHL group.

A control group of TH children was drawn from an existing community sample, which is described in Wichstrøm et al. (2012). From the original sample of 1,250 children, 180 were drawn to act as a control group; this procedure is described elsewhere (Laugen et al. 2016). Data regarding social skills were available for 123 of these children, who comprised the TH group included in the analyses. Further details are provided in Table 1. A larger proportion of children with hearing loss (both MSHL and UMHL) than TH children had a history of NICU stay ($p = .018$). No other differences among the groups were identified.

[Table 1 near here]

Measures

We used the Norwegian version of the Social Skills Rating System – Parent Report (SSRS; Gresham and Elliott 1990). The questionnaire includes 39 items presenting examples of social behaviors such as following household rules or making friends. The behaviors are rated by the

parents in terms of frequency (how often the behavior occurs) and importance (in the parent's opinion, how important the behavior is for the child's development). In this study, only the frequency scale was used. Whereas the original SSRS uses a 3-point Likert scale, the Norwegian version extends the scale to 4 points (0 = never, 3 = very often) (Ogden 2003). This version of the SSRS has shown good validity in Norwegian TH populations (Gamst-Klaussen et al. 2016; Ogden 2003). The Cronbach's alpha for the total score was .89 for the total sample and .88 for the HH children.

We included one measure of receptive vocabulary: the Norwegian version of the Peabody Picture Vocabulary Test – Third Edition (PPVT-III; Dunn and Dunn 1997). A child is presented with four drawings and is asked to point to the drawing that corresponds to the target word presented by the test administrator. The test consists of 10 blocks of 12 items each, and the testing is terminated when the child gives 8 wrong answers within one block. The PPVT-III is widely used both in TH and DHH populations (Bennett, Gardner, and Rizzi 2014; Betz, Eickhoff, and Sullivan 2013). The Cronbach's alpha for our sample was .97 for both the total sample and for the HH children. Although receptive grammar is only one aspect of language development, the PPVT-III shows moderate to strong correlations with other language measures and is considered useful as a screening instrument for children with language difficulties (Williams and Wang 1997, 46). Still, caution is needed when interpreting the data.

A questionnaire was used to collect information concerning the child's hearing loss and family background. The child's level of hearing loss was reported by the parents separately for each ear using the categories normal (<25 dB), mild (26–40 dB), moderate (41–55 dB), moderately severe (56–70 dB), severe (71–90), and profound (>90 dB). Based on the hearing level of the best ear, the HH children were assigned to the UMHL (≤ 40 dB) or the MSHL (> 40 dB) group. Age at identification and amplification were reported in months. As

amplification and early intervention services often take place within a short time frame, the age at amplification provides an estimate of the onset of early intervention. Education levels were reported for each of the parents on an 11-point scale (1 = did not complete elementary school, 11 = PhD). Parental education was calculated as the mean level of both parents. If data for one parent was missing, the level reported for the other parent was used. Although maternal education level was frequently used in the previous literature, we chose to include paternal education due to the increasing involvement of fathers in their children's lives. Conducting the analyses using maternal education only did not alter the results.

Procedure

This study is part of a larger project addressing psychosocial development, emotion comprehension and social skills in HH preschool children (Laugen et al. 2016). The children with hearing loss were seen either at home, in daycares, or at the facilities of a local service provider, according to the family's preference. The parents completed the questionnaire while the child's vocabulary comprehension was assessed by a clinical psychologist experienced in working with DHH children. The families of the TH children were seen at NTNU, the Norwegian University of Science and Technology. The study was approved by the Regional Committee for Medical and Health Research Ethics, Mid-Norway.

Statistical analysis

To ensure that assumptions were met, the data were examined using boxplots, skewness and kurtosis values, the Kolmogorov-Smirnov test, and Levene's test. Age at amplification and parental education did not meet the assumptions of normality; therefore, nonparametric tests were chosen for the analyses that included these variables.

Differences in social skills and vocabulary scores between the groups were explored using univariate analysis of variance (ANOVA). Due to the unequal sample sizes, Hochberg's GT2 was used for the post hoc analyses (Hochberg 1974). For parental education, the Kruskal-Wallis test was used. The difference in age at amplification between the UMHL and MSHL groups was determined using the Mann-Whitney test. The effect sizes in the ANOVA are reported using omega squared (ω^2); suggested values for small, medium and large effect sizes are .01, .06 and .14, respectively (Kirk 1996).

To explore whether social skills were associated with vocabulary, age at amplification and parental education in the children with hearing loss, Kendall's tau correlations for social skills, vocabulary, age at amplification and parental education were calculated.

Results

The social skills, vocabulary, age at amplification and parental education values for the three groups are displayed in Table 2. The TH children and the children with MSHL showed similar levels of social skills. In contrast, the children with UMHL were rated almost one SD lower than the TH group. An ANOVA yielded a group effect on social skills, $F(2, 154) = 4.11, p = .018, \omega^2 = .04$. Hochberg's GT2 post hoc analysis confirmed that the scores of the children with UMHL were lower than those of the TH group ($p = .014$). No other group differences in social skills were found.

[Table 2 near here]

The vocabulary scores also showed a significant group effect: $F(2, 154) = 3.372, p = .037, \omega^2 = .03$. The post hoc tests did not yield any significant results; however, when UMHL and MSHL were combined, the children with hearing loss scored lower than the TH group: t

= 2.60, $p = .01$, $g = .50$. Additionally, the children with UMHL were fitted with hearing aids later than the children with MSHL, $U = 205.0$, $p = .001$, $r = .55$. Parental education levels for the three groups were not significantly different, $H(2) = 3.97$, $p = .14$.

Regarding associations between social skills, vocabulary, age at amplification and parental education, a negative relationship between age at amplification and social skills was found: $\tau = -.256$, 95 % BCa CI [-.002, -.477], $p = .044$. In other words, later amplification was associated with lower social skills. No other significant correlations emerged.

Discussion

Social skills in children with UMHL

In our study, the children with UMHL were rated by their parents as having considerably fewer social skills than the TH children. In contrast, no such difference was detected between the children with MSHL and TH.

The relationship between the severity of a condition and its functional outcomes is not necessarily linear (WHO 2001). In the DHH population, adolescents with less severe hearing loss might be more vulnerable to emotional disorders than adolescents with profound hearing loss (van Gent, Goedhart, and Treffers 2011), and similar findings have been reported for health-related quality of life (Wake et al. 2004).

Issues of identity and expectation could play a role in the difficulties of children with UMHL. Children with UMHL may more likely to be compared with their TH peers and expected to speak, listen, and function well socially in a hearing environment; whereas the families of children with MSHL may more readily adapt their communication environments to fit the child's preferences, and the children may identify with the Deaf community. Consequently, a child with UMHL could experience a larger discrepancy between their auditory abilities and expectations than a child with MSHL.

Another difference between children with UMHL and MSHL is that hearing aid use is less consistent in UMHL children compared with MSHL children (Walker et al. 2015), which may influence the degree to which they participate in social settings. In our study, the majority of children with hearing loss used their hearing aids most of the day; the 5 children who did not belong to the UMHL group. Further analyses of the effect of hearing aid use were not possible due to the low variability. Still, a more frequently mentioned explanation for difficulties in the UMHL population – their later age of hearing loss detection and intervention - was supported by our findings related to age at amplification.

Age at amplification

The difficulties of children with UMHL are often attributed to age at detection and intervention; historically, these children are diagnosed late and thus miss many years of support (Moeller 2007). Although the implementation of universal newborn hearing screening has provided the ability to identify UMHL earlier than before, our study found that the children with UMHL were diagnosed later and received their amplification later than the children with MSHL, even though all were born in hospitals with universal newborn hearing screening. The later amplification could reflect hesitation and lack of knowledge among professionals concerning the need for amplification and early intervention, as described in other studies (Fitzpatrick et al. 2016; McKay, Gravel, and Tharpe 2008). Likewise, a Canadian population study revealed that children with UMHL often experienced a considerable delay between diagnosis and amplification (Fitzpatrick et al. 2014).

The association we found between late age at amplification and lower social skills scores aligns well with previous research indicating several developmental advantages associated with early intervention (Yoshinaga-Itano 2003). Although early amplification has been considered most effective for children with severe and profound hearing loss (Ching et

al. 2013), the outcomes of our study underscore the importance of an early diagnostic process leading to early intervention for children with UMHL. However, as amplification and other types of intervention often co-occur, it is not clear from our study whether the amplification itself or other types of intervention might be more important. Most likely, the combination of several interventions, in interaction with child and family characteristics, contribute to the outcome.

The relationship between social skills and vocabulary

Our study contrasts with the finding of Hoffman, Quittner, and Cejas (2015), who found an association between language and social skills; however, it aligns well with other studies reporting a lack of association between different language measures and social functioning in children. For example, Netten et al. (2015) suggest that rather than specific language measures such as vocabulary, communication abilities (for example, the use of complex sentences) could be more accurate for predicting social functioning. DeLuzio and Girolametto (2011) suggest that rather than vocabulary as measured by a standardized test, the acquisition of the specific vocabulary used in the child's environment (for example, in preschool) could be of greater importance.

The 2007 position statement from the Joint Committee on Infant Hearing (Joint Committee on Infant Hearing 2007) states that the goal of early intervention is to promote language development, which in turn affects other areas, such as socio-emotional development. The language measure in our study was limited to vocabulary scores; still, our findings suggest that social skills difficulties might not follow from vocabulary delays. Rather, vocabulary and social skills development seem to develop more independently from each other, possibly with working memory as the mediating factor, as suggested by Tuller and Delage (2014). Such cognitive costs are likely to affect both social skills and different aspects

of language development, such as vocabulary. To develop effective early intervention services, it is important to confirm or disconfirm the existence of such a relationship in future studies, which need to include larger samples than the present study.

With the benefit of their residual hearing, children with UMHL have access to some auditory information starting at birth. Thus, the onset of amplification may not have such a dramatic effect on vocabulary development as it would for children with severe or profound hearing loss. In fact, it has been argued that screening and early intervention for children with slight and mild hearing loss (16-40 dB) may not be necessary (Wake et al. 2006). However, whereas linguistic information might be readily audible in quiet surroundings for children with UMHL, less-pronounced preverbal signals, which are assumed to be important in early socioemotional development (Papoušek 2007), might not be perceived. Moreover, sounds such as the parent speaking from another room or the parent speaking in a room with background noise might be lost. Missing such subtle but socially important sounds may influence the behavior of the child, for example, in terms of the ability to calm down. Unless the parent is aware of the hearing loss, such behaviors might be misinterpreted, thus causing long-term effects on social skills development (Sameroff and Fiese 2000, 3-19). In contrast, early intervention may provide better auditory access through amplification and increased parent competence, thus minimizing such misinterpretations and promoting social skills development.

Limitations

Our study has several limitations. Most importantly, the sample size is rather small, and the findings must be interpreted with caution. There may have been differences and associations that we were not able to detect, and the effect sizes were small to medium. Further, due to the small sample, we were not able to analyze the children with unilateral and mild hearing loss

separately. Although these groups face many similar difficulties, there are also important differences, such as the increased difficulties in sound localization in unilateral hearing loss (Winiger, Alexander, and Diefensdorf 2016).

Many children with UMHL do not have hearing aids. Hearing aid use may not be indicated for their type or degree of hearing loss, the hearing loss may not have been detected, or amplification may have been recommended but not used by the child. As our study included only children with hearing aids, caution is needed in the interpretation of the findings.

We also lack information about the families' participation in early intervention services. Just as they are at risk for later amplification, children with UMHL may also risk receiving less follow-up because their needs could be underestimated or less visible (Holstrum et al. 2008). Although it is reasonable to assume that early amplification is accompanied by other intervention services, there are also likely to be cases in which families are enrolled in early intervention services before or after the child is fitted with hearing aids.

Social skills, such as knowing how to compromise or ask for help, are important components of a child's development of social competence. However, it must be noted that even with a wide repertoire of skills, challenges regarding adjusting one's behavior to various contexts and individuals may remain (Rose-Krasnor 1997; Rose-Krasnor and Denham 2009, 168). Thus, although assessing social skills provides valuable information about the challenges and strengths of children with hearing loss, the broader picture of social competence should not be neglected. In addition, as mentioned by Antia et al. (2011), it is possible to have excellent social skills but still lack close friends.

Conclusion

Our study suggests that children with UMHL are at risk of social skills difficulties. They are also at risk for vocabulary difficulties; however, there is not a strong relationship between the two areas of development. Further, children with UMHL were identified and amplified considerably later than children with MSHL.

Although children with UMHL may not benefit from early amplification in terms of vocabulary development, the impact on social skills is substantial; however, future studies should confirm our findings and clarify whether the contributing factor is amplification itself or other aspects of early intervention. In any case, our findings have implications for early hearing detection and intervention. Current screening methods often fail to detect mild hearing losses (Johnson et al. 2005), and improvement is needed. Further, children with any degree of hearing loss should be considered eligible for early intervention.

Our results suggest that the development of social skills needs to be monitored in children with any degree of hearing loss, even those with good vocabulary scores.

Acknowledgements: This work was supported by the Norwegian Extra Foundation for Health and Rehabilitation [2013/2/0251]. The authors would like to thank the families and children who participated in the study.

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Table 1.*Demographic profile of the participants*

Variable	TH (n = 123)	UMHL (n = 14)	MSHL (n = 21)
Age, mean (SD) months	55.1 (3.5)	57.5 (5.1)	56.1 (6.9)
Boys	54.9 (3.5)	59.4 (5.4)	57.8 (7.1)
Girls	55.0 (3.5)	55.6 (4.4)	54.8 (6.8)
Male gender, no (%)	59 (48.0)	7 (50.0)	9 (42.9)
Female gender, no (%)	64 (52.0)	7 (50.0)	12 (57.1)
Gestation age, mean (SD) weeks	39.4 (3.0)	39.3 (2.4)	39.6 (3.0)
NICU stay, no (%)	11 (8.9)	3 (21.4)	6 (28.6)
Degree of hearing loss, no (%)			
Unilateral		4 (11.4)	
Mild (26-40 dB)		10 (28.6)	
Moderate (41-55 dB)			15 (42.9)
Moderately severe (56-70 dB)			4 (11.4)
Severe (71-90 dB)			2 (5.6)
Hearing aid use, no (%)			
Most waking hours		9 (64.3)	21 (100.0)
Half of waking hours or less		4 (28.6)	0 (0.0)
Missing		1 (7.1)	0 (0.0)
Age at detection, median (interquartile range), months		22.1 (14.4)	11.5 (15.6)

Note. TH = typical hearing; UMHL = unilateral and mild bilateral hearing loss; MSHL = moderate to severe hearing loss.

Table 2.*Psychometric properties and group values for social skills, vocabulary and age at amplification*

Instrument	Items	Range	α	TH (n = 123)	UMHL (n = 14)	MSHL (n = 21)
SSRS	40 ¹	0-120	.89	66.1 (11.2) ²	56.7 (13.3) ²	64.9 (13.8) ²
PPVT-III	120	0-120	.97	64.2 (19.7) ²	53.3 (24.9) ²	54.6 (21.0) ²
Parental education		1-11		7.0 (3.5) ³	5.3 (2.8) ³	6.5 (1.5) ³
Age at amplification		1-60			36 (14.5) ³	8 (26) ³

Note. TH = typical hearing; UMHL = unilateral and mild bilateral hearing loss; MSHL = moderate to severe hearing loss. 1) The form has 39 items; one item appears in two subscales. 2) Mean values, SDs in parentheses. 3) Median values, interquartile range in parentheses.