Speech and Language Characteristics of Children with Significant Hearing Loss in New Zealand

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Abstract

Hearing loss presents challenges to the communication development of children who need language input in order to develop speech and language. However, research into the speech and language skills of children with hearing loss have varied considerably in the past as to the depth and detail of the analysis that has been carried out. Studies have mainly used norm-referenced tests and have been much less likely to involve more naturalistic language sample analyses. These results, although undoubtedly useful, may benefit from the addition of some in-depth analysis.

This thesis presents the results of a detailed analysis of some of the speech and language skills and some relevant contextual features (e.g. those of background, family and history) found in a cohort of 11 preschool children with hearing loss aged between 3 and 5 years of age from Auckland, New Zealand. An equal number of typically hearing children matched in age, gender, socioeconomic status and ethnicity were also assessed. The older children with hearing loss were re-assessed a year later to see what changes had occurred over a year.

The most obvious finding was the variability among children's results. Three groups were found, those performing within the normal range, those performing below the normal range, and some whose performance was borderline or fluctuated in the first assessment, but who were found to have joined the upper performing group a year later.

There were significant differences between the mean group scores of the children with hearing loss (especially older children) and their matched controls on most of the standardised speech and language measures. The detailed analyses indicated more issues in expressive morpho-syntax than other speech or language features. However another main finding was how much language measures, including syntax, was affected by the chosen task and the genre of interaction. The value of understanding more about the contextual features of the children was also very clear. Age of diagnosis, use of hearing aids and family beliefs featured as issues of probable significance to the groupings found within the children.

The discussion considers how in-depth analysis of speech and language skills in children with hearing loss, in this case using LARSP and Speech Act Analysis, might be of benefit in the assessment regimes for these children. Recommendations are made for further research on a

range of issues raised by the results of this study.

This thesis is lovingly dedicated to my husband: Morteza

And

My little angel: Negar

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Abbreviations

ABEL: Auditory Behaviour in Everyday Life
AoDC: Advisor on Deaf Children
ASS: Assertive/ness
Aux: Auxiliary
BEPTA: Better Ear Pure Tone Average
CDI: Child Development Inventory
CELF: Clinical Evaluation of Language Fundamentals (Preschool version)
CI: Cochlear Implant
Cl: Clause
Cop: Copula
CU: Communication Unit
DAdjN: Determiner + Adjective + Noun
dBHL: Decibels Hearing Level
'gen': Genitive Marker
GFTA-2: Goldman-Fristoe Test of Articulation-2
HL: Hearing Loss
MLU: Mean Length of Utterances
MSS: Mainstream State School
NICU: Newborn Intensive Care Unit
NZ: New Zealand
NZSL: New Zealand Sign Language
PCC: Percent Consonants Correct
PCC-R: Percentage of Consonants Correct-Revised
PEACH: Parents' Evaluation of Aural/Oral Performance of Children
Phr: Phrase
PLS: Preschool Language Scale
PPC: Percent Phonemes Correct
PPVT: Peabody Picture Vocabulary Test III
PrDN: Preposition + Determiner +Noun
Pron: Pronoun
PTA: Pure Tone Audiometry
PVC: Percent Vowels Correct
PVC-R: Percentage of Vowels Correct-Revised
RQ: Request
RQAC: Request for Action
RQAT: Request for Attention
RQCL: Request for Clarification
RQIN: Request for Information
RS: Response
SD: Standard Deviation
SF: Syllable Final
SI: Syllable Initial
SLT: Speech and Language Therapy
SPSS: Statistical Package for Social Sciences Software
SV: Subject + Verb
SVO: Subject + Verb + Object
SVC: Subject + Verb +Complement
SVA: Subject + Verb + Adverbial
Wd: Word

Chapter 1: Introduction

1. Introduction

This thesis investigated the speech and language characteristics of children with significant hearing loss at age 3-4 and 4-5 years in New Zealand (NZ). It also evaluated the changes that took place after a period of a year for the older group when they were 5-6 years old. A control group was also recruited to see possible differences between children with significant hearing loss and children with typical hearing.

There is a great deal of literature on hearing loss in children, which will be examined in some depth in chapter 2. In this chapter however, those issues found in this literature which are most salient to this study will be described. It will highlight the discrepancies in the field at present which motivated this in-depth examination of a less studied population of children with hearing loss. Chapter one covers the context, purposes, significance and scope of the research, together with definitions of specific terms and the thesis outline.

1.1 The Context

Communication skills are essential to human functioning in many ways, including the establishment and management of social relationships, learning and education, and subsequent vocational activity and citizenship. Communication is a key to the understanding of practices of societies, development of identity and human happiness. Through interactions children find out the truth and facts of the real world, knowledge about themselves and the people around them, and learn about being part of society and the behavioural strategies to manage meaningful interactions (Vaccari & Marschark, 1997). Unfortunately hearing loss introduces challenges to the progress of communication development in children. Hearing loss makes it more difficult for children to receive clear input from which they derive the rules and patterns of speech and language (Briscoe, Bishop, & Norbury, 2001; Delage & Tuller, 2007; Hindley, 2005; Most, Shina-August, & Meilijson, 2010). The communication difficulties associated with hearing loss can also impact children's mental health (Theunissen et al., 2012). Theunissen et al. reported higher level of social anxiety in children with hearing aids but not for children with cochlear implants. In addition, as a number of authors have pointed out (Bobzien et al., 2013; Lederberg, Schick, & Spencer, 2013; Lieu, 2004) these communication problems are not restricted to an individual's childhood years, for they affect their social, academic and vocational achievements in the future. Because children with normal hearing become more sophisticated in their communication the gap in speech and language skills between children with hearing loss and their typically hearing peers becomes more apparent as children get older. The extent and the rate of degradation of different aspects of communication relative to age peers will be different and depends on many confounding factors.

Before reviewing speech and language problems in the wider context of the child and their world, the importance of the different features of hearing loss in the context of the world, and in NZ will briefly be discussed in the following two subsections. This has been done so as to establish the extent of hearing loss and its consequences. These subsections will touch on financial issues, prevalence, conflict/divergence of new programmes and technology, the weaknesses of existing data and familial situations in regard to children with hearing loss who have hearing parents.

1.1.1 The International Context

There are a number of issues which are important to this study that apply to all families of children with hearing loss, no matter where they may be. These issues are not necessarily about the hearing loss itself, or how best to fix it or minimise it. Rather they are issues about how hearing loss in children affects people, at the level of the individual, the family and in the wider society. Those issues which appear most clearly are about stress, about financial impacts, about the problem of incidence and definition, about the extent to which the cochlear implant has, or has not, solved many of the problems, and the relative lack of in-depth developmental language data on these children. These will be discussed briefly here to set the scene, and in more depth in Chapter 2.

A less studied issue in the field of hearing loss in children is the psychological and emotional reactions that families experience. They are significant because these reactions have an impact on a child's development, not least on their communication. Stress and anxiety are the most common feelings experienced by parents after a child has been diagnosed as hearing impaired (Doğan, 2010; Pipp-Siegel, Sedey, & Yoshinaga - Itano, 2002). Doğan (2010) found that mothers were especially at risk for developing psychiatric/psychological symptoms. These in turn will have effects on child-parent attachment and interactions. Particular factors intensify the chances of parents feeling stressed, depressed or insecure. Pipp-Siegel et al. (2002) found on a specific subscale related to parent-child interaction, that three variables can predict an increase in the mothers' level of stress: children's language delay, milder types of hearing loss and existence of additional disabilities in addition to hearing loss. They also found that annual family income and social support were among the factors that predicted maternal stress level. These findings highlight the need to consider the wider family system in considering any issue of children with hearing loss.

A second issue not commonly discussed is that of financial stress connected to children with hearing loss. Such stress is felt at the level of the family, but also impact on the wider society (First Voice, 2011; Schroeder et al., 2006). Health economists have tried to quantify these costs. For example, in the United Kingdom, Schroeder et al. (2006) found that the mean societal cost for children with permanent childhood hearing loss at 7 to 9 years of age (analysed in terms of health costs, social costs and other resources such as special education costs) was £14,092.5, compared to £4,206.8 for typically hearing children. This is a considerable difference. And while such figures may be viewed as broader social costs, the individuals and families also show the effects. (Blanchfield, Feldman, Dunbar, & Gardner, 2001) found that people with hearing loss in the USA had lower family incomes, were less likely to have private insurance, were less educated and were less likely to be employed. This again is an issue demonstrating the problems go beyond the individual child and need to be considered in the broader context. Thus problems with hearing loss and financial issues are linked, and this fact should inform the development of policies and strategies to decrease pressure on families and wider society.

It is difficult to plan such services however until the proper extent of the problems are known. It would seem a simple matter to know how many children have hearing loss; in practice, it seems not to be simple at all. Internationally, the reported prevalence of hearing loss varies depending on the degree of hearing loss required to fall within the definition, what age hearing loss is measured at, and the geographical areas that are involved. Kumar et al (2008) concluded that an exact figure for incidence or prevalence of permanent childhood hearing loss internationally is difficult to determine (Kumar et al., 2008). Numerous studies have examined prevalence for different populations. Fortnum, Summerfield, Marshall, Davis, and Bamford (2001) examined confirmed permanent bilateral hearing loss > 40 decibels hearing level (40 dB HL[1]), in all children born in the UK from 1980 to 1995, and found found 17,160 individual children. This amounted to a prevalence of 0.91/1000 for 3-year-old children, and 1.65/1000 for children aged 9-16. This level of loss is considered 'moderate'. Inclusion of children with mild and unilateral hearing loss would increase these figures. In Western Australia, Bailey, Bower, Krishnaswamy, and Coates (2002) conducted a pilot study and found 0.68/1000 of children screened at birth had bilateral permanent hearing loss (> 35 dB HL in the better ear).

A significant development for children with hearing loss was the introduction and implementation internationally of Newborn Hearing Screening and Early Intervention programmes. Data from these programmes, which cover all types of hearing loss, may be a more comprehensive source for incidence and prevalence of hearing loss than the previous studies. Dalzell et al. (2000) assessed 43,311 infants in a newborn screening programme in New York State and included any abnormal hearing sensitivity > 20 dB HL, a much lower threshold which therefore had the chance of including milder and unilateral forms of hearing loss, giving a more accurate figure. They found a prevalence of 2.0/1000 with sensori-neural, mixed or structural-conductive hearing loss. This resembles Fortnum et al.'s (2001) adjusted figure. However, some permanent childhood hearing impairments cannot be identified by newborn hearing screening, so the real number of children with hearing loss will be higher again (Fortnum et al., 2001). In China, Lü et al. (2011) studied the prevalence of delayed onset hearing loss in preschool children who passed newborn hearing screening. They assessed 21,427 preschool children and found 0.75/1000 had permanent delayed-onset hearing loss (which includes unilateral and bilateral hearing loss of any severity), so this figure needs to be added to those diagnosed in the newborn screening.

The differences in the various criteria means that these studies are not strictly comparable but it would seem, at least in the developed world, that between one and three per thousand children are likely to be affected by permanent hearing loss and its consequences. Adding in the number of children with milder types of hearing loss will double or triple these figures (Digby, Purdy, & Kelly, 2013; Digby, Purdy, & Kelly, 2014).

It is clear that hearing loss in children is a significant problem, with consequences for the individual, the family and for the wider society. Studies have shown that with better language

[1] The degree of hearing loss in dB HL as a function of sound frequency (pitch) is represented visually on a pure tone audiogram (Northern & Downs, 2002) that shows the amount of hearing impairment in decibels compared to the median normal hearing threshold of 0 dB HL.

development in these children, there would be less cost to families and government. It is for this reason that early speech and language intervention for children with hearing impairment is widely recommended (First Voice, 2011; Schroeder et al., 2006). If effective early intervention is to be put in place, however, it is necessary to have reliable information regarding the nature of the problems that children with hearing impairment have. It may seem obvious that such data should exist, however not only are there a number of problems in gathering such data, but also there are problems with the data that currently exist.

The Newborn Hearing Screening and Early Intervention programmes began in the mid to late 1990s and resulted in the average age of diagnosis and intervention for congenital hearing loss decreasing from two years of age to less than six months in areas where screening programmes have been in place for some time. According to Yoshinaga-Itano (2003a) this development has brought about an enormous change for the better in children's speech and language outcomes. This progress might have consequences for existing data reported in the literature, since the children who received these services should show different speech and language profiles from those children who did not.

The development of cochlear implants was a major achievement which has improved hearing status in those who received them (Svirsky, Robbins, Kirk, Pisoni, & Miyamoto, 2000). Subsequently, a great deal of research effort has been put into studying the impact of cochlear implants on children's hearing and development. However, it is still the case that only a minority of children with hearing loss receive a cochlear implant. The majority of children with hearing loss are not eligible for cochlear implants and use other hearing aids, and some who meet the criteria for severe-profound hearing loss may still not receive a CI, for example for Financial or medical issues, or family choice. Thus data on cochlear implants and their effect on speech, language and communication cannot be generalized to the whole population of children with hearing loss.

A further issue was that there has been a considerably stronger focus on the speech skills of children with hearing loss than on their language skills. When studies do evaluate language, they tend to use only one or two measures. These measures are often of features which may be diagnostically significant (such as plural morphemes or auxiliary verbs) but which do not give a rich picture of the child as a communicator, or of the skills they use to achieve such communication. The measures have tended to focus on the surface of children's communication skills, rather than examining them as complex, functional, interactive and contextualised behaviours. To have a particular linguistic unit is one thing; to use it in context in order to fulfil a meaningful conversation with another person (or persons) is another thing entirely. This is why some studies have investigated the quality of interaction between children with hearing loss and their communicative partners (Lederberg & Everhart, 2000; Vaccari & Marschark, 1997). However, the majority have used only a limited perspective and limited measures of 'language'.

Another potential weakness in the research literature is that the population is heterogeneous. Children, for example, come with a wide range of different types and degrees of hearing loss, different modes of communication, different amounts of intervention, different ages of diagnosis and intervention, some are bilingual and have cultural differences, and some have additional disabilities. All of these factors may have effects on a child's speech and language development and performance. Studies tend to take one of two choices, namely to exclude children on the basis of one or more factors (such as bilingualism, age of diagnosis, or type of hearing assistance), or to include them in a large group and report the results of the group overall. In both cases, the heterogeneity is not studied in and of itself, making it more difficult to apply the results to any given child. This makes it problematic in some cases to extend the results from each study to any particular population and to do studies with similar designs, or to compare results across studies and replicate them.

The position of children with hearing loss is complicated by the fact that they are generally in a hearing world. About 94% of deaf children have parents who can hear (Lederberg, 2006; National Institute on Deafness and Other Communication Disorders, 2010). Deaf children with deaf caregivers[2] can use sign language from the beginning, but for deaf children with hearing caregivers, communication can be complicated. It is often a struggle for caregivers to learn sign language, and most will not be proficient users and this is not a good language learning environment for the child. Many caregivers choose not to learn sign language, hence children need to hear and learn oral speech and language in order to communicate with their parents. When they are placed in aural/oral programs, parents and others expect that the children will communicate with speech and oral language and go to mainstream schools (Lederberg, 2006).

The terms *speech* and *language* refer to different concepts. Speech is the oral production of language, whereas 'language' is the much broader concept of the meaning system, which may

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[2] In this thesis, 'caregiver' refers to parents, guardians and/or other adults caring for the child at home.

use speech but may use other modes (such as sign, writing, etc). Bernthal and Bankson (2004) called speech “a system that relates meaning with sound” and language “an arbitrary system of signs and symbols used according to prescribed rules to convey meaning within a linguistic community” (p. 1). Speech and language difficulties often co-occur, but can also occur in isolation. For example, a child with a speech sound disorder can have normal language skills, while, a child with language disorder might produce speech sounds without any difficulty (Paul &Norbury, 2012). It is also the case that impairments in one of them may influence the other, so that a child with unintelligible speech may talk less because they are not understood, and their expressive language may fall behind. Additionally, as a particular Sign Language is a different language to the oral language of the country - as different as English and French - children with hearing loss may have good sign language skills but poor oral language (Geers, Moog, & Schick, 1984). Hearing loss is not in itself a language disorder – it is an impediment to the learning of language because of an input problem. This leads to an expectation that children with hearing loss should have intact oral/aural language learning skills and therefore if the input is taken care of (e.g. with cochlear implants) normal language development and educational achievements maybe achieved. However, this logical expectation may not be realistic. Research has tended to show that even in the best conditions and with the best facilities, children with hearing loss typically have some developmental gaps compared to their normal hearing peers (Young, 2002; Jackson, 2014).

1.1.2 In New Zealand

The picture in the NZ context is not appreciably different to that found internationally. However, there is considerably less data available. There is no comprehensive study of the prevalence of hearing loss in children in NZ. A national newborn hearing screening programme was launched over a three-year period from 2007 to 2010 (Digby et al., 2014; Ministry of Health, 2013). Some districts such as the Auckland District Health Board did not begin screening until 2010 (Digby et al., 2013; Digby et al., 2014) and at the time of writing there were no comprehensive published results of this screening programme. There were ‘Deafness Notification Database reports’ published in 2013 and 2014, and in these Digby and colleagues estimated that if the NZ newborn screening programme could cover all possible participants and follow up every possible case, then based on overseas studies such as in Australia (Queensland Government, 2007) and the United Kingdom (Fortnum etal.,2001), there would be 90 diagnoses of hearing loss per 62,000 newborns in NZ. However in 2012 only 45 out of 189 of the notifications and in 2013, only 53 out of 200 of the notifications of diagnoses of hearing loss in children made in NZ came from the newborn screening programme. Flynn, Austin, Flynn, Ford and Buckland (2004) looked at newborn hearing screening results in Christchurch, but specifically studied newborn intensive care unit (NICU) babies. They found two out of 435 babies had hearing loss. However the NICU population is not typical of all births and these results cannot be extended to the whole population of NZ. At the time of writing, relatively little was known about the extent of hearing loss and its consequences in children in NZ, and services are provided based on the best estimation rather than on accurate figures.

Only one published study on stress using NZ data was located. This study assessed the level of stress in the parents of children with hearing loss (Purdy, Chard, Moran, & Hodgson, 1995). It found that the average stress level in six families whose children had received a cochlear implant was comparable to those of families whose children did not have hearing loss. However while the average level was similar, the range was not. Some families of children with hearing loss showed much higher levels of parental stress than the control families. These authors concluded that this high level of stress might happen where there were unrealistic expectations about the performance of cochlear implants and/or where parents had less involvement/contribution in rehabilitation. Since 1995 many changes have taken place in NZ regarding age of diagnosis, age of intervention, better hearing support devices, and more integrated hearing services, so perhaps families today will show a different picture with respect to stress, their expectations and their involvement in rehabilitation.

Societies need to consider the costs involved in managing disabilities, as this helps inform decision making and service provision (Schroederet al., 2006). No document was found indicating empirical data for NZ on costs associated with children with hearing loss. However one author publishes an annual report on deafness notifications in NZ, which indicated that the provision of services in different parts of NZ differs, and so therefore does the cost (Digby, personal communication, 21/5/2012). For example, ‘Hearing House’ is a private service provider of auditory-verbal therapy for children under 5 years old with hearing loss with cochlear implants and their families in the greater Auckland region, and also works with families in some remote are as in the North Island via telehealth. For each child with a cochlear implant, Hearing House receives $15,000 from the Ministry of Health to provide 96 hours of rehabilitation for the first two years after implantation. In addition, the Hearing House will add up to $9,000 to that budget for additional service components. So, as in the case of other countries, there are financial demands not only on the family of a child with hearing loss but also on government and society. This informant did not have figures on costs of service provision for children with in-ear and other hearing aids.

Some further costs maybe ascertained in other areas. The Ministry of Education provides Advisors on Deaf Children (AoDCs), Speech and Language Therapists, Resource Teachers for the Deaf and other support services for children and their families. Salary rates ranged through $40,000-$74,000 per year in 2012 (Ministry of Education, 2012a). Because some children live in rural areas, transportation costs and other costs associated with travel to a clinic to receive treatment should be included. These costs should reduce in the future with the development of telehealth services in the deafness field (Ciccia, Whitford, Krumm, & McNeal, 2011; Krumm & Syms, 2011; Swanepoel de etal., 2010). However, NZ could benefit from calculations of the true costs to make comparisons possible in the future.

Since 2003-4, about 75-80 cochlear implantations have been performed annually in NZ. Of these, 25 were funded by the government, of which 15 were reserved for children (Bird & Murray, 2008). They have been prescribed for severe to profound hearing loss only, and then usually monaurally (Bird & Murray, 2008), but in 2014 the NZ government decided to fund bilateral cochlear implants for children (Ryall, 2014).

A literature search revealed there are few published papers on speech and language outcomes for children with cochlear implants in NZ. One of the few studies of any kind on speech or language issues was Looi and Radford (2011) who looked at speech recognition and pitch ranking abilities among children with a unilateral cochlear implant, or bimodal hearing aids (cochlear implant in one ear and in-ear hearing aid in the other). They did not find any significant differences between these groups for any of these tasks. But no published study has reported speech and language features for children with cochlear implants, nor for other groups of children with hearing loss. We need data of this kind in children who use traditional hearing aids or other types of hearing support systems as well as those receiving implants. This information can inform guidelines for rehabilitation and educational provisions.

Another reason for gathering specific NZ data is the particular speech and language situation in NZ. NZ is an English-dominant society, but has a multicultural population including more than 16% indigenous Māori and a significant immigrant population from the islands of Polynesia (c. 7%) (Statistics New Zealand, 2013a). NZ, therefore, has its own varieties of English. These have a range of lexical, rhythmic and pragmatic characteristics (e.g., using high rising terminal intonation for statements and the pragmatic particle ‘eh’) and phonological differences (for example, the dental fricative /θ/ can be replaced with /t/ and /f/; /ð/ can be replaced with /d/ and /v/) (Maclagan, King, & Gillon, 2008). Hence, overseas based studies and assessment instruments may vary in their degree of applicability to NZ.

To the best of the researcher’s knowledge, no study in NZ has investigated the interaction, communication skills and pragmatic abilities of children with hearing loss with their parents or other communication partners. Education systems need clear data in order to plan for the needs of children who will be coming into their systems. In NZ, special needs planning in education is organised according to the best known information about children’s needs in relation to their presenting difficulty. Therefore, some more detailed knowledge about the communication skills of children with hearing loss in NZ has immediate and salient value for the education sector. It also has value for families and all those likely to be interacting with the children and family.

1.2 Technical and Functional Aspects of Hearing Loss

There is a range of definitions of hearing loss. At the simplest level, Clark (1981, cited in Thorne et al 2008) defines hearing loss as:

> “Any change in hearing acuity in quiet or in the presence of background noise, but can be quantified in an audiogram as an auditory threshold of greater than 15 dB HL at any frequency” (p. 34).

Most sources agree on six categories of hearing loss, and these are used in NZ: *slight* (15–25 dB HL), *mild* (26–40 dB HL), *moderate* (41–55 dB HL), *moderately severe* (56–70 dB HL), *severe* (71–90 dB HL),and *profound* (91 dB HL and above) (Northern & Downs, 2002; Thorne et al., 2008).

There is no simple relationship between the technical degree of loss and the impact on development, hence definitions based on dB level alone fail to give a real perspective on hearing loss and its consequences (Ross, Brackett, & Maxon, 1991). A child with a mild degree of hearing loss may have considerable speech and language problems, whereas another child with a moderate degree of hearing loss may have no particular problems. A term like “mild hearing loss” does not necessarily mean that there is a mild delay in a child’s speech and language functioning, as this simply refers to the audiometric thresholds. If a label of hearing loss by severity does not adequately describe a child's auditory functioning, capacities or deficits, then professionals cannot effectively use them to plan and programme for children's needs.

Northern and Downs (2002) proposed that a diagnosis of a "handicapping" hearing loss should only be applied after a comprehensive evaluation which includes not only hearing tests but receptive and expressive language and speech assessments, examination of vocalisations in younger children and finally behavioural functioning assessments. In fact they believe an earlier definition of hearing loss would be more appropriate:

> "A handicapping hearing loss in a child is any degree of hearing that reduces the intelligibility of a speech message to a degree inadequate for accurate interpretation of speech or as to interfere with learning" (Northern and Downs, 2002, p. 23).

Even though Northern and Downs argued for a comprehensive assessment focused on diagnosing a *handicapping* hearing loss, their definition included only a few aspects of speech and learning effects. Sataloff and Sataloff (2005) developed this idea a little further b referring to hearing loss where the child had demonstrated educational effects as "significant hearing loss". They noted that this applied to 2.8 - 4.0% of school aged children.

The problem with a definition that depends on educational outcomes is that 'significance' is not able to be recognised until school age. In contrast, there is an emphasis is on early intervention in many places, attempting to recognise children with hearing loss as early as possible and offer them supportive services to overcome any possible problems in the future. There is a need for a better way of considering what the significance of hearing loss is for preschool children.

Auditory threshold categorisation gives one measure of hearing loss. Other descriptions focussing on speech, language or learning may enable the auditory threshold category to be gauged for its significance to any given individual and family. Hearing loss is ongoing; however there is a lack of agreement in the literature not only about appropriate auditory measures but also for meaningful labels and definitions for hearing loss and its severity or impact across the lifespan.

New technologies can further complicate the issue. In many cases, when children who are deaf receive cochlear implantation, they gain access to a considerable amount of hearing information and may have a language development rate after implantation close to 100% of what is typical for a child their age. Their language development is therefore faster than their peers without an implant (Robbins, Svirsky, & Kirk, 1997; Svirsky, Chute, Green, Bollard, & Miyamoto, 2000). Thus for these children the level of ‘hearing’ based solely on audiometric thresholds with a cochlear implant on can no longer can be used to define their needs and auditory abilities.

The linear view in which we study, define and treat hearing loss is limited. A linear perspective, having much in common with a biomedical model, looks at the disease and then prescribes a treatment such as hearing aids or cochlear implants. It then deals with the existing deficit in development by applying an intervention (therapy). This linear approach does not take into account the other simultaneous dysfunctions and disabilities that are common in hearing loss (Threats & Worrall, 2004; Washington, 2007), nor does it look necessarily at the complex contexts and systems that the person with hearing loss is sited within. The linear model has been prevalent in many disciplines, including speech-language therapy and audiology over many years but it maybe better to use a comprehensive model.

Some researchers (Threats & Worrall, 2004; Washington, 2007) have suggested that the inadequacy of the biomedical model means that a new, more social and comprehensive model should be used by speech and language therapists. A model is needed which covers any possible variation in children’s requirements, and that will help those trying to prepare services to think about each set of group requirements, the level of support they might need and any possible coordination that should be made among different government agencies and any other related organisations (such as parent groups). A more comprehensive definition of hearing loss could be useful for addressing research goals since this approach looks at each child’s situation separately and tries to determine difficulties across a range of areas. Sarant, Holt, Dowell, Rickards, & Blamey, (2009) concluded that many factors (for example, family contribution, degree of hearing loss, presence of other disabilities and cognitive ability) have effects on the functional outcomes of hearing loss in children, and it is therefore difficult to have comprehensive plans for a group of children solely based on auditory thresholds. Clear terms are needed to characterise how much hearing loss affects children, their family, school and future work lives, their vocational and academic achievement, and their relationships with peers, family members and the wider community.

A useful alternative to the linear/biomedical model is that presented by the International Classification of Functioning, Disability and Health - Children and Youth Version or ICF-CY, deriving from the social theory of disability. The ICF-CY looks at impairment caused by a disease and then the consequent limitations and disabilities resulting from that impairment (World Health Organization, 2001, 2007). The ICF has two parts, one related to functioning and disabilities and the other involving contextual factors (Figure 1). Each component includes a number of domains and each domain covers a number of categories (McLeod, 2006; World HealthOrganization, 2007). For hearing loss, based on this framework, there is damage to the ear structures, perhaps resulting from genetic factors, infections or structural anomalies. The result is that the child cannot detect sound well, so now s/he has a hearing loss based on audiometric measures. This problem typically brings some consequences for the child in terms of limiting their activity and restricting their participation in their world; for example they maynot be able to do auditory tasks or be involved in verbal conversations. Consequently, they may miss opportunities for learning, communication, interpersonal relationships, interactions with hearing age mates and many socialisation processes (Vaccari & Marschark, 1997).

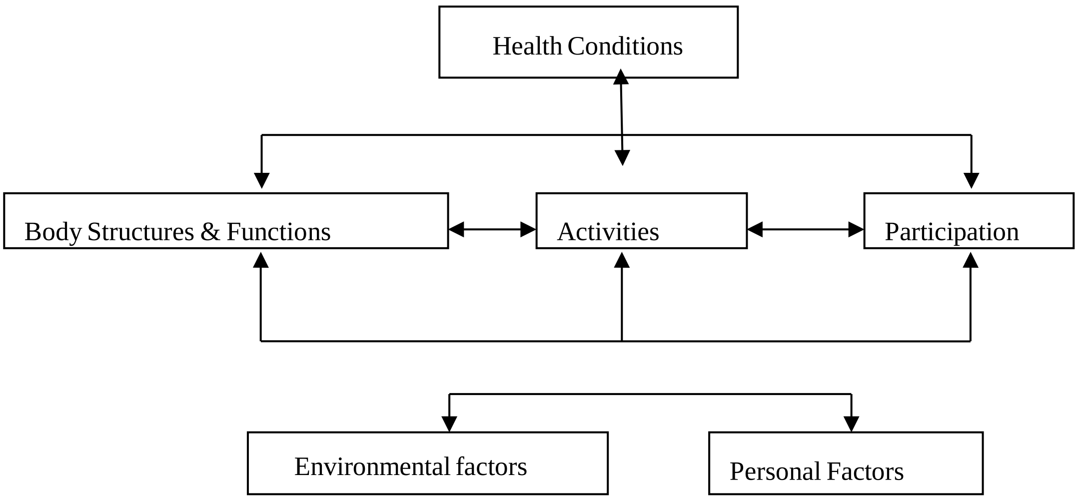

Figure 1: Interaction between the Components of the International Classification of Functioning (ICF) (Threats & Worrall, 2004).

The ICF-CY allows the particular nature of children's lives to be included when considering hearing loss. Personal factors include living background and special features such as gender, race, age, fitness, lifestyle and overall behaviour pattern (World Health Organization, 2007). Children experience variability in each year of their lives due to changes to communication partners (from parents to friends and school mates), physical environment (home, kindergarten, school, university, work, sports or club settings), and the dynamic process of development (bio-psycho-social maturity). Children's functioning is dependent on a continuous reciprocal interaction of these factors. Thus factors other than the hearing loss can have prominent effects on this dynamic process (World Health Organization, 2007). For example, as occurs for children with typical hearing, children with hearing loss use their visual ability in the first year of their lives to explore their world, to participate in give and take games with their parents, they use some gestures to share meaning, and they participate in body games (Preisler, 1999). If they cannot acquire a usual spoken communicative system (generally spoken language when they have hearing parents) they can potentially develop a gestural/sign communication system.

Personal and environmental factors feature significantly in NZ because of the cultural context. Māori children are more likely to have hearing loss than other children in NZ (Digby et al., 2014); the number of people with hearing loss increases with age and there is a greater probability that males will have hearing loss than females (Digby et al., 2014; Greville, 2005). Kumar et al. (2008) prepared a systematic review of the literature on early intervention for children with permanent hearing loss and found evidence for the effect of personal factors such as cognitive abilities on speech and language outcomes in children with hearing loss. The relationship between cognitive abilities and speech and language outcomes is a complex process and there are not many studies that have looked at cognitive abilities as confounding factors. However, some studies have reported that cognitive abilities can influence speech and language outcomes. This influence has been reported on speech perception (Geers, Brenner, & Davidson, 2003), speech production (Tobey, Geers, Brenner, Altuna, & Gabbert, 2003) and language skills (Geers, Nicholas, & Sedey, 2003a; Mayne, Yoshinaga-Itano, Sedey, & Carey, 1998).

In the current study the ICF-CY was used as a framework in the research design and when evaluating children's speech and language. The current research tried not to assess children in isolation, but instead paid attention to the nature of their interactions and the environment that the children were in. This research attempted to provide a description of each child's situation according to each child's speech and language performance, their activity limitations and participation restrictions, and to the environmental factors[3] important for a child's speech and language performance. A goal of this study is to integrate detailed information about individual children with hearing loss in order that the results might be used for educational and

[3] "Environmental factors make up physical, social, and attitudinal environment in which people live and conduct their lives" (p. 9, World Health Organization (2007)).

intervention planning that addresses the complexity of this population.

In NZ the main person supporting the family of the child with hearing loss is the Adviser of Deaf Children. Advisors are involved after a child is identified as having hearing loss by an audiologist, and they are responsible for connecting families with the services and support which might be needed. Given the lack of other satisfactory definitions, in the current study, ‘significant’ hearing loss is a functional definition meaning the consequences of the child’s hearing loss has put them on the Advisors’ caseload.

1.3 Types of Hearing Loss

In general, the types of hearing loss are defined by the site of damage in the auditory system. The usual terms to define them are conductive, sensorineural, central or a combination of these (Sataloff & Sataloff, 2005). Whenever transmission of sound via external and middle ear is disrupted, conductive hearing loss will happen. Conductive hearing loss may result from an obstruction in the external ear canal, lack of formation of the external ear canal (atresia), problems with the ear drum such as a perforation, damage to the middle ear structures such as ossicular chain fixation or fluid or scarring in the middle ear space.

Conductive hearing loss can be curable. This type of hearing loss typically has a better prognosis than patients with sensorineural hearing loss. In some cases where medical or surgical procedures do not work or are not possible, this group benefits from hearing aids because they only need some sound amplification. If the damage happens in the inner ear, the auditory nerve, or both, sensorineural hearing loss occurs. In the majority of clients sensorineural hearing loss is not curable and is permanent.

The point of injury for central hearing loss is in the central nervous system, somewhere between the brainstem auditory nuclei (in the medulla oblongata) and the cortex. In this type of hearing loss, known as central auditory processing disorder, typically no organic lesion in the auditory pathway can be found when brain imaging studies are conducted, although some causes of central auditory processing disorder such as neurologic disease can be established. Children with central auditory processing disorder have normal hearing function, but they have problems processing, understanding, analysing, interpreting, and storing spoken language (Sataloff & Sataloff, 2005). The term “functional” hearing loss (also known as pseudohypacusis) has been used to refer to hearing loss that is apparent on audiometric testing that is thought to be not a true hearing loss. This condition is rare but can occur in children (Pracy, Walsh, Mepham, & Bowdler, 1996). It is possible psychological or emotional problems are responsible for this situation.

The final category is mixed hearing loss. This term always refers to the coexistence of conductive and sensorineural hearing loss (Sataloff & Sataloff, 2005). It can arise when children have middle ear infections and have a conductive overlay in addition to sensorineural hearing loss.

Each type of hearing loss has its own typical features that make it possible to distinguish between children in order to provide the most appropriate services. As well as type of loss, there is a distinction between congenital hearing loss (happening before, at, or shortly after birth but prior to the learning of speech and language) (Jacobson, 1997) or acquired, occurring after at last some degree of speech and language development. Either of these can occur as a consequence of endogenous (genetic) or exogenous causes (e.g., lack of oxygen, bacterial or viral infection) (Flexer, 1999).

Harrison and Roush (1996) reported that in regard to the causes of children’s hearing loss: 49.6% were unknown, heredity (15%), meningitis (6.7%), prematurity (3.8%), perinatal trauma (3.8%), and maternal rubella (0.3%), which together accounted for 29.6% of the reported causes of hearing loss. Twenty percent of parents marked the category "Other" and answered that the suspected cause of hearing loss was cytomegalovirus, syndromes (e.g., Goldenhar, Waardenburg), aural atresia, and ototoxic drugs.

In NZ, in the latest report from the Deafness Notification Database (Digby et al., 2014), 85% of their subjects had unknown causes and only 15% of notifications had known causes. The reasons for the high percentage of unknown aetiology probably were the newborn hearing screening (since they do not do any genetic tests) and being more specific in the questionnaire (the audiologist should report the confirmed causes). In those 15% with known causes, 11 cases had acquired hearing loss, one had non-syndromic genetic causes, six had syndromic causes, two had other causes, while eight were not listed.

Knowing the pathology and the cause of hearing loss is also important since in some studies children with different causes showed different speech and language outcomes or had different reactions to the special hearing support device. However, hearing loss of any cause can have negative consequences for children.In the next chapter we will look into the available literature on the relationship between causes of hearing loss and outcomes for children. Other issues which may affect these outcomes will also be examined.

1.4 Purposes and Research Questions

As seen in the above discussion, there is a lack of detailed information about the speech and language and communication skills of children with hearing loss in NZ. This study was planned to be a comprehensive study of a small group of children with hearing loss to provide as much information as possible about the children's speech perception, speech production, language comprehension, expressive language and finally the factors which might affect their speech and language. In this study, there was also a focus on children's interactions with their caregivers and the main features that could be seen in their relationship. It seems that due to the vast amount of time, energy, money and special knowledge that families and government agencies invest in improving the speech and language performance of children with hearing loss in NZ, such studies have an important role. The other value of such a study is that the data can serve as a baseline to compare the effect of any new programme or device or even for future longer term follow up. Any further discussion of hearing loss should begin by outlining what is meant by the term 'hearing loss', and what the implications of hearing loss are for children's development.

The overall purpose of the study was to provide an in depth description of the speech and language features of preschool children with significant hearing loss in a large metropolitan area in NZ. The criterion for what constituted significant hearing loss was that these children appeared on the caseload of an AoDC.

One of the issues about research in this area is that children, or sometimes just their abilities, are often described in isolation. The ICF framework confronts us with the need to see children more holistically as a part of, and embedded in, their environments. Therefore a second main purpose was to gather a range of data on the children, their history and and their family or whanau, in order to see how this data might better inform our understanding of children with hearing loss and their strengths and needs.

A third purpose was to gather some degree of longitudinal data. Specifically, to see how much progress the children made in a year across the time they entered formal schooling at age 5, to help determine what kind of support they might still need for their speech and language development.

A fourth purpose was to compare the speech and language and other characteristics of children with hearing loss with those of a matched control group of children with normal hearing. This allowed the standardised test results and the other measures or descriptions to be more deeply evaluated for the impact of hearing loss on these children.

The four central research questions were:

1 What are the features of the listening, speech and language skills of children with hearing loss in NZ?

   Specifically, how well do these children listen, comprehend oral language on standardised tests, express themselves orally on standardised tests and language sample analyses, interact verbally with caregivers and speak, relative to standardised speech measures? Are they inside or outside of the normal range of speech and language skills for their ages? Are they competent communicators?

2 What are the background features of history, family and environment that seem to be related to the listening, speech and language skills of these children?

   Specifically, what is revealed from interviews and questionaires with the AoDCs and the caregivers as to the history of the child and their hearing loss, the family adjustment, feelings and attitudes, general development, and educational history?

3 How much do these skills change over a year when children have made the transition into school?

4 How do the skills and features of the children with significant hearing loss compare to those of their typically hearing matched peers?

1.5 Thesis Outline

This thesis is divided into seven chapters. Chapter 1 as already seen outlined the problems faced by children with hearing loss in NZ and in the wider world, and the need for such a study in NZ. Chapter 2 examines the literature in detail to see how much we know at present about the speech and language of children with hearing loss. Chapter 3 explains the method of study. Chapter 4 outlines the results of the investigations into background issues, chapter 5 describes the speech and language characteristics of children with hearing loss and chapter 6 compares children with hearing loss and their matched controls based on the results of different speech and language assessment tools. Chapter 7 discusses the meanings and implications of the study findings along with the limitations of the study and recommendations for future studies.

Chapter 2: Review of the Literature

2.Introduction

Hearing loss is one of the most common developmental issues for children. Hearing loss can impact almost all aspects of development, but the most obvious function affected by hearing loss is the ability to communicate based on speech and verbal language (Ching et al., 2010; Davis, Elfenbein, Schum, & Bentler, 1986; Ross et al., 1991; Sataloff & Sataloff, 2005). In fact, hearing loss can have a devastating, life-long effect on the development of speech and language (Briscoe et al., 2001; Delage & Tuller, 2007; Hindley, 2005; Most et al., 2010). Even having appropriate language skills, these children are not always able to interact successfully (Deluzio & Girolametto, 2011). The greatest impact of hearing loss can be seen in children's verbal interaction, speech perception, speech production, language comprehension and expressive language (Fitzpatrick, Crawford, Ni, & Durieux-Smith, 2011; Sarant et al., 2009; Serry & Blamey, 1999). The current investigation of the NZ and international literature on preschool children with hearing loss was seeking available information related to the main aims of this study, which are to investigate the characteristics of speech and language in children with hearing loss, their speech and language differences from typically hearing children and the nature of speech and language improvement over time. This investigation will provide insight into the situation for hearing loss and its consequences in NZ and will be used to establish a basis for seeing the differences between the available information and the results of this study.

2.1 Language

Learning language starts very early in a child's life (Preisler, 1999) but children with congenital hearing loss cannot acquire language naturally (Hoemann, 1972) unless they have parents who are proficient in sign language. In the latter case sign language, but not oral language, may develop. Historically, 'language' has not been investigated as much as 'speech'. This is due partly to lack of a clear distinction between speech and language, and partly to a belief that these children were not language or learning disordered, but hearing disordered; if speech could get in to the auditory system, then language would get out.

Additionally, speech and its problems were more obvious. Language is a complex world of symbols which a child needs to understand, learn, and then represent in different ways such as in speech, sign, and writing (Preisler, 1999), hence is more subtle and complex in its manifestations of difficulty. Another factor was that hearing loss is an invisible problem, especially when in milder degrees (the child develops relatively normally in the first year) (Löhle, Holm, & Lehnhardt, 1999), hence it will not necessarily be picked up early unless detected via universal newborn screening, and the child may lose the chance to develop language at the right time. This delay will have consequences for later language development.

The new technology of cochlear implants allowed many deaf children to have good access to spoken language for the first time. This,along with new habilitation programs, has given rise to an increase in studies of language outcomes in children with hearing loss (Blamey et al., 2001; Delage & Tuller, 2007; Dornan, Hickson, Murdoch, & Houston, 2007; Fitzpatrick et al., 2011; Geers, 2004; Geers et al., 1984; Geers et al., 2003a; Jackson & Schatschneider, 2014; Koehlinger, Owen Van Horne, & Moeller, 2013; Mayne, Yoshinaga-Itano, & Sedey, 1998; Mayne, Yoshinaga-Itano, Sedey, et al., 1998; McGuckian & Henry, 2007; Mouvet, Matthijs, Loots, Taverniers, & Herreweghe, 2013; Pipp-Siegel, Sedey, Vanleeuwen, & Yoshinaga-Itano, 2003; Sarant et al., 2009; Tuller & Delage, 2014; Yoshinaga-Itano, 2003a).

Reviewing the literature revealed two main types of study. The first group investigated language skills using only standardised tests, generating standard scores which can be used for different quantitative purposes such as reporting the rate of language development or the amount of delay compared to a normative sample. The second group examined spontaneous language samples, analysing different aspects of language such as morphology or pragmatics and providing a qualitative picture of language. In the following discussion about the state of present knowledge on language development in children with hearing loss both types of studies have been used to identify language features of children with hearing loss, and their rates of language improvement over time.

2.1.1 Language: The Overall Findings

It is usually the family's decision to put children in a habilitation and/or educational setting that focuses on an Oral Communication mode or Total Communication mode (Lederberg et al., 2013). However with early diagnosis, early intervention and intensive language intervention and the evolution of hearing aids and cochlear implants, it seems the number of children with hearing loss who use verbal language is increasing and the use of sign languages decreasing, and the possibility of these children going to mainstream school is increasing. Hence it is worth observing language outcomes in preschool children with hearing loss receiving early intervention compared to those who are not, and the relationship between their language outcomes and influential factors such as severity of hearing loss.

In an Australian study, Sarant et al. (2009) evaluated 57 preschool children aged 1 to 6 years, with severity of hearing loss from mild to profound. The age of diagnosis ranged from under 6 months to over 25 months, with a total of 33 (about 60%) diagnosed before 12 months of age. They received hearing aids or cochlear implants and were registered in early intervention programs. For 1 to 3 year olds, the Child Development Inventory (CDI) was administered, for 3-year olds, the CDI, Peabody Picture Vocabulary Test (PPVT-III) (Dunn & Dunn, 1997) and Clinical Evaluation of Language Fundamentals (CELF P) (Semel, Wiig, & Secord, 1992) were used and for 4 to 6 year olds, the PPVT and CELF-P were administered. The researchers did not categorise children based on types of hearing device or type of hearing loss and they also did not exclude any child with an additional disability such as low cognitive ability. They divided the results of language assessments into three groups: normal, mild-moderate delay and severe delay.

In this study 42 parents completed the CDI questionnaire for children aged 2-3 years: 32 for children with normal cognitive ability and 10 for children with low cognitive ability. Nine (three of whom were diagnosed before 6 months) of the 32 and one (diagnosed before six months) of the 10 from each group had age-appropriate receptive and expressive language skills. In the 3-6 year-old group, 37 children had normal cognitive abilities, 29 of them had age-appropriate vocabularies; 22 had receptive language skills at their age level and 17 had age appropriate expressive language skills. In the older group there were five children with low levels of cognitive functioning. All of these children with lower cognitive functioning had delayed vocabulary development and expressive language skills and just one of them had age-appropriate receptive language. This study highlights the complexity of language outcomes in children with hearing loss.

Sarant et al. also evaluated 20 children with hearing loss but normal cognitive ability, aged 55-75 months, before they entered school. On the PPVT receptive vocabulary test, 13 had age-appropriate vocabulary scores, and seven were 1.5 SD below the mean of children with normal hearing. Eight of them had age-appropriate language skills, six had a mild delay and six were severely language delayed at school entry.

The researchers found a negative relationship between pure tone audiometry (PTA) and language skills but there was no significant relationship between language skill and age of diagnosis. Other factors influencing children's language skills were family contribution, parent education, and cognitive ability. There was great variability in the language results that the researchers believed it was related to the special features of some families.

Sarant et al. (2009) showed that early diagnosis and intervention were not the only influential factors in regard to language outcomes because about half of their participants had delays in their language skills. They also showed that children could have age appropriate language skills even with hearing loss. Mixing the different degrees of hearing loss in one group and drawing conclusions from them places the results in a doubt so the results should be interpreted with caution. Nor did these researchers discuss those children with better outcomes or lower outcomes separately but, like other studies, they acknowledged the high variability in their results and checked and controlled some possible factors by statistics. They also did not include any spontaneous language analysis to find any possible differences between children's language function based on formal and informal language measures.

In a study that better specified age and severity of hearing loss groups, Fitzpatrick et al. (2011) described speech and language skills of children with in-ear hearing aids (HA) and cochlear implants (CI) in comparison with normal hearing children. They assessed 88 children (26 with CI, 25 with HAs, and 37 normal hearing). Children ranged in age from 4 to 5 years. The HA users had a wide range of degree of unaided hearing loss from 25 to 95 dB HL, and the CI users had an unaided range of 85-115 dB HL. One third of their participants were referred by newborn hearing screening. The assessment tools in this study were PPVT-III, the Preschool Language Scale, Fourth Edition (PLS-4), the Goldman-Fristoe Test of Articulation-2 (GFTA-2) and the CDI. Children with hearing loss scored significantly lower than their matched controls with normal hearing in almost all measures. The only exception was that the HA users did not show significant difference from the matched controls in the language comprehension scale of the CDI. The HA users scored higher for all measures in comparison with CI users but the only statistically significant difference was in the GFTA-2.

The researchers checked the relationship between PTA and speech and language scores and found that children with milder degrees of hearing loss (≤ 70 dB HL) achieved higher scores than children with more severe degrees of hearing loss (≥ 71 dB HL); this correlation was moderate and negative (i.e., greater hearing loss associated with poorer scores). Children with mild to moderate-severe hearing loss showed that for every 10 dB HL improvement in their auditory level, there would be a 2-3 unit increase in their standard scores in these measures. They did not find any particular relationship between age of diagnosis and children's scores on these measures but there was a positive correlation between parents' education and children's language skills.

This study shows how hearing loss, even in mild forms can have negative effects on children's speech and language and cause them to lag behind their normal hearing age matched controls. The main predictors of speech and language outcomes in this study were severity of hearing loss and parent education.

The Fitzpatrick et al. (2011) and Sarant et al. (2009) studies and similar ones are not entirely satisfactory indicators of those speech and language features that are most susceptible to hearing loss. They do not show, for example, issues such as the possibility of specific problems in morphology and syntax and they will not answer many questions about children's ability to use imperfect language to communicate with their peers, parents and others. These aspects of language need to be examined in detail and not only by formal tests. Some qualitative investigations based on children's spontaneous language samples in more informal situations will provide a better understanding of these language deficits. Then the clinicians and other professionals who are in charge of the rehabilitation and education of children with hearing loss will have more realistic data to use for planning intervention. It is for this reason that below is a review of the existing data about the morpho-syntactic features of language in children with hearing loss.

2.1.2 Language: The Specific Findings

One of the language components that may be most susceptible to the effects of hearing loss is morphology. This is based on evidence for links between speech perception and morphological endings in English that typically involve high pitched, soft sounds such as /s/, /z/, /d/, and /t/ (Ling-Yu, Spencer, & Tomblin, 2013; Norbury, Bishop, & Briscoe, 2001; Spencer, Tye-

Murray, & Tomblin, 1998). Morphology refers to the structures of words and patterns of word formation in a language. In English, morphology has two domains: 1) lexical or derivational morphology (combination of elements to make new words) and 2) inflectional morphology (variation in forms to express a grammatical contrast) (Crystal, 2003). Inflectional morphemes are usually in the final position in words, such as tense markers, plurals, or comparative and superlative morphemes. They can be challenging for children with hearing loss. Studies indicate that final consonant deletion is common in children with hearing loss (Ambrose et al., 2014). Morphological endings have less energy during pronunciation, which can make them unnoticeable for people with hearing loss. Even young typically hearing English- speaking children do not use these morphological endings consistently (Ling-Yu et al., 2013).

Inflectional morphemes play an important role for children to comprehend language in their environment. Investigating the development of tense markers over time in preschool children with hearing loss, and the relationship between children's speech perception abilities and the occurrence of tense markers were the aims of a study by Ling-Yu et al. (2013). These researchers followed up nine children with cochlear implants using a story-retell task for three years after implantation. Their participants were from 4;04[4] to 6;04 years old and they had received their CI before 30 months. The researchers also recruited a matched control group (N=27) with similar years of hearing experience (nine participants 3 years old, nine matched 4 years old and nine matched 5 years old). They used six stories (each included a four picture-sequence) and prewritten scripts. They then counted the percentage of correct tense markers and found that the hearing loss children produced significantly more tense markers at four and five years post-implantation than at three years (similar to matched controls). The difference in percentage of correct tense markers between four and five years was not significant (for either group). The percentages of correct tense markers four and five years after implantation (but not three years), were significantly below those of the matched controls. Thus at three years the children with implants overlapped with the controls, but they fell behind the control children as they developed their language skills. There was a lot of variability in the results of children with cochlear implants. For example, at five years after implantation, four children were below the mean of the matched controls, while five performed like the matched controls. There was a trend for reduced variability in the cochlear implant group over time, but individual children

[4] Years; Months

showed different patterns of development over time. Children in both groups made more omission errors than commission errors. For all error types and for both groups the number of errors decreased over time.

In another part of their study, Ling-Yu et al. (2013) found a significant correlation between children's speech perception scores three years after implantation and percentage of correct tense markers four and five years after implantation. There was also a significant correlation between speech perception scores at four years post-implantation and percentage of correct tense markers five years after implantation, which means CI users with better speech perception abilities produced the tense markers more accurately.

Ling-Yu et al.'s study is one of the few studies that provides valuable information on a particular part of the morphology of language in children with hearing loss. It also shows the rate of language development in this part of the morphology and its relationship with speech perception. However, the study has design limitations that make it difficult to extend the results to the whole population of children with hearing loss. Some of these limitations were the restricted number of participants, and the inclusion of only CI users (only unilateral). Because nowadays children are often implanted at or less than 12 months of age and the number of children with bilateral cochlear implants has increased the results might be different. In addition the situation in regard to hearing aid users is not clear and children with milder types of hearing loss were not included.

To see how hearing loss - even mild to moderate degrees - affects the learning of finite verb morphology, Norbury et al. (2001) evaluated 19 children aged 5;09 to 10;07 with mild, moderate and high frequency hearing loss. They administered two sets of assessments: formal language tests which included the British Picture Vocabulary Scale (for receptive vocabulary); the Test for Reception of Grammar (a multiple-choice test in which the child chooses one picture according to a spoken sentence), the Recalling Sentences subtest of the Clinical Evaluation of Language Fundamentals-Revised UK (to assess children's expressive language skills) and two different verb tasks for third person singular and past tense markers.

There were no significant differences between children with mild-moderate hearing loss and typically hearing age matched controls on the British Picture Vocabulary Scale and the Test for Reception of Grammar. However, children with mild-moderate hearing loss had a significantly lower mean score on the Recalling Sentences tasks than that of the matched group. In the third person singular task, there was a difference between children with hearing loss and the matched controls but it did not reach the significance level (p = .058). This is probably because children with hearing loss had a wide range of performance (based on the reported standard deviation) in comparison to the matched controls. While none of the matched controls scored below 66%, three out of 19 participants with hearing loss scored below 66% (these children met criteria for language impairment). In the past tense marker task, children with mild-moderate hearing loss did not differ significantly from chronologically age matched controls, however the variation in the hearing impaired group based on the reported SD of scores was very high. They had four outliers, two were the youngest participants (5;09 and 6;05 years old) and the other two met criteria for language impairment.

These researchers found a significant correlation between third person singular and the past tense marker tasks, which show a similar construction is common to them. Although the frequency of verbs and their regularity for the past tense marker had significant effects on the past tense marker task, this effect was similar for both groups. In their exploration to discover the cause of the high variability in the scores of children with hearing loss, the researchers categorised them into two groups: a group with the impairment in these two morphology tasks and another group without impairment. Those children with impairment in these tasks were significantly younger than those children without impairment and they also had significantly lower scores in all the language measures. There was a significant correlation between children's scores in the verb finite tasks and language scores.

This study showed that some children with hearing loss who do not show significant delay in expressive language might still struggle with these morphemes. They also showed that this problem was not a specific or selective deficit but was consistent with the children's total language level. The existence of a specific language disorder along with hearing loss in some children is an indicator that care should be applied in the examination, data interpretation and treatment of children with hearing loss. Although the study tested morphology in some special verb morphemes, the information on the other parts of morphology is unknown. The researchers also used structured tasks to test the children but in a spontaneous language sample the situation might be different. Placing children with a wide age range and different severities of hearing loss together in one group makes judgment of the whole group of children with hearing loss more difficult and the results should thus be approached with caution.

Perhaps one of the most effective ways to assess morphology and syntax in children with and without hearing loss would be in a narrative task. Narration is a continuous flow of utterances and the examiners can control the language output by changing simple structures such as the number or complexity of pictures or the topics. Also, children's wider abilities in spoken language such as their vocabularies, syntax, morphology and phonology will be evident in their narratives. It is likely that any immaturities in any of these skills would appear in their narratives. To the best knowledge of the author not many studies have undertaken an in-depth look into the narrative skills and language structures of children with hearing loss. One of the few studies that have done this was by Worsfold, Mahon, Yuen, and Kennedy (2010). They undertook a detailed analysis of expressive language in two groups of children with permanent childhood hearing loss (late and early identified) with 10-15 minutes of retelling a story consisting of 12 pictures and a 15-sentence script. Their participants were 89 children with hearing aids or cochlear implants (>40 dB HL) aged between 6;06 and 10;09 (mean age 7;07), and 63 children with normal hearing (mean age 8;01). About half of the children with hearing loss were diagnosed before nine months and the remainder were late diagnosed. They analysed all samples syntactically and morphologically using the Language Assessment Remediation and Screening Procedure (LARSP)[5]. They were selective about the items in this profile, using only the number of whole sentences, the number of sentences with subordinate clauses, and the morphemes with high pitched sounds (i.e. markers of plural, past tense '-ed', third person singular '3s', contracted negative 'n't', contracted copula 's' and contracted auxiliary 'aux') and low pitched sounds (i.e. markers of the present participle '-ing', past perfect '-en', superlative '-est', comparative '-er' and adverb '-ly').

They found the groups of children with hearing loss had a similar probability of an increased number of sentences with subordinate clauses, and a similar number of morphological endings with low frequency sounds. However, the early diagnosed group were superior to the late diagnosed group in the number of sentences and the number of morphological endings with high frequency sounds. Examining children with hearing loss as one group and comparing them with normal hearing children showed that, with the exception of the number of sentences and the number of morphological endings with low frequency sounds, children with hearing

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[5] The LARSP will be discussed in Chapter 2 (Methods).

loss scored significantly below the matched group. Children with hearing loss had high variability only for high frequency morphological endings. This study is a useful source to indicate that children with hearing loss use these morphological endings in their expressive language even though they have language delays. However, there are still some aspects of language that have not been addressed.

The investigation of the effects of hearing loss on grammatical features (mainly morphological endings) has been confusing since in most studies the results came from a mixed population of children with hearing aids and cochlear implants, and less attention was paid to milder degrees of hearing loss. In addition, many studies used matched controls younger than the comparison group. To address these doubts and questions, Koehlinger et al. (2013) chose children with mild to moderately-severe hearing loss (20-80 dB HL). All of the children with hearing loss were HA users except for three with mild hearing loss who did not have hearing aids. Sixty 3 year olds with hearing loss were matched with 23 children with normal hearing and forty 6 years old with hearing loss were matched with 17 children with normal hearing. To assess language skills the researchers used both a formal test (The Comprehensive Assessment of Spoken Language) and informal language assessments which included 20 minutes of interaction between a 3-year old child, a parent and the examiner on selected activities, analysed for a range of language features. For the 6-year old children interaction included eight minutes between examiner and a child on a similar selected activity and 12 minutes of a modelled conversational interview. They compared the mean length of utterance (MLU) of the 6-year old group with hearing loss with both matched controls and found that children with hearing loss had significantly lower MLU than their age peers but both groups at age six had a significantly higher MLU level than the three-year old, normal hearing children. To put it simply, 43% of children with hearing loss in both age groups had MLU measures more than 1 SD below the mean of the normal hearing matched groups.

Koehlinger et al. also compared groups based on hearing status for the accurate use of verb morphology (‘be’, -3s and -ed). Both age groups of children with hearing loss used these morphemes significantly less accurately than their matched controls, however both groups at age 6 used them significantly more accurately than the 3-year old groups. In the morphology measures, 38% of the younger group and 63% of the older group of children with hearing loss were more than 1 SD below the mean of their matched controls. The researchers only completed these analyses for those children with good production skills, especially on some phones such as /s, z, t, d/, and they excluded children with less than 75% accuracy on final consonant production. Running tests including all children did not change the general findings. They found a lot of variability in the results of children with hearing loss in both age groups. For example in verb morphemes in both age groups, some children used them accurately 100% of the time and some used them accurately less than 25% of the time. In their regression analyses the researchers found age and then audibility and age of fitting were strong predictors for language outcomes and for verb morphemes. Better ear pure tone average (BEPTA) was the best predictor.

To sum up, this study and those discussed earlier show that children with hearing loss are either behind children with typical hearing or simply show a delay in their language abilities and use of grammatical features. These studies included some children with morpho-syntactic skills comparable to age-matched peers thus demonstrating that not every child with hearing loss will have a deficit language profile. It seems morphology and syntax are more vulnerable than other layers of language since they showed deficits even in milder types of hearing loss. No additional qualitative studies that specifically examined language syntax and morphology structures, and which described the errors better were found.

Most of the studies identified were either general or specific in their language aims. The main index for syntactical development in many studies was MLU and only final verb morphemes were examined for morphology. The studies were also mainly focused on children of one ethnicity, who were monolingual and without other disabilities. This means caution is required when extending their results to the whole population of children with hearing loss. More comprehensive qualitative and quantitative studies are needed to clarify some doubt in regard to the language structures of children with hearing loss.

The study in this thesis will therefore seek answers to questions such as: what morphological endings in nouns and verbs do children with hearing loss use? In a spontaneous language sample, would the finite verb morphemes be produced? What are the most common sentence structures in the language profiles of children with hearing loss? Do they have any preference for producing these structures? How do children with hearing loss act at phrase level? Is it possible that those children who lack morphological endings can overcome their problems with age? What severity of hearing loss would be needed to impact on the acquisition of morphological or syntactical features in these children? This degree of detail may result in a much richer perspective on the productive and functional language of children with hearing loss.

2.1.3 Rate of Language Development

Rate of language development is one of those variables that can be quantified and can show the impact of hearing loss. The general assumption is that hearing loss can slow down the rate of language development in children. To find out the relationship between age, hearing loss and language development (or developmental rates) Blamey et al. (2001) investigated language in 40 HA users and 47 CI users from primary schools in Australia with severe hearing loss who had been diagnosed late. They administered two language tests (the PPVT-III and the CELF-III (Semel, Wiig, & Secord, 1995) and took a spontaneous language sample to calculate MLU for each child annually across three years to provide general indicators of language use. Their sessions lasted about 15 minutes and at least 30 utterances were collected for each child.

The language development rate in both groups with CI or HA was on average about 50-70% that of the typically developing children. Interestingly, and in contrast to other studies about aspects of language and children with hearing loss, the researchers did not find any relationship between severity of hearing loss and rate of language development. From this study it can be said that the children with hearing loss had slower language development rates than the normal hearing children and their difference from the normal range of language development was significant. The researchers concluded that at the age of 12, these children with hearing loss would enter secondary school with an average of 4-5 years delay in their language. However, this finding was for children who had severe hearing loss, which had been recognised later in their life and who had received their hearing technology later. In a more recent study, Jackson and Schatschneider (2014) evaluated the rate of speech and language development in a group of 24 children with hearing loss who were in an early intervention programme and were receiving auditory verbal therapy. The had no other disability, were consistent hearing support users, and English was their home language. Using the PLS-4 the same examiner assessed the children at least twice with a six month interval in between. They found as a group the children’s expressive language and auditory-listening comprehension scores were below the normal range. The children showed an upward trend based on their raw scores but did not show an upward trend when their scores were converted to standard scores. This means they did progress but they did not reach their age expectations and their expressive language skills were more more like those of younger children with normal hearing. After age 3, there was a lot of variability between children and the growth rates of language were different. Some children were on the typical language development track. Some of them maintained the same relative distance from the normal range of development and some of them fell behind and their standard scores decreased over time. The growth rate was not different between CI users and HA users. The duration of auditory verbal therapy, severity of hearing loss, age, and consistent use of hearing support devices had a significant impact on children's comprehension and expression scores.

Jackson and Schatschneider's study also provided some evidence on the rate of language development and how there are individual differences in t. Even with all available services, the literature suggests that we cannot expect a normal rate for language development for all children with hearing loss, probably because it is influenced by many factors. However, Jackson and Schatschneider showed some children had a normal rate of language development. The limitations of this study are the use of an available convenience sample and including only formal assessment.

To conclude, almost all of the studies reviewed have shown that children with hearing loss as a group have different degrees of language impairment, regardless of the degree of hearing loss, age of identification and the type of hearing support system used. The next question that needs to be addressed is about the characteristics of children's interactions with their caregivers. With this flawed language system, are the children able to communicate? Do these language impairments stop them communicating effectively with their communication partners? Do the children's speech and language problems cause them to act differently? This brings us to consider what socio-conversational skills children with hearing loss have. What is the extent of their pragmatic skills relating to topic management? In the next section some studies that investigated children's abilities in these areas will be discussed.

2.1.4 Child-Caregiver Interactions

Babies interact from very early in life using eye gaze, gestures and vocalisations. During the second year of their life they extend their repertoire from these early communicative behaviours to a more sophisticated verbal approach. They can start a topic, answer some questions properly and even ask for information from their communication partner. As they grow, their management of topics in talk increases, along with their use of a range of speech acts such as requesting information, commenting, and showing disagreement in conversation.

Where children have hearing loss, these developments may be affected. The literature on inteactional communication of children with hearing loss includes a number of studies involving children younger than 3 years (Batten, Oakes, & Alexander, 2014; Janjua, Woll, & Kyle, 2002; Jones, 1996; Koester, 1995; Lederberg & Everhart, 2000; Meadow-Orlans & Steinberg, 1993; Pancsofar & Vernon-Feagans, 2006). In contrast, there are not many studies on older children and few studies have examined children's interaction with their peers (Bobzien et al., 2013; Deluzio & Girolametto, 2011; Preisler, Ahlström, & Tvingstedt, 1997).

One of the most comprehensive studies for which detailed results are reported is the longitudinal study of Lederberg and Everhart (2000). There has been a view in the literature that mothers of children with hearing loss play a controlling role in the conversation and, because of this, children lose their enthusiasm to participate in a conversation and consequently the rate of children's dyadic conversation will gradually decrease (e.g; Geers et al., 1984). An alternative line of logic suggests that the speech, language and pragmatic difficulties of children with hearing loss change parents' communication styles. Lederberg and Everhart's (2000) longitudinal study of 20 severe-profound hearing impaired toddlers (22 months and then 3 years old) with hearing parents and 20 normal hearing children and their hearing parents examined these communication features in both the children and the caregivers' communication features and their changes over time. The main communication analysis was based on about 15 minutes of interaction between children and their mothers in a laboratory play room prepared with toys for these two age groups. The middle five minutes of each child-mother interaction were chosen to be analysed, then all intentional communicative behaviours (including all linguistic and non-linguistic, sign or verbal) in the samples were coded. Rather than use utterances as their unit of analysis, they introduced 'Communication Units' (CU) which could be an utterance, or a gesture or a combination of the two. The majority of children with hearing loss were severely language delayed, such that their language performance at age 3 was similar to that of their matched controls at age 22 months (i.e., they were on average using only single word utterances). At age 22 months, the children with hearing loss had about 11% linguistic CUs and at age 3 years about 41% linguistic CUs, while these figures for their matched controls were 53% and 75% respectively.

At age 3, the hearing children had significantly more CUs and topic maintenance than the children with hearing loss and both groups had significant increases in the frequency of CUs, topic initiation and topic maintenance with age. The children with normal hearing had a significant decrease in the proportion of imitation (almost none at age 3) while children with hearing loss had a smaller proportion of imitation at 22 months than the normal hearing children but at age 3 the proportion of imitation increased significantly. Both groups showed a significant increase in the proportion of responsiveness from 22 months to three years old, demonstrating almost the same rates at both ages.

The functions of the CUs were categorised as classifiable (directives, questions and statements) or unclassifiable. There was a declining trend in the unclassifiable CUs from 22 months to 3 years old for both groups; however children with hearing loss had a higher proportion of unclassifiable CUs than the matched controls. The matched controls at both ages made more statements and infrequently asked questions or used directives. The children with hearing loss at age 22 months mainly used directives, used fewer statements and seldom asked questions. The proportion of statements increased to match that of children with normal hearing at 3 years of age, but they still used more directives with their mothers seldom asked questions.

The mothers' talk showed no significant differences in terms of the number of CUs and the proportion of topic initiation between the mothers of children with and without hearing loss. The only significant difference was for the dyads' CUs, which was because the children with hearing loss had fewer CUs than their matched controls, so their mothers had fewer dyads' CUs than the mothers of matched controls. Hearing status did not have any effect on the mothers' responsiveness, but age of the child had a significant effect. With increasing age there was an increase in the mothers' responsiveness.

Two features of the mothers' talk were significantly different overall between the groups, and that was in the proportion of repetition and in the use of 'direct' directives. The mothers of children with hearing loss used more of both of these features than the mothers of children with nornal hearing, although the use decreased with age for both groups.

Other features of mothers' talk showed similarities for at the earlier measure point, but differences when the children reached 3 years. Directives whose main function was classified as 'attention-getting' was similar in proportion for both groups of mothers at 22 months, but was maintained at this level for the mothers of children with hearing loss at 3 years, whereas it had declined in the talk of the mothers of the matched controls. 'Positive acknowledgements' were also similar at 22 months, but proportion had increased by age 3 for the matched controls only.

These results tend to support the idea that the parents of children with hearing loss are more directive, and are tending to respond as they did with younger children. However it also reveals that communicative behaviours are changed on both sides, as you might expect given the interactive and responsive nature of human communication. Therefore communication in use is an important target for examining language and its development in children with hearing loss. It is not enough to examine only the child's language skills, as the ICF model has also made clear.

However, not every communicative skill was affected by hearing loss. Children with hearing loss used very similar acts for communication to their hearing peers, albeit in different proportions. They had a slower developmental rate for communication skills in comparison with their matched controls. Mothers of children with hearing loss did not have major differences from the mothers of matched controls except for the area of response control and that was presumably largely due to the children's language abilities.

This study involved only a limited age group and it could therefore not predict what will happen for children with hearing loss later in life. The study found a lot of variability in children's language skills especially at age 3, but did not separate the results according to language levels. Milder degrees of hearing loss, bilingualism, additional disabilities, different types of hearing support system (HA vs CI), and cultural differences in communication and pragmatic skills may be factors that influence the particular picture for any given child. Other communication partners such as age peers, friends, teachers and familiar and non-familiar people will have increasing influence as children get older, and these partners may change the style of communication as they have different communication expectations and practices.

2.2 Speech Production

Disruption of normal speech development is one of the most obvious effects of hearing loss (Osberger & McGarr, 1982), thus the most common concern and desirable outcome for children with hearing loss from the parents' and professionals' perspectives is the acquisition of intelligible and age appropriate speech after implantation, hearing aid fitting and speech and language intervention (Baudonck, Dhooge, D`haeseleer, & Van Lierde, 2010a; Geers et al., 2003a). It might be said that the data available from typically hearing children would be enough to set up therapeutic plans, but we do know from studies that each child has her/his own developmental progression and that the same degree of hearing loss might have different consequences for different children. It would be valuable to have a developmental pattern for children with hearing loss as well. Because of methodological differences, the available data for speech production of typically hearing children varies across studies and it would be difficult to choose one of these studies as a standard for children with hearing loss. This is especially the case if confounding factors such as severity of hearing loss, age of diagnosis, the type of hearing support system (Yoshinaga-Itano & Sedey, 1998) and the educational system (Tobey et al., 2003) are added.

Speech production might appear to be a simple concept but it represents a large amount of language knowledge, i.e. phonology, or the representation of the sound system of a language. Additionally series of motor processes such as articulation, phonation, resonance and prosody need to work together to result in intelligible speech (Baudonck et al., 2010a). In the present study the motor processes were not investigated, so here the focus is just on the literature dealing with produced speech.

Children with hearing loss have a number of issues in regard to their speech production skills, as numerous studies have shown (Baudonck et al., 2010a; Baudonck, Dhooge, & Van Lierde, 2010b; Blamey et al., 2001a; Blamey, Barry, & Jacq, 2001b; Blamey et al., 2001; Flipsen Jr, 2008; Flipsen Jr & Colvard, 2006; Flipsen Jr & Parker, 2008; Serry & Blamey, 1999; Serry, Blamey, & Grogan, 1997; Van Lierde, Vinck, Baudonck, De Vel, & Dhooge, 2005). This section will review related articles to investigate the current knowledge on a number of these issues. At the end of this review, we want to find answers to the following questions. First, what are the phonemic and/or phonetic inventories of children with hearing loss? Is it acceptable to assume all children with hearing loss have a faulty speech sound repertoire? If so, what is it? Second, what kind of phonological processes do children with hearing loss have? Are these phonological processes developmental or atypical? Third, do the children's speech production problems decrease with development, education or rehabilitation? Fourth, do children with hearing loss have intelligible speech as a result of new technology and early intervention and diagnosis? This study addresses these questions about children in NZ as a contribution to the wider understanding of the issues.

2.2.1 Speech Sound Inventories

Children with typical hearing start to produce vocalizations such as babbling during the first year of their life and they shape their first speech sound inventories. This is where children with hearing loss will start to differ from children with typical hearing (Eilers & Oller, 1994; Nathani, Neal, & Oller, 2007; Oller & Eilers, 1988; Oller, Eilers, Bull, & Carney, 1985). Studies have shown that even with temporary hearing loss such as in otitis media there may be a delay in shaping and producing speech sounds (Rvachew, Slawinski, & Williams, 1996). McGowan, Nittrouer, and Chenausky (2008) showed that after 12 months, children with hearing loss are still behind their typical hearing peers in speech sound production.

The speech production problems continue. Ambrose et al. (2014) examined speech production skills in 70 monolingual 2-year old children (mean age 26 months) with bilateral mild to severe hearing loss (25-75dB HL) and 37 monolingual normal hearing children matched in terms of age and socioeconomic status in the USA. They looked at speech production skills at age 2, the influential factors at this age and how much skills at age 2 can predict speech production skills at age 3. They used part of the Open and Closed Set Test[6] (this is an unpublished assessment tool produced by Ertmer, Miller & Quesenberry (2004) cited in Ambrose et al 2014) to elicit speech sounds and assess word comprehension. For the open set, the child imitates words and for comprehension they pick out a target word (e.g. 'cow') from three pictures (e.g 'elephant' and 'bear'). The researchers calculated phonological accuracy, word acceptability and word identification.

[6] This tool uses early-emerging vocabulary as stimuli to examine speech perception, word comprehension, and speech sound production abilities in very young children with bilateral hearing loss (Ambrose et al., 2014).

Their results showed that for all three measures children with hearing loss scored significantly lower than children with typical hearing. The children with hearing loss did not have significant differences in terms of vowel production, but there were significant differences in consonant production. They had similar developmental patterns for consonants, but produced them consistently later. The order of consonants for both groups was bilabial, alveolar, and then velar; however the children with hearing loss produced alveolar and velar consonants with significantly less accuracy.

The children were re-assessed one year later (mean age 36 months), using the GFTA, which was now valid for their age. The mean standard score of the children with hearing loss (N = 70) was significantly below that of the matched controls. Thirty nine percent of the children with hearing loss achieved standard scores at or below 85, i.e. more than 1 SD below the mean for age. To look at the predictive factors at age 2, they investigated the relationship between Percentage of Vowels Correct-Revised (PVC-R) and Percentage of Consonants Correct-Revised (PCC-R) at age 2 with the scores of GFTA at age 3. They found a moderate correlation between the PVC-R and GFTA scores (HL: $r = .497$, $p < .001$; NH: $r = .443$, $p = .016$) and a strong correlation between the PCC-R and GFTA scores (HH: $r = .730$, $p < .001$; NH: $r = .542$, $p = .002$). Further statistical analysis showed that PCC-R could be a significant predictor of the speech production skills of children at age 3.

This study also found a relationship between severity of hearing loss and children's PCCR scores. Children with a PTA of 20-45 dB HL did not show significant differences from the typical hearing children while children with a PTA above 45 dB HL did show significant differences. They also found a significant relationship between the age when hearing aids were fitted and PCC-R scores. Children who received their hearing aids when they were under six months old did not have significant differences from the typical hearing children while those children who received their hearing aids at or above six months old showed significant differences from typical hearing children.

These group differences demonstrated delayed speech production development in children even with milder types of hearing loss compared to their typically hearing peers. However, the grouped results of the research provide little specific clinical guidance. This is because the variability of performance was very high as shown in the SDs and the graphs. This is perhaps predictable, in that children with a wide range of degrees of hearing loss were grouped together, and the trajectories of individuals or subgroups within them were not followed. This variability happened even though the researchers excluded 20% of children with hearing loss and 5% of typical hearing children from their sample because they could not at first imitate enough words on the task. So these results might overestimate the speech production skills of children with hearing loss. The list of the words[7] used was limited (the researchers chose only one out of three word lists since they could administer it more quickly for young children) and the words might not have covered all sounds or all potential phonological processes. The procedure for eliciting words was imitation which meant that the data not a spontaneous representation of children's production. Mixing data from a wide range of hearing impaired children, with a large number of influential factors, could be misleading. So there is still a need to explore the factors influencing speech production skills in children with hearing loss.

There are numerous studies of the speech production skills of 3-year old (and older) children with hearing loss (Baudonck et al., 2010a; Blamey et al., 2001; Borg, Edquist, Reinholdson, Risberg, & McAllister, 2007; Ching et al., 2013a; Eriks-Brophy, Gibson, & Tucker, 2013; Fitzpatrick et al., 2011; Geers, 1997; Geers et al., 2003a; Gold, 1980; Kirk & Hill-brown, 1985; Moeller et al., 2010; Osberger & McGarr, 1982; Schönweiler, Ptok, & Radü, 1998; Schorr, Roth, & Fox, 2008; Serry & Blamey, 1999; Serry et al., 1997; Tomblin, Oleson, Ambrose, Walker, & Moeller, 2014; Tomblin, Peng, Spencer, & Lu, 2008; Van Lierde et al., 2005; Wiggin, Sedey, Awad, Bogle, & Yoshinaga-ltano, 2013; Yoshinaga-Itano, 2003a). However many of them relied solely on standard scores of speech, and they did not reveal what aspects of speech had been affected and what the differences were between the speech of these children and their typical-hearing peers. Some of the studies had only a quick, general look at speech production to find its relationship with other parts of communication or development components such as language, speech perception and cognition. Some of them also recruited small numbers of children, belonging to specific categories, which makes it difficult to extend the results to the general population of children with hearing loss. Finally, some of the studies only focused on children with cochlear implants. These children are a small part of the hearing impaired population and, as stated earlier, this population involves a larger group of children with other types of hearing loss and hearing support systems who do not fall into this category and should be considered separately. However, some of these studies included more detail, and

[7] This list includes boat, baby, babbles, keys, cow, duck, diaper, airplane, milk, and shoe.

had better designs, so these articles will be discussed below to find out about the speech production characteristics of children with hearing loss who are at or above 3 years old.

In a descriptive study, Wiggin et al. (2013) investigated the emergence of consonants in the spoken language of 269 children with hearing loss aged 15-84 months in the USA. They provided longitudinal data for 226 children for the period 1996 to 2010. They included every child with bilateral hearing loss with any degree (mild, moderate, severe and profound) and any hearing support system (cochlear implant or hearing aids). They recorded 25 minutes of interactions between the children and their mothers and reported those consonants which 50% and 80% of the children were able to produce. Their criterion for a sound was registration of two or more examples of a consonant even it was not produced in the right place (for example if a child said /tig/ rather than /dig/ then /t/ would be included in their inventory). At age 7, 50% of children were able to produce all of the consonants of English. The first three categories of consonants that children with any degree of hearing loss were able to produce were stops, glides and two of the three nasals (/m, n/). The fricatives and affricates seemed to be the difficult ones to produce since just /h/, /s/, /z/ appeared early and the criterion of 80% of children using (/ʤ/, /ʧ/, /v/, /θ/, /ð/, /ʃ/, /ʒ/) had still not been achived for this population at age 6. The general order of phoneme acquisition was similar between the groups, with stops, glides, nasals and then fricatives and affricates).

The researchers also provided data based on the severity of hearing loss and types of hearing support systems. It took longer for children with more severe hearing loss (who used cochlear implants and hearing aids) to master phonemes while children with milder losses achieved them earlier. Eighty percent of children with a cochlear implant (n = 48) were able to produce some phonemes (/m/, /w/, /j/, /z/, /h/) earlier than the children with severe to profound hearing loss who wore hearing aids. But at the age of 7, the criterion of 80% of children with cochlear implant using /ŋ/, /ʧ/, /ʤ/, /θ/, /ʃ/, /ʒ/, and /v/ was not achieved.

Eighty percent of the children with mild hearing loss (n = 68) were able to produce stops, glides and two of the three nasals /m, n/ at or before 27 months of age. By age six, the criterion of 80% of the group producing these phones had not been reached for /ʤ/, /ʧ/, /θ/, /ʃ/, /ʒ/. More than 80% of the children in the moderate category (n = 93) produced /n/, /m/ and /h/, all of the glides, and all of the stops except /g/ at age 27 months. At the age of 7, the criterion of 80% of the group producing these phones had not been reached for /ʤ/, /ʧ/, /θ/, /ʃ/, /ʒ/. In the severe category, which included 40 children, the situation was completely different. There were 12 consonants that did not reach the criterion of 80% of the group producing these phones at the age of 4 but by age 7, this number had decreased to only 4 phones (/n/, /ʤ/, /ʧ/, /v/).

This study provided a lot of information, especially a scale for single consonant emergence in children with different severities of hearing loss which can be used for intervention plans. However, to make any judgment we need information about vowels and consonant clusters. The researchers also used spontaneous speech samples which might have some restrictions in terms of providing a similar chance for each phoneme to be produced, for example some phonemes such as /ʒ/ are not as frequent as /b/ or /d/ so in spontaneous speech samples they might not occur. Their criterion to include a speech sample in the analysis was at least 10 different words from the child, so those children who babbled or produced fewer words were not included, which means the level of difficulty in the overall group of children would be underestimated by the data that was obtained.

Another series of studies that addressed some of these issues were those of Blamey and colleagues. They conducted a longitudinal study across four years, involving nine children, each with profound hearing loss, and who had received cochlear implantation when under 5 years old. The average age at implantation was 3;09, with a range from 2;06 to 5;02. The first of these studies, Serry et al. (1997), studied phonetic development. They took two language samples, six and three months before implantation and then eight samples after implantation (with 3, 6, 12, 18, 24, 30, 36, and 48 months intervals). In total they took 69 language samples, of which 19 (early samples) had few identifiable words so the researchers termed them ‘babble’. They transcribed at least 50 utterances from each sample (12% of the samples excluding the ‘babble’ ones had fewer than 50 utterances) and they defined two acquisition conditions to classify different stages in the acquisition of each phoneme: ‘target’ and ‘targetless’ acquisitions[8]. ‘Target’ acquisition refers to a situation where a phoneme was produced at least twice within a sample and a minimum of 50% of these phonemes were perceptually correct. For ‘targetless’ acquisition, there should be at least two perfect examples of a phone in a sample, not necessarily in identifiable words (e.g. using [s] for /f/ but not for /s/

[8] This categorization points to the physical ability of children to produce phonemes for a period of time before these phonemes are integrated into a meaningful linguistic context.

e.g., ‘for’ is [sɔ] but ‘so’ is [dou]). Twelve months after implantation, their participants produced all monophthongs in targetless contexts, while it took on average four years for consonants to be produced even in targetless contexts, and this excluded /z/, /θ/, /ʒ/, and /ʤ/, which were not all correctly produced by the end of the four years. As target phonemes, after four years of using cochlear implants all monophthongs but only 13 consonants were acquired. The diphthongs, fricatives and affricates were slower to appear and to reach the target. The researchers concluded that the order of development was similar to that of children with typical hearing: nasals, stops, glides, and liquids were earlier while fricatives and affricates were later (this is in agreement with part of the findings presented by Wiggin et al., 2013). In typical development, front sounds appear before back sounds, and Blamey et al. also concluded that for children with cochlear implants the order of phonemes was similar, but the rate of acquisition was slower.

In another study the researchers provided more detailed information to investigate the relationship between speech production and speech perception (see Serry and Blamey, 1999). After four years from implantation two diphthongs /ʊə/ and /ɪə/ had not yet reached the targetless criteria.

Since acquisition continued at a steady pace after implantation, the authors assumed that the process of acquisition might not stop over four years. To check this assumption, and also to see what speech sounds would appear after four years, they kept following the children in the study. Five and six years after implantation the children were relatively intelligible, most of the phones had emerged, and the inclusion of ‘targetless’ phonemes was no longer needed (Blamey et al., 2001b). All monophthongs were present for six of the participants four years after implantation and for the other three participants six years after. Diphthongs still had a slow rate of development and by the end of six years there was still one vowel (/ʊə/) which was not even in a targetless condition for most of the participants. The consonants /θ/ and /ʒ/ had reached the ‘targetless’ criterion. Five (/k/, /g/, /ŋ/, /ʤ/, /ð/) out of nine consonants had only the ‘targetless’ criterion after four years and these phonemes had reached the ‘target’ criterion by year six. However, /t/, /s/, /z/ and /ʧ/ were still only meeting the targetless criterion. The rate of progression for all of the children was slower in the fifth and sixth year post- implantation.

This longitudinal study and similar ones provide valuable data on the development of speech production in children with hearing loss especially for children who received Cochlear Implants. However, it can be argued that the sample from Blamey and colleagues' studies represents the best possible outcome, rather than what might be most typical. For example, the majority of children with hearing loss are not yet fitted with cochlear implants and, instead, will have in-ear hearing aids. Even with cochlear implants, not all children have received the enriched speech and language intervention that the nine children in these studies received. It is also a small sample, albeit large enough to indicate some important issues in speech development. We will see in speech perception studies, ethnicity can be counted as a variable for speech and language development, and none of the above studies mentioned this. In NZ, with a multi- ethnic context and its own variety of English, there is need for in depth information which is derived from its own people.

In conclusion, these studies show that children with hearing loss follow a parallel but delayed developmental pattern for speech sounds acquisition. Vowels are more intact than consonants. More vulnerable sounds for these children are fricatives and affricateaffricates. The acquisition process for children with Cochlear Implants did not stop. However, this is a limited perspective on speech production and it does not provide us with a sufficient explanation for the development of all speech production skills. A more phonological approach will reveal broader patterns and processes, and will go beyond the one word level.

2.2.2 Phonological Processes

Researchers often refer to phonological processes (patterns) to describe speech production in children (Flipsen Jr & Parker, 2008). The term was intended to refer to systematic and rule-governed changes to the target phonology that occur in normal speech development (e.g. final consonant deletion, when children will say for example "ba" for "bath", or cluster reduction when they say "tar" for "star"). There are also phonological processs that occur in a language, such as the nasalisation of vowel sounds before a nasal consonant, which are a normal part of the language which apply to all native speakers. The processes that occur in young children are termed "developmental" phonological processes. However children who have apparently consistent and rule-governed differences from the target which do not occur in normal development are often also described in the clinical literature as having phonological processes, often preceded by the term 'atypical' (e.g. *initial consonant deletion*).

This use of the term 'phonological processes' is contentious in phonological theory, but has been found to be clinically useful as an indicator of whether the child is progressing typically or not (Flipsen Jr & Parker, 2008). Dodd and Iacano (1989) introduced non-developmental (atypical) processes as characteristic of unintelligible speech that has only small changes during the preschool years. A developmental progression is found in the developmental processes, for example studies indicate that 'voicing' as a process (e.g., saying 'doe' for 'toe') may be suppressed as early as age 3;0, while 'gliding' (e.g. "woe" for "row") may last until age 6;0 (Dodd, Hua, Crosbie, Holm, & Ozanne, 2002). The types and frequency of these processes in children with hearing loss have been targeted in some studies (Ambrose et al., 2014; Dodd & So, 1994; Eriks-Brophy et al., 2013; Flipsen Jr & Parker, 2008; Huttunen, 2001; Oller, Jensen, & Lafayette, 1978). These researchers found children with hearing loss used both developmental and atypical phonological processes and they used these phonological processes beyond the expected ages of suppression.

Flipsen Jr and Parker's study in the United States (2008) investigated these phonological processes in depth in six children with hearing loss who had received a cochlear implant by age 3 years. The children had a mean age of 5,0, with a range from 3;09 to 6;02 at the first sample, and were then followed for 12-21 months from 18 months after implantation. Their speech was sampled at three month intervals, taking from 5-8 samples for each participant.

This method allowed for considerable detail of analysis, because it used connected speech samples rather than restricted data sets from single word assessments. From the samples, 90 different, intelligible words were selected. The researchers calculated the percentage of occurrence of each process for each sample of 90 words, based on the number of opportunities that each process had to occur. For example, in one transcript, there were 15 opportunities for cluster reduction to happen. So, if a child had six examples of cluster reduction the percentage of occurrence for cluster reduction in this transcript would be 40%.

The analysis resulted in a list of 24 phonological processes, some of which were sub-divisions (e.g.velar fronting in word initial position versus word final position). The list amounted to eight developmental processes (Cluster reduction, Assimilation, Velar fronting, Final Consonant Deletion, Weak Syllable Deletion, Gliding (termed 'liquid simplification'), Stopping and 'Palatal Fronting') and four atypical processes (Initial consonant deletion, use of Glottal Stops, Backing, and changes to vowels, subdivided into 'substitution', 'neutralisation' and ‘diphthong simplification’).

The percentages of occurrence for the group ranged from very small (0.1% for the assimilations and glottal stops – final) to larger (e.g. Cluster Reduction and Stopping at around 36%). However these are means for the group; it may be more interesting to look at the ranges of occurrence – all went from 0 (meaning at least one child did not use that process at all) to a range of higher numbers up to 100% (meaning at least one child used that process consistently) (for details see Appendix A). The fact that 14 of their 24 measures did not even reach 20% at the top of the range gives rise to some concern as to what was meant by the presence of a process. Most phonologists would argue that at 80% or more *non*-occurrence, a ‘process’ cannot be said to be occurring as an explanation of the child’s phonological system. This was especially an issue of the ‘atypical’ processes – 8 of the 9 processes the authors list did not reach even the modest upper range of 20% occurrence.

Regarding post implant age (or the amount of implant use), about 18% of transcripts showed greater use of phonological processes than the normal range. The processes concerned were stopping-initial, final consonant deletion, cluster reduction-initial, unstressed syllable deletion, and liquid simplification. In the investigation of the relationship between age and frequency of each pattern, one child who had better outcomes skewed the results so the authors presented their data in two parts, including and excluding this child that they viewed as an outlier. The findings without the data from this child showed the pattern of occurrence of vowel substitution and initial consonant deletion had significant negative correlation with age and including this child in the analysis added liquid simplification final which had a significant correlation with age. They then checked the individual trends of the frequency of vowel substitution and initial consonant deletion by age for all six children’s samples. The trends represented the group results but the researchers also found that the reduction of frequency of each process was not necessarily a perfect linear trend from sample to sample either for each child or for the whole group. The particular child did not stand out from the group in this aspect of the study and showed a similar general trend and variability in her/his samples.

Although this study investigated phonological processes in depth, there were some design limitations that make it difficult to generalise the findings of the study to the whole population of children with hearing loss. These limitations were the number of participants, including only children with cochlear implants, using only intelligible words from the samples, relying on presentation of only figures and numbers rather than using examples of the samples, and finally the study lacked a control group which (at least in some respects) matched the characteristics of the children in the study.

Eriks-Brophy et al. (2013) evaluated speech and phonological processes in childrenin Canada with hearing loss as preschoolers. They examined 25 children aged 3 to 5 years who had received auditory verbal therapy, were without additional disabilities, were using cochlear implants or hearing aids, and who used the English language regularly. The researchers recruited 35 age-matched controls with typical hearing. The assessment tools were GFTA-2nd edition and the Khan-Lewis Phonological Assessment-2nd edition (Khan & Lewis, 2002). They compared children's phonological processes based on their standard scores on the Khan-Lewis Phonological Assessment-2nd edition, which evaluates 10 common phonological processes and 30 less-frequent phonological processes. The standard score results showed significant differences between children with hearing loss and their matched controls for use of phonological processes. It is worth noting that 68% (17 out of 25) of the children with hearing loss scored at or above 85, which is within normal limits on the test, but their matched controls' mean was 100 hence the significant difference between the group scores. In both groups, the most to least common processes were reduction processes, manner and place processes and then voicing in descending order. The differences between the groups were significant for the reduction and voicing processes but not for the manner and place processes. For less-frequent phonological processes, the participants with hearing loss had a noticeable mean (over 20) for 'Stridency Deletion' at age 3; while their controls had a mean over 5 for 'Stridency Addition' at age 3 and 4. Both groups used the remaining less-frequent phonological processes relatively rarely. The study's findings did not show that atypical phonological processes (such as 'initial consonant deletion' or 'glottal replacement') were common in children with hearing loss.

Although the study had many findings similar to the results of previous studies their participants had higher performance on the both assessment tools which might be because of early detection, early intervention and auditory verbal therapy. The children were also from high socioeconomic groups, some of them were from families who spoke languages other than English at home, and they were living with their two parents. Because of all these features the results cannot be simply extended to hearing impaired children in NZ.

In summary, the speech of children with hearing loss has been reported to have both typical and atypical phonological processes, but the use of the measures is problematic at times. Applying these studies and similar ones to NZ children should be done with caution because the English language in NZ is different. There are also differences in the methods and aims of these studies which make it difficult to reach definite conclusions. For these reasons, replication of such studies for children with hearing loss in NZ is an understandable need.

2.2.3 Speech Intelligibility

One of the main purposes for aiding children's hearing is to ensure input is sufficient for children to develop intelligible speech. Intelligibility is a relative measure of the degree to which a speaker's speech signal is comprehended, depending on such characteristics as the nature of the communication partners, the topics under discussion and the place of conversation (Ball, Perkins, Müller, & Howard, 2008). Intelligible speech is one of the main considerations in the rehabilitation and education of children with hearing loss since a high level of speech intelligibility will help inexperienced people to understand the child's speech at the first encounter (Gold, 1980). A low level of speech intelligibility will cause disruption and difficulties during conversation with familiar and non-familiar people. Unfortunately, children with hearing loss frequently experience such difficulties in their interactions (Flipsen Jr, 2008; Flipsen Jr & Colvard, 2006). An evaluation of speech intelligibility can enable researchers and clinicians to get useful indirect information on the level of benefit provided by hearing aids/cochlear implants, inform the design of intervention plans, and determine children's success as oral communicators (Ertmer, 2011).

In a comprehensive review in 1980 of available literature, Gold reported only 20% of the speech of children with severe to profound hearing loss ('deaf' in his paper) could be understood by unfamiliar people. Twenty eight years later in 2008, Flipsen Jr did another review of the literature on the intelligibility of speech in children with cochlear implants. He reported that the speech intelligibility of these children had increased substantially when compared to the previous reports and this increase appeared to be dependent on the age of implantation. Even children who had received their cochlear implants later (e.g. after 5 years of age) the review indicated there would be a gradual improvement in their speech intelligibility for at least 10 years after implantation.

The usual procedures to assess speech intelligibility are '*Scaling*[9]' and '*Item-identification*[10]' (Ertmer, 2011). Intelligibility can also be deduced from evaluation of articulation in the areas of phonetic inventory, phonological processes and the accuracy of phonemes. However, in many studies these are regarded only as areas of speech production not of speech intelligibility. The present study used the indirect method (evaluation of speech production skills) to assess children's speech intelligibility. The existence of knowledge regarding the phonemic inventory and phonological processes for children with hearing loss has already been discussed. Here the final aspect of speech production skills – phoneme accuracy– will be investigated. By the end of this section, we will be able to reach some conclusions about the intelligibility of speech in children with hearing loss. Ambrose et al.'s findings about phoneme accuracy in the phonetic inventory section have already been discussed; here another study which assessed older children's phoneme accuracy will be discussed.

The long-term trajectories of the development of speech sounds were investigated by Tomblin et al. (2008) in the United States. The researchers evaluated the accuracy of speech sounds in speech samples during a period of 10 years after cochlear implantation. Their participants were 27 children with at least eight years CI experience. The age range of receipt of CI was from 2.58 to 7.44 with a mean of 4.57. They were monolingual (only English) but only two of them used only oral communication and 25 of them used total communication. The analysis of speech samples from the children showed their mean of speech sound accuracy was 15.51% before implantation but it increased to 62.90% four years after implantation, 76.28% 6 years after implantation and 81.40% after 10 years of device usage. Based on the results in the fourth year the other important finding was the predictability of progression during the period 5-10 years after implantation. This study and other similar studies such as Blamey et al. (2001a) showed the development of speech sound accuracy after long term experience with CI, and how phoneme accuracy increased rapidly during the first six year period and then at a slower rate during the period 6 to 10 years after implantation. Such studies also showed the benefit of CI for children with severe to profound hearing loss for the development of speech sounds accuracy over time. However, there are some structural aspects in regard to this study which makes it problematic to extend the findings to the NZ population such as including mainly

[9] Listeners evaluate intelligibility of a speech sample on a x-point scale included from the lowest to the highest (Ertmer, 2011).
[10] Listeners write down every word they understand from a speech sample (Ertmer, 2011).

participants who used total communication. CI users are a small part of the hearing impaired population and these results cannot be extended to children with milder types of hearing impairment and traditional hearing aids.

There have been many studies on the speech production of children with hearing loss. However there are still many questions to answer. From the current literature on children with cochlear implants and with milder degrees of hearing loss it is obvious that they also struggle with speech skills. The high frequency speech sounds, especially those in the fricative and affricate categories, are absent from their phonemic inventories. Vowels are usually intact or are affected to a lesser degree. Phonological processes may be evident in their speech. The processes take longer to be suppressed and some of them (like final consonant deletion, based on its high frequency of occurrence) can be related to hearing loss. Speech sounds are less accurate. For children with CI, speech sound accuracy depends on the duration of CI experience but even though some children reached above 95% accuracy it is not 100% accurate even after 10 years of use. None of these studies reported any child with a complete phonemic inventory, without any speech errors along with highly accurate speech sounds. The number of phonemes and the accuracy of speech sounds increased with age and the number of phonological processes decreased. Based on structural differences and the different make-up of the NZ population, it is worth investigating the speech production skills of children with hearing loss in NZ. No published studies on the speech skills of children with hearing loss in NZ were identified. Not many studies evaluated bilingual children or children with additional disabilities or from different ethnicities so the situation for these children remained unclear. In the next section, in order to investigate existing knowledge internationally and in the context of NZ, existing data on a more fundamental skill category (assuming perception precedes production) *speech perception* will be discussed.

2.3 Speech Perception

Initially, a child’s speech is affected by hearing loss because sound input is impaired. With insufficient speech sound input or distorted input, the higher brain centres are deprived of enough stimulus to develop understanding of speech and consequently language (Eisenberg, Johnson, & Martinez, 2005). Thus, the first consequences of hearing loss on children’s communication skills will be speech perception problems which start to show very early in a child's life (see Barker and Tomblin (2004)) and may not be solved by hearing aids or cochlear implants.

Many studies have investigated the speech perception skills of children with hearing loss (Looi & Radford, 2011; Mildner, Sindija, & Zrinski, 2006; Mondain et al., 1997; Most, Rothem, & Luntz, 2009; Osberger et al., 1991; Pittman, 2011; Sarant, Blamey, Dowell, Clark, & Gibson, 2001; Snik, Vermeulen, Geelen, Brokx, & Broek, 1997a). These speech perception studies had different aims, methods and designs, i.e. to assess the effect of a hearing support device such as comparison of speech perception skills before and after cochlear implantation, to compare speech perception skills between children who used different types of hearing support systems and to investigate the relationship between speech perception and speech production or language skills (Blamey et al., 2001; Davis et al., 1986; DesJardin, Ambrose, Martinez, & Eisenberg, 2009; Tye-Murray, Spencer, & Gilbert-Bedia, 1995). These studies are valuable in many aspects.

First, their main findings showed children with hearing loss had lower performance in speech perception tasks when compared to their typical hearing controls at different ages, regardless of their hearing support system. This means that the speech perception problems that started early in life would not resolve with age for most of the children. Second, in almost all longitudinal studies which followed children before and after cochlear implantation, children gradually improved their performance in speech perception tasks in their post-implantation assessments (with different progression rates). Third, in most of the studies, the children with cochlear implants showed better speech perception performance than those with traditional hearing aids. However, in some speech perception tasks children with acoustic hearing (hearing aids) scored higher than children with electrical stimulation (cochlear implant), but the reverse was true in other tasks. Fourth, even though there was no statistically significant difference between children with hearing loss and typical hearing children, there was a lot of variability in the children's scores. Children with hearing loss tended to be scattered all over the graphs from the lowest to the highest performance while children with typical hearing were at the ceiling and close to each other. Finally, most of the studies supported a positive relationship between speech perception skills and speech production or language skills, which means that children with better speech perception skills will perform better in other aspects of verbal communication.

These main findings do not necessarily imply that all of the studies had similar findings. In fact some of them provided strong evidence against some particular finding. The studies also had structural or cultural limitations that ought to be taken into consideration before any definite conclusions can be made. For example, Blamey et al. (2001) compared speech perception skills between HA users (n = 40) and CI users (n = 47) in primary school aged children in Australia, and found no significant differences. In the auditory-only condition, the speech perception scores of HA users decreased significantly (about 5% for every 10 dB of hearing loss). That these children were in primary school suggests that speech perception problems do not disappear with time. The researchers found slightly superior performance when visual conditions were added to auditory-only ones, a finding which suggests that a combination of auditory and visual input could be a compensatory strategy to overcome speech perception problems. However, the study's scatter plots showed a great deal of variability in these skills for the children. Statistical differences were not found for the groups and not every child had higher performance for speech perception tasks with access to visual cues. They also found a strong correlation between children's speech perception scores and their speech production and language skills scores in both auditory and auditory-visual conditions. This study did not include children with typical hearing (they might have assumed that typically hearing children at this age have perfect speech perception skills for the tasks investigated) and children with other types of hearing support systems so the real gap between the participating children and their hearing peers was not clear. Similarly, children with milder degrees of hearing loss were not included so it is not possible to know whether or not similar speech perception deficiencies apply to them.

In New Zealand, Looi and Radford (2011) included children with typical hearing in their studies and they covered several groups of children with different types of hearing support systems. They evaluated speech recognition skills in four groups of children: 15 participants with typical hearing (8-16 years old, M = 12 years), eight participants with just cochlear implants (11-14 years old, M = 12 years), six participants with bilateral hearing aids (6-13 years old, M = 9 years) and nine bimodal stimulation[11] users (6-9 years old, M = 9 years). They did not find significant differences between the groups for perception of words in quiet and sentences in quiet and noisy conditions. However, 80% of bimodal stimulation users scored

[11] One ear has a cochlear implant while the opposite ear has a hearing aid.

over 80% which was significantly higher than the percentages of CI users (25%) and HA users (17%) who scored over 80%. These scores show that many children with a hearing aid or cochlear implant are significantly behind their peers with typical hearing or bimodal stimulation support systems. In another part of their study, the researchers checked the children's ability to rank pitch and found that children with typical hearing and HA users ranked pitch accurately to a significantly greater degree than the other two groups. CI users and bimodal stimulation users did not show a significant difference in the pitch ranking task. In both parts of the study the variability of results was obvious from the large SD and the presented graphs. This study partially filled the gap in information regarding speech perception skills between children with hearing loss and their typical hearing peers. With the addition of another group of hearing support system users the results of the study provided support to the possibility of having different results for different types of hearing support systems. However, there are still some questions that remained to be answered. The researchers did not mention anything about children with lower degrees of hearing loss or those with specific types of hearing loss such as high-frequency sensorineural hearing loss. They also only looked at speech perception skills so the contribution and effect of speech perception skills in speech production and language skills is not clear. In addition, there is no mention of participants' speech and language skills, which as we know from earlier studies have a strong relationship with children's speech perception scores. Finally, because the study had only a small number of participants, the results should be considered with caution.

There are few studies which include children with all degrees of hearing loss (e.g.Schönweiler et al. (1998)). There are a greater number of children with mild hearing loss, including unilateral sensorineural hearing loss, mild bilateral sensorineural hearing loss, high- frequency sensorineural hearing loss, and bilateral conductive hearing loss, than there are children with more severe types of hearing loss (Bess, Dodd-Murphy, & Parker, 1998; Tharpe & Bess, 1991). Speech perception skills in this milder group have received less attention, on the grounds that the degree of hearing loss is not sufficient to significantly affect those skills. However, conductive hearing loss, especially because of otitis media and similar problems, is an exception in the literature. A large amount of work has been done in this area. The main body of literature about the effects of conductive hearing loss (especially recurrent otitis media) show that this type of hearing loss can have detrimental effects on the speech (perception and production), language and cognition of children (Dyson, Holmes, & Duffitt, 1987; Furukawa, 1988; Klausen, Møller, Holmefjord, Reisaeter, & Asbjørnsen, 2000; Lehmann, Charron, Kummer, & Keith, 1979; Majerus et al., 2005; Rach, Zielhuis, & Van den Broek, 1988; Schönweiler et al., 1998; Žargi & Boltežar, 1992). There has been a focus on the study of conductive hearing loss in indigenous groups (Australian, Native American, and other ethnicities), where incidence tends to be higher than in dominant culture groups (Homøe, 1999; Homøe, Christensenb, & Bretlau, 1996; Hunter, Davey, Kohtz, & Daly, 2007; Leach, 1999; Pugh, Burke, & Brown, 2004; Ward, Mcpherson, & Thomason, 1994). Aithal, Yonovitz, and Aithal (2008) evaluated speech perception in indigenous students in Australia who had a history of conductive hearing loss. Tiwi was the native language of the students and they learned English as a second language at school. The researchers established three groups: indigenous Tiwi speaking children with a history of hearing loss and otitis media from childhood, and two control groups, indigenous Tiwi speaking children without a history of hearing loss and otitis media from childhood, and English speaking, non-indigenous children without a history of hearing loss and otitis media. They evaluated the speech perception of English consonants by measuring the children's reaction time when choosing either the 'same' or 'different' buttons after a pair of words. The two Tiwi speaking groups were significantly slower than the English speaking group, but also significantly different to each other in that those with a history of hearing loss were slower than those without. This study might indicate that the more delicate and subtle parts of speech and language could be affected by conductive hearing loss which means that although there might not be a clearly evident difference in the overall picture of speech and language deeper and more subtle speech and language areas could still be affected by this type of hearing loss. This study was in agreement with results reported by Klausen et al. (2000). They found that those children with otitis media with effusion scored significantly lower on tests of articulation and sound discrimination. However, there was no significant difference between these children and typical hearing children in terms of word discrimination, or on the Boston Naming Test and the Illinois Test of Psycholinguistic Abilities. These finding have been supported by many other studies such as those of Žargi and Boltežar (1992), Petinou, Schwartz, Gravel, and Raphael (2001) and Majerus et al. (2005).

On the other hand, there are some studies which do not show any relationship between otitis media and speech or language development (Johnson, McCormick, & Baldwin, 2008; Lous, 1995; Serbetcioglu, Ugurtay, Kirkim, & Mutlu, 2008; Wright et al., 1988). The reason for this might be because the researchers looked at the general picture of speech and language and did not include the more subtle aspects of speech and language. Since there is disagreement on the effect of conductive hearing loss, specifically otitis media, on speech and language development, the results of these studies should be interpreted with caution. At least three other factors in addition to hearing could have had an effect on speech and language outcomes, such as appropriate interaction with the environment, cognitive abilities and an intact nervous system (Furukawa, 1988). Confounding factors (such as ethnicity, as above) might also increase the chances of acquiring diseases such as otitis media, resulting in a longer duration of hearing deprivation. The possibility of negative effects of conductive hearing loss should not be neglected, especially for children with a history of chronic or recurrent middle ear disease.

This brief review of available studies of the speech perception skills of children with hearing loss has provided a general picture but more in depth studies are required. To reach a more definite conclusion there is a need for studies that include all types and severities of hearing loss and hearing aids. Linguistic background should be considered as a possible factor influencing speech perception skills. No two studies used exactly the same tests, had similar aims or reached similar conclusions. Because of these inconsistencies in the research literature, the significance of measured speech perception in children with hearing loss is therefore not entirely clear. However the strong logical relationship between perception and production makes this an obvious area for investigation. There is a need for NZ-specific speech perception tools that are matched with the society and its culture and which are readily available for use with children.

2.4 Influential Factors

At the beginning of this thesis, I mentioned that there has been an assumption that the measured degree of hearing loss was the main issue that would probably account for most of the outcomes, but that this assumption was too simple. There are many potential features in the lives of children and their families which could influence both the significance of the hearing loss and the outcomes, as the ICF model makes clear. However the literature has investigated these very partially and unsystematically thus far. A comprehensive reviewof these possible issues found in the research literature was conducted by Kumar et al. in 2008. They investigated studies to find variables with possible positive or negative influences on the communication and learning outcomes of children with hearing loss aged 0-3 years who had received early intervention.

The review listed over 40 variables from 170 studies that have been examined as to whether they decrease or increase the complications of hearing loss. These variables were from three different areas: the demographic features of the child with hearing loss, intrinsic features (those related to the child him/herself) and extrinsic features (related to the services that the child and family received). The reviewers categorized these variables into three groups (see Table 1 below). The first group were variables with a known effect on the outcomes for children with hearing loss, such as ‘age at onset of hearing loss’, ‘age at detection of hearing loss’ or ‘duration of hearing loss’. The literature also indicated that early intervention can increase the positive outcomes for children with hearing loss.

The second group of variables was of those that may influence outcomes for children with hearing loss, but these should be interpreted with caution. This group included items such as ethnicity, gender, socioeconomic status, and family structures. Finally a third category included only those variables which had no appreciable impact in these studies, which included without possible effects therapist’s experience, and place of residence.

Table 1: Categorisation of Variables Based on Their Possible Effects On Communication Outcomes in Children, (*Adapted from Kumar et al., 2008)*

Variables with Known Effects	*Variables without any Possible Effect*
Age at onset of hearing loss	Intensity of intervention
Age at detection of hearing loss	Therapist's experience
Duration of hearing loss	Educational placement: public versus private
Age at cochlear implantation	Educational placement: home versus centre-based
Early intervention / educational placement:	Place of residence
	Family functioning
	Maternal employment
	Parental compliance
Variables with Potential Effects	
Ethnicity	Parental stress and coping
Socioeconomic status	Quality of parent-child interaction
Gender	Family structure
Cause of hearing loss	Family-centred versus child-centred intervention
Degree of hearing loss	Maternal characteristics
Cognitive ability (intelligence)	Parental communication
Cognitive variables (e.g. short term memory)	Parental hearing status
Pre-cochlear implant variables	Parental involvement
Additional disabilities	Parental guidance
Age at exposure to sign language	Duration of hearing aid use
Age at fitting of hearing aids	Duration of cochlear implant use
Communication Approach	Having a cochlear implant (versus hearing aids and not
Single Communication Programmes	Use of Cochlear Implant
Lip reading ability	Cochlear implant characteristics
Use of unilateral versus bilateral hearing aids	Cochlear implant centres

Kumar et al. proposed an evidence based practice for any intervention plan, hence their review of significant factors related to outcomes. They also called for consistency of terms in the field of hearing loss, as their review revealed terms were used variably in different studies. They also found that although there was apparently a large body of research, these studeies tended to concentrate on specific groups such as those with a cochlear implant, or children in early intervention, making comparisions across groups difficult. They also found significant methodological limitations across the board, again making it difficult to get clear conclusions. They rcommended repetition of studies with clearer populations and definitions of terms.

Some of these variables have already been mentioned, such as the severity of hearing loss, and parental involvement in intervention. More of the literature on these variables will be discussed in chapter 4.

2.5 Conclusion

Existing data shows that, as a group, children with hearing loss tend to have delays and disorders in their speech and language skills. Generally the literature suggests that these delays and disorders do not prevent children with hearing loss from interacting with others. However a disquieting finding is that in the most recent studies, most of these children were from early diagnosis and intervention programmes but their language outcomes were still problematic. It seems that, even with new technology, these children have a long way to go to reach normal speech and language. Many questions still remain regarding children with hearing loss and their communication skills.

Available studies of children with hearing loss have structural limitations such as the types of tests used, restricted sample size, and restricted inclusionary criteria all of which make it difficult to extend the results directly. In almost all studies, individual differences were mentioned but researchers only looked for influential factors that caused these differences. It may be better to interpret the data together so as to provide a comprehensive picture on the results for any given individual, which could be used to inform and improve services and facilities for children with hearing loss.

There is a lack of information about the speech, language and communication features of NZ children with hearing loss. It is necessary that such studies be repeated in NZ because of differences in the demographic characteristics of NZ, whereby differences in outcomes may be present. There is also a noticeable difference between the age of diagnosis and intervention for NZ children with hearing loss and children from other socio-economically comparable countries, and hence it is important to better describe the situation for these children in New Zealand. This study was an effort to provide such information for NZ children.

Chapter 3: Methods

3. Design & Procedure

This study is an in-depth description of the communication skills of 11 children with significant hearing loss. Two small groups were studied cross-sectionally, one consisting of four children aged between 3 and 4 years, and the second of seven children aged between 4 and 5 years. There were also matched controls of 11 normally hearing children who were given the same assessment battery. There was a longitudinal element to the study of the older group of children with hearing loss, who were re-assessed a year later to see what development had occurred across a year, and what changes were associated with school attendance.

3.1 Participants

3.1.1 Children with Hearing Loss

All children with significant hearing loss in NZ are on the caseloads of Advisers on Deaf Children (AoDC), funded through the Ministry of Education (Ministry of Education, 2012a). The Advisers have face to face meetings with families and are therefore known and trusted by them, and thus provided a way to locate potential participants. Their support for the research made it acceptable to the families and thus made research participants more accessible.

The original intention was to include all children aged 3-5 with significant hearing loss who were on the Advisers' caseloads in the Auckland metropolitan area during the period March 2011 to December 2011. In order to gain a picture of the population of children with hearing loss as a whole, the study specifically did not exclude children with multiple language backgrounds nor with any complicating condition such as physical or intellectual disability.

There were 11 Advisers for Deaf Children in Metropolitan Auckland at the time of recruitment to the study. Of those 11, four did not have any child in the age range of the study. One of the Advisers had one child on the list, but declined to pass on the study invitation to the family saying, "she had enough speech and language assessment and I don`t think she needs more". One of the Advisers declined to participate. Two introduced one family each, and the other three Advisers introduced 15 families.

There were some discrepancies between the number of children the Ministry of Education indicated they knew of with significant hearing loss in the Auckland area and the number of children referred by the Advisers to the researcher. The Ministry of Education listed around 36 children aged 3-5 years in an anonymised database made available to the researcher, but the advisers referred only 17 families. Eleven of the 17 families who had children with significant hearing loss agreed to participate.

3.1.2 Control Group

Each of the study children was matched by gender, ethnicity, and age to a child without hearing problems. The control group came from kindergartens and day care centres or friends of the children with hearing loss. The researcher asked kindergartens and day care centres to distribute a pamphlet asking families of children who had the matching characteristics if they would like to participate. The families of the children with hearing loss, however, distributed the pamphlet among their friends to be part of this study. Four of the matched controls families opted for assessment at their children`s preschools and seven families opted for home-based assessments.

Participants' details can be seen in Table 2. All names are pseudonyms. Each pair of children (child with hearing loss and his/her matched control) was given the same first letter in their pseudonyms, to help track the matches.

Five out of 11 children with hearing loss in this study came from non-dominant culture (i.e. not Pakeha NZ), but this does not necessarily mean they were also bilingual. Therefore their matched controls were matched as far as possible on ethnicity and the languages that they talked at home. For example, Kiana was adopted by her Samoan grandmother and Pakeha foster grandmother early in life. She was reported by these caregivers to be monolingual in English. Her matched control was also a Samoan girl who was bilingual but, according to the parent report, English was her dominant language. Kim was born to a Māori-Pakeha mother and a Pasifika father but was adopted into an English-speaking Pakeha family and grew up in that language and culture. His match was a monolingual English-speaking Pakeha boy.

Table 2: The Characteristics of Participants with Hearing Loss and Their Matched Controls

Participant[12]	*Age*	*Gender*[*]	*Ethnicity*[**]	*SES*[***]	*Matched control*	*Age*	*Gender*	*Ethnicity*	*SES*
Julia	3;07	F	1 & 3	4	Josie	3;07	F	1 & 3	6
Nemo	3;07	M	2	2	Nick	3;06	M	2 & 3	4
Sara	3;07	F	1	6	Sue	3;10	F	1	8
Eris	3;07	F	1	4	Erina	3;10	F	1	4
Myra	4;00	F	1	4	Myron	4;05	F	1	4
Jack	4;05	M	1	5	Jasper	4;07	M	1	4
Kiana	4;05	F	3	4	Keyna	4;02	F	3	1
Kim	4;00	M	1, 2, 3	2	Kenny	4;01	M	1	4
Paul	4;07	M	2	1	Pete	4;01	M	2	1
Cheryl	4;03	F	2	2	Cherish	4;02	F	1 & 2	4
Hannah	4;10	F	1	6	Hanne	4;10	F	1	9

[*] Gender Codes: F = Female, and M = Male

[**] Ethnicity Codes: 1 = Pakeha, 2 = Māori, 3 = Pacifica. (By family report)

[***] Decile Ranking: Based on the area in which the child lived. Ranking ranges from 1= low income to 10= high income (New Zealand Ministry of Education, 2014)

This project was approved by the University of Auckland human participants' ethics committee (reference number 2011/421) for a period of three years from August 2011. The families were given a pamphlet by the AoDC, and if they were willing to participate they indicated this to either their AoDC or directly to the researcher, who then made an appointment to meet with them. At this first meeting with the family, the researcher talked through the information sheet with the families, and the families signed the consent form before any of the procedures were followed.

3.2 Assessment Procedure

The researcher conducted the assessments in the place of each family's choice, which was at home for all the children with hearing loss. Two or three visits were needed to conduct all of the assessments, with the younger children needing more sessions than those in the older

[12] All names are pseudonyms.

groups. The control group children were assessed at their preschools (four participants) or in their own homes (seven participants).

The assessment procedure started with the Early Speech Perception Tests (Moog, 1990) and all the standardised assessments (see Table 3) were administered ending with The New Reynell Developmental Language Scales (Edwards, 2011), across one, or more usually two, sessions. The language samples were taken in a different session, sometimes the first session, sometimes in the last one. All interactions and the language samples were taken when the children were interacting with their caregivers. All of the assessment sessions were videotaped and voice recorded, and the researcher recorded responses and made notes on the answer sheets during the sessions. The video and audio recordings were used to double check the accuracy of the on-line recording, to fill in any gaps, and were used for reliability assessment.

Information was gathered from the families in an interview format. This interview was usually in the first session, after or in the middle of the child's assessments. With permission from the families the AoDCs were also interviewed at a different time and place. The AoDCs were invited to attend the children's assessment sessions, but only one of them came. This was possibly because parents nominated dates and times that were after hours, on weekends or during holidays.

3.3 Assessment Tools

The assessment tools used in this study were interview protocols, questionnaires, standardised tests (which were used for speech perception, speech production and language assessment), and a spontaneous language sample (Table 3).

Table 3: Assessments

Area	*Assessment Tool*	*Method*
Background information, history of hearing loss etc. Observed change over 12 months	Interview with caregiver Interview with Adviser on Deaf Children	Interview
General Development	Children Development Inventory (CDI)	Questionnaire for Caregivers
Children`s Hearing Behaviours	Parents' Evaluation of Aural/Oral Performance of Children (PEACH) (Short version)	Questionnaire for Caregivers
	Auditory Behaviour in Everyday Life (ABEL) (Short version)	Questionnaire for Caregivers
Speech Perception Skills	Early Speech Perception Test (ESPT) The North-Western University-Children's Perception of Speech (NU-CHIPS)	Standardised Tests. Administered by the Examiner using a local Recorded Voice
Speech Production Skills	Diagnostic Evaluation of Articulation and Phonology (DEAP)	Standardised Test: Administered by the Examiner
Expressive Language and Language Comprehension Skills	The New Reynell Developmental Language Scales (Comprehension and Exrpession)	Standardised Test: Administered by the Examiner Using a local Recorded Voice
	Spontaneous Language Analysis (Language Assessment, Remediation and Screening Procedure (LARSP) and Socio-Conversational Analysis)	Language sample of caregiver and child interacting in play or activity, transcribed & analysed
	Children Development Inventory (CDI)	Questionnaire for Caregivers

3.3.1 Interviews

a) Interview with the caregiver

Two sets of interview questions were designed. One set was for the first year to get background information and the second was for the follow-up year for the older group, to look for any changes after the 12-month period. The first interview had two main sections (see Appendix B). The first was centred on the main caregiver and covered information regarding their relationship to the child, their age, suburb/area they live in, their hearing status and any related information to determine if they had hearing loss, any other kind of health or disability problems, and their educational level.

The second and larger part of the interview involved questions relating to the child. It included general information; the child's hearing loss and aids, perceived speech intelligibility, other supportive tools for communication and the caregivers' knowledge of them, any other health or disability problems, education, and the caregivers' desires, hopes, and wishes for their children. The caregivers were also asked about their child's personality and character, their attention span, usual behaviour, and interests. At the end of all the interviews there was an open question asking caregivers for any comments, concerns or any other relevant issues about their child.

The children were present for all of these interviews, which may have had an impact on what the caregivers felt they could say. This was a disadvantage, but the advantage of being in the natural environment of home where interviewees were more likely to be relaxed was felt to be greater than the disadvantages. Some children were sent off to play outside by the caregives, but in several cases theyb had to be brought back in because of fights with their siblings or other problem behaviours.

The interview used in the second year for the older group focussed on any changes, such as in the caregiver status, the number of family members, any new health or disability problems, any changes to the child's hearing status and their hearing aids, and the child's speech intelligibility. It also asked about any education or speech and language therapy programmes the child had been involved in for the past year, and the child's performance in them (see Appendix C).

The caregivers of the matched control children had the same first-year interview, with the questions concerning hearing problems omitted (see Appendix D).

b) Interview with the AoDC

The AoDCs were also interviewed about the children, both during the initial assessments and then a year later for the older group (see Appendix E). The interview questions were the same as those for the families (see Appendix F).

3.3.2 The Child Development Inventory

The Child Development Inventory (CDI) (Ireton, 1997) was used to give a picture of the child's general development. The inventory covers a range of developmental areas, divided into self-help, social development, gross and fine motor development, language development and pre-literacy scales. The CDI is a parent report inventory. It covers a developmental age range of 15 months to six years old (Table 4).

There are 30 further items at the end of these scales which describe problems such as auditory or visual problems and behaviour problems (such as attentional or emotional problems).

Table 4: The Child Development Inventory (CDI)

Scale	*Content*	*Example*
Social	40 items regarding the child's interaction with familiar and unfamiliar people	'shows affection (gives hugs and kisses)' or 'makes excuses'
Self Help	40 items based on daily activities	'chews food' or 'ties shoelaces'
Gross Motor	30 items on a range of activities from walking to balance and coordination	'sits without support' or 'rides a two wheeled bike, with or without training wheels'
Fine Motor	30 items to check eye-hand coordination	'picks up objects with one hand' or 'draws recognizable pictures'
Expressive Language	50 items on simple to complex language expressions	'calls you "mama" or "dada" or similar name' or 'names the days of the week in correct order'
Language Comprehension	50 items on simple to more complex language comprehension	'responds to his(her) name; turns and looks' or 'uses the words "today, "yesterday" and "tomorrow" correctly'
Letters	15 items on preliminary reading and writing skills	'Tries to read familiar books.' or 'attempts to read words by separating them into parts, for example "el-e- phant"
Numbers	15 items simple to complex skills	'understands "one" and gives you just one when you ask for "one"'
General development	70 items chosen from the above eight scales	The items are age-discriminating. For younger children most of these items are chosen from social, self-help, gross motor and expressive language scales. For older children the items come from letters, numbers and fine motor scales.

The scores for each of the eight scales and an overall general development score are used to create a profile for each child. The child's scores for each subscale and the overall score are compared to the expected result for a child of that age. A score 25% below the age mean is more than -1.5 SD below the norm for that age and 30% below the age mean is -2 SD. This tool reports means for age but does not include standard score tables, although it is possible to deduce standard deviations from the 'percent below age guide' tables (p. 20) in the manual. When children's scores are at or above the mean scores for children who are 30% younger, the test manual (p.21) regards the child as within age expectation. There is a ceiling effect for a number of scales, for example, the maximum score for the Gross Motor scale is 30, whereas for language comprehension it is 50. This ceiling effect limits the information available in some scales. Research results were reported in three categories: within the normal range, below -1.5 SD and below -2 SD. It is also possible to report the results for the language subscales as a percentage such as language quotients (Fitzpatrick et al., 2011; Sarant et al., 2009; Yoshinaga-Itano & Sedey, 1998). In this case 100% indicates that the child's score matches the norm for their age, and a score below 100% indicates some language delay.

3.3.3 Hearing Behaviour

The caregivers filled out two instruments about their child's hearing behaviour, the Parents' Evaluation of Aural/Oral Performance of Children (PEACH)(Short version) (Ching & Hill, 2007), and the Auditory Behaviour in Everyday Life (ABEL) (Purdy, Farrington, Moran, Chard, & Hodgson, 2002) (Short version).

The purpose of these instruments is to fill the gap between measured speech perception and use of hearing in real life situations. The PEACH uses the caregiver report to evaluate the effectiveness of amplification (hearing aids and/or cochlear implants) for children with hearing loss in daily life (Ching & Hill, 2007) (see Appendix G). It has 13 questions. The first two questions deal with how often the child has worn his/her hearing aids/cochlear implant/s and how often the child has complained or been upset by loud sounds. These questions are not counted for scoring. Six of the remaining 11 questions deal with the child's hearing function in a quiet environment and five questions deal with a noisy environment. Answers are given on a five point rating scale from 0 (*Never* or 0%) to 4 (*Always* or >75%) about the child's behaviour during the previous week. There is an overall score, and two sub-scores to show the child's functioning in quiet and noisy environments.

The ABEL is a 26-item questionnaire to evaluate caregivers' observations of their children's auditory behaviour. It consists of three parts: Auditory-Oral (11 items), Auditory Awareness

(10 Items), and Conversational/Social Skills (5 items) (see Appendix H). It uses seven point Likert scales from 0 (never) to 6 (always) for the child's behaviour over the previous week. The score of each subscale and overall will be calculated by taking a mean from the Likert scores across all items. It is expected that a child with normal hearing development should show all of the listed skills in this questionnaire by age six.

As the instrument was designed for children with hearing loss, some of the questions were not applicable to the matched control group, e.g 'knows when hearing aid(s) or cochlear implant(s) are not working'. Scores were calculated using the remaining questions for the control children.

3.3.4 Speech Perception

Many studies have shown that children with hearing loss have problems with speech perception (Aithal et al., 2008; Blamey et al., 2001; DesJardin et al., 2009; Geers, 1997; Most et al., 2009; Snik et al., 1997a). This will affect their ability to learn clear speech themselves, and also is likely to affect their language comprehension. Improvements in speech perception are an indicator of the beneficial impact of hearing aids or cochlear implants. Speech perception also improves with development in typically developing children (Elliott & Katz, 1980; Tsao, Liu, & Kuhl, 2004). Measuring speech perception changes over time can be an effective way to indicate progress as a result of education, rehabilitation or typical development.

Two closed-set, picture-pointing tests of speech perception were administered. The first, the Early Speech Perception Test (ESPT), was designed for children at very early stages of their development. The second test, the North-Western University-Children's Perception of Speech (NU-CHIPS), is too complex for children at these early stages. If a child passed the ESPT, they were eligible to be assessed on the NU-CHIPS. All children were assessed on the ESPT, even though some were already eligible to complete the NU-CHIPS.

Both of these tests used pre-recorded stimuli in the local New Zealand English accent, with sounds produced at a set distance from and a set decibel level for each child (70 dBA SPL). The presentation level of the speech was measured using a digital sound level meter (Model Q1362, Class B). Efforts were made to provide consistent acoustic conditions to all of the children, including those in the older group who were re-assessed a year later. To minimise any reflections from the ground or table, a thick scarf made of wool and cotton was placed under the laptop and the speakers. All other sources of masking noise such as that from television, radio, and mobile phones were turned off. All windows were closed. The distance between the children's ears and the speakers was as close as possible to 60 cm, the background noise was low and the recorded voice level was adjusted to 70 dBA SPL. All children with hearing loss were tested with their hearing aids/cochlear implants on, and there was no break during the administration of these tests. These conditions were also applied to the matched control group, except that they did not have hearing aids/implants.

a) The Early Speech Perception Test

The ESPT was developed to assess speech discrimination skills in children with profound hearing loss who have limited vocabulary (Moog, 1990). The test consists of three subtests: 1) the Pattern Perception Subtest (12 words with four different durational or stress patterns such as 'shoe', 'hotdog' or 'ice cream cone'); 2) the Spondee Identification Subtest (12 words with broadly differing vowels and consonants to evaluate word recognition such as 'bathtub', 'cowboy' or 'cupcake); 3) the Monosyllable Identification Subtest (12 monosyllabic words, such as 'bed', 'ball' or 'boot', which are quite similar and require finer segmental speech discrimination skills than the Spondee Identification Subtest).

The ESPT uses simple pictures on cards for each of the subtests, each card having 12 pictures. The first card assesses pattern perception; to get a correct score, the child must choose a word with the same stress pattern (for example if the child points to 'cookie' for 'baby', or 'hotdog' for 'airplane' it is scored as the correct pattern). The second and the third cards involve word identification. Each word related to a picture is spoken twice in random order, and the child points to what he or she thinks is the correct picture.

There is a cut off score for each subtest. For the Pattern Perception Subtest, the child must have 17 correct responses to proceed to the Spondee Identification Subtest. In this case, s/he would be in Category 2 (i.e. judged as having Pattern Perception). To move from the Spondee Identification Subtest to the Monosyllable Identification Subtest, the child must provide eight correct responses, which places them in Category 3 (i.e. judged as having some Word Identification). The Monosyllable Identification Subtest requires 13 correct responses (better than 50%) indicating that the child has good discrimination ability. This places them in category 4 (judged as having Consistent Word Identification).

Children who score above 75% in the Monosyllable Identification Subtest have auditory skills beyond Category 4. This makes them eligible to attempt the more complicated speech discrimination test, the North-Western University-Children’s Perception of Speech (NU-CHIPS) (Elliott & Katz, 1980).

b) The North-Western University-Children's Perception of Speech (NU-CHIPS)

The NU-CHIPS is a speech discrimination test designed for children with hearing loss who are at a more advanced level than those only able to do the Early Speech Perception Test. Generally this means children who have a language age of around 3 years (Elliott & Katz, 1980). The test consists of one of two books, A and B, each with 50 pictures of words within a typical English-speaking child’s three-year old receptive vocabulary. The words between them contain all of the most commonly occurring phonemes of English except initial /r/.

There are four pictures per page of words related in sound to a greater or lesser degree, e.g. dog, frog, ball, car. Incorrect answers are deducted from 50, and the resulting score is then multiplied by two, resulting in a percent correct score. In this study, to be consistent with all of the children, only picture book ‘A’ was used.

3.3.5 Speech Production

The clearest effect of hearing loss is often its impact on the development of children’s speech production. To evaluate this area, the Diagnostic Evaluation of Articulation and Phonology (DEAP) (Dodd et al., 2002) was used. The DEAP assesses speech production in children with standardisation data on Australian children from the ages of 3; 0 to 6; 11 years.

For this study, the three subtests of Articulation, Phonology and Inconsistency were used to get children’s phoneme inventories, their active phonological processes and their inconsistency rates. All are picture naming tasks. At the time of assessment, the examiner took notes and transcribed as much as possible and then she checked all transcriptions with the audio and video recordings.

The Articulation subtest involved 25 pictures which included all the English vowels and all of the singleton consonants in syllable initial and syllable final positions in which they occur in English. If a child did not know the name or word required, the test allowed use of semantic cues e.g. for ‘jam’ a cue such as ‘your Mum puts it on your toast with butter’. If the child still did not produce the word even with presented cues, then children were asked to imitate the word after the researcher e.g., ‘say: jam’. All productions that were cued or imitated were marked as such on the score form. A stimulability assessment was carried out, which normally involves the child imitating sounds or syllables from the examiner. In this study we used a recorded voice so there would be a local accent. This did tend to confuse the children with hearing loss so the researcher did also produce stimuli for imitation which gave some further data. However in both conditions the results were not valid to be reported in this thesis.

The Phonology subtest involved 50 pictures. From this data, two types of measures were taken, the first of percentage of phonemes judged to be correct (Percent Consonants Correct - PCC, Percent Vowels Correct -PVC, and Percent Phonemes Correct- PPC). The second measure was of Phonological Processes which were present in the child’s speech. Two instances of weak syllable deletion and five or more instances of other processes are required by the test to count as active processes (Dodd et al. (2002), p. 23).

The Inconsistency subtest was assessed by 25 particular words being produced 3 times separated by an activity. If all three productions were the same, the child’s score for that word would be zero (i.e., no inconsistency). If any of the three productions were different from the other(s), the score would be one (i.e. inconsistent). The total inconsistent score is divided by 25 and then multiplied by 100 to calculate the inconsistency rate. For example, if a child had 8 inconsistent productions, the inconsistency rate would be 32%. Any age appropriate developmental variation in the child’s production was excluded from the calculation and the inconsistency rate calculated for the remaining words.

Reliability

A second scorer who was a native speaker of English and trained in phonetic transcription and in the use of the assessment tool independently transcribed and scored a randomly chosen 10% of all speech samples from the videos. Reliability was calculated for each of the subtests. Details can be seen in Appendix I.

a. Articulation and Phonolgy: The total number of phonemes in articulation part was 62. Any difference in scoring between the two raters was counted and then divided by all possible items, and the result was then multiplied by 100 to get a % agreement figure. For example where there was non-agreement on two phonemes, 2 was divided by 62 (total number of phonemes expected) and then multiplied by 100. This resulted in a percentage agreement of 96.77%. Agreement was calculated separately for the three samples, and a mean calculated. In the case of the Articulation subtest, the mean percentage agreement between the two raters was 95.70%. The same procedure was applied to find the agreement between examiner and scorer for phonolgy. Agreements in regard to the other two participants were calculated in the same way and the mean was calculated as 89.35%.

b. Inconsistency: The scores for inconsistency are 1 when any one of the three productions were different, or 0 when the three productions were similar. For the 10% of samples, agreement on each score was calculated The mean agreement across the three children was 76%.

In literature, there are three benchmarking models for communicating about inter-rater reliability: Landis and Koch-Kappa, Fleiss, and Altman. These models were initially developed to be used with Kappa coeffieicnet, but they also can be used for other agreement coefficient. Based on Landis and Koch-Kappa's model, these reliability measures for speech transcription are 'almost perfect' for two of the subtests (ie. Between .8 and 1), and 'substantial' (i.e. between .6 and .8) for the inconsistency (Gwet, 2010). The inconsistency subtest has a smaller possible total, hence small differences can have a larger impact on the percentage of agreement.

3.3.6 Language

Language comprehension was assessed using a standardised test, and expressive language was assessed both on that test and with spontaneous language sample analysis.

a) The New Reynell Developmental Language Scales

The New Reynell Developmental Language Scales (Edwards, 2011) are measures designed for children aged 2; 00 – 7; 06. It consists of a comprehension and an expression scale. The 72 items for language comprehension start from objective and simple materials, such as selecting objects or relating two objects, to more subjective and abstract skills such as complex sentences and inferencing. The expressive language scale has 64 items which all follow the same trend: from simple concrete tasks such as naming objects, up to more complex and abstract skills such as producing complex sentences. Not all of the scales are administered. Children are started at a subtest related to their chronological age (going back to an earlier age if they do not pass this first one), and continue until they fail to get any items in two consecutive subtests. A local accent female voice recording was used to administer the test items. This test, like the speech perception tests, was conducted with consistent decibel and background noise levels.

b) The Spontaneous Language Sample

Formal tests give only part of the view of a child as a communicator. A sample of normal interaction permits a view of a child's use of their communicative skills in the context of normal communication. The examiner asked the caregiver to play a game or carry out an activity with their child for about 30 minutes. The caregivers were provided with a range of items that the researcher had brought if the caregivers wished to use them for play (e.g. toys and books), or the caregivers could do activities of their own choice. The activities chosen by the caregivers varied and included reading story books, spelling games, playing with special types of toys, solving a puzzle, playing with Lego, symbolic games and baking a cake. Some families changed from one activity to another during the 30 minutes, some did the same task but changed topics. For example, one pair was reading a book, and then the caregiver started to ask questions about school and what her child had learned that day.

There was no pressure on either the child to talk or on the caregivers to encourage the child to talk. The examiner sat quietly in the corner of the room taking notes and made no comments unless caregivers had particular questions.

The whole session was videotaped and transcribed by the examiner for further analysis. The time frame was 30 minutes, which was manageable for the families in terms of tiredness and the domestic routines which needed to be followed. The middle 15 minutes of the session was chosen as representative of the sample and to exclude 'choosing time' (the time that child and caregiver spent discussing the type of the activity they wanted to spend time on). This is consistent with advice in the literature (Owens, 2013; Paul & Norbury, 2012). All utterances were transcribed from the recordings. The only language which was not analysed was reading from a book, as it does not have the characteristics of spontaneous language. Applying the Language Assessment, Remediation and Screening Procedure (LARSP) analysis (Crystal, Fletcher & Garman, 1989), the samples were then analysed for the expressive syntax used. The language samples were also analysed further in the matter of discourse levels and speech acts based on the Fey's (1986) socio-conversational analysis.

LARSP analysis

LARSP is a systematic and detailed analysis of expressive syntax designed to be used with natural samples. LARSP can be used as a frame for screening goals, a holistic view of the child's syntax during assessment and diagnosis, and as a provider of a fundamental therapeutic procedure (Crystal, Fletcher, & Garman, 1989). It is a criterion-referenced clinical tool, with developmental guidelines relating to the complexity of clause, phrase and morphological development using the grammar of Quirk & Greenbaum's 1973 University Grammar of English (Quirk & Gereenbaum, 1973). The analysed sample data is presented on a one-page profile (see Figure 2).

The researcher aimed to describe the patterns of expressive syntax the children produced. LARSP is organised in developmental progression, and is intended to look for broadly even progression down the clause, phrase and word morpheme stages in any given sample. Certain patterns of gaps in areas of syntax, or uneven progression, appear in the samples of children and adults with language difficulties (Crystal et al., 1989). This study looked for whether gaps or unevenness appeared, if the profiles were consistent across children with hearing loss (i.e. is there a pattern within this disorder), or whether they showed a consistent developmental order that was below the level expected for the child's age. No published account of the use of this tool to research the language of English speaking children with hearing loss could be found in the literature.

Reliability

Two inter-rater reliability scorers trained in LARSP analysis independently analysed a randomly selected 10% of the language samples. A point-by-point agreement count was conducted. Each utterance was analysed based on the LARSP in different levels. For example, "that is my Teddy" from Myra's language sample could be analysed as below:

C: Spontaneous: Full Major
Clause: Stage III: SVC
Phrase: Stage III: Pronoun (Other), Copula Verb,
Stage II: Determiner-Noun
Word: Third Person Singular

The analyses from the reliability scorers and the researcher were checked point by point in each level and then the percentage of agreement of the scores between the researcher and the reliability scorers were calculated. These agreement scores were 85.8 % and 85.3%, with an average of 85.55%. Details can be seen in Appendix J. In the main grammatical analysis, or the clause, phrase and word levels, agreement was over 98%. This is extremely high given the level of detail involved in the analysis.

A Unanalysed	Problematic
1. unintelligible 2.symbolic noise 3. Deviant	1. Incomplete 2. Ambiguous 3. Stereotype

B Responses	Repe-titions	Normal Response: Major: Elliptical 1	2	3+	Reduced	Full	Minor	Abnormal: Struct-ural	☐	Problems
Stimulus Type Totals										
Questions										
Others										
C Spontaneous										
D Reactions										

Stage						
Stg I (0:9-1:6)	Minor Responses Vocatives Other Problems					
	Major	Comm	Quest	Statement		
		'V'	'Q'	'V' 'N' Other Problems		
	Conn	Clause			Phrase	Word
Stg II (1;6-2;6)		VX	QX	SV SO SC Neg X	AX VO VC Other	DN AdjN NN PrN VV V part Int X Other	- ing
		X+S:NP X + V:VP X +O:NP X + C:NP X + A:AP					
Stg III (2;0 – 2;6)		VXY let XY do XY	QXY VS(X)	SVC SVO SVA negXY	VCA VOA VOiOd other	D Adj N Adj N Pr DN Prono Cop Adj Auxm PronP Aux0 other	Pl -ed -en
		XY+S: NP XY+V: VP XY+ C:NP XY+ O:NP XY+ A: AP					3s
Stg IV (2;6 – 3;0)		+S VXY +	QVS QXY+ VS(X+) Tag	SVOA SVCA SVOiOd SVOC	AAXY other	NP pr NP Adj N XcX Neg V Pr D Neg X cX 2 aux other	gen n't
Stg V (3;0 – 3;6)	and c s other	Coord . other	Coord. Other	Coord. 1 1+ Subord. A 1 1+ S C O Comparative		Postmod. Clause 1 1+ Postmod. Phrase 1+	'co p 'au

(3;6- -4;6)	(+)			(-)				
	NP	VP	Clause	Conn	Clause	Phrase: NP	Phrase: VP	Word: N V
	Initiator Coord.	Complex	Passive Complement how What	and c s	Element ☐ ☐ concord	D pr PronP D ☐ pr ☐ D ☐ pr ☐	Aux M O Aux Cop ☐	irreg reg
	Other				Ambiguous			

Stg VII (4;6+)	Discourse	Syntactic Comprehension
	A Connectivity it Comment clause there Emphatic order other	Style

Total No. Sentences:	Mean No. Sentences per turn:	Mean Sentence Length:

Figure 2: LARSP Profile (Crystal et al., 1989)

Socio-conversational analysis

Analysis of language in children with hearing loss has tended to concentrate on language form (e.g. grammar or morphology). As discussed in chapter one, there are not many published studies of pragmatic skills of children with hearing loss. Some of these studies were conducted with children from younger age groups than those in this study and found that there are some interaction differences between children with hearing loss and typical hearing children. Those studies on pre-schoolers placed their focus mainly on peer interaction and again found some differences (Bobzien et al., 2013; Deluzio & Girolametto, 2011). It seems there is a gap in the literature about caregiver-child interaction in preschool age and how hearing loss may affect it.

In the current study, the language samples (those samples used for LARSP) were investigated to find features of the communicative interaction between children with significant hearing loss and their main caregivers. The framework for this analysis was taken from Fey's 1986 examination of social-conversational participation, using primarily speech act analysis. It is based on the notion that in normal conversation, each partner does about half of the assertive work of the interaction (makes comments, asks questions, introduces and extends topics). This is normal communicative assertiveness. In addition, each partner responds to most of the utterances of the other person which require a response (e.g. answers a request for information or clarification). This is normal responsiveness.

Fey considered that four combinations of normal or low assertiveness and responsiveness were possible (see Figure 3). These were 1) Active conversationalist, (both normally assertive and responsive); 2) Passive conversationalist, (responsive but non-assertive); 3) Inactive communicator, (neither assertive nor responsive); and finally 4) Verbal non-communicator, (verbally active but not responsive).

ASSERTIVENESS		
EXPECTED	+ ASSERTIVENSS +RESPONSIVENESS *(active conversationalist)*	+ASSERTIVENSS -RESPONSIVENESS *(verbal non-communicator)*
LOW	-ASSERTIVENSS +RESPONSIVENSS *(passive conversationalist)*	-ASSERTIVENSS -RESPONSIVENSS *(inactive communicator)*
	EXPECTED	LOW

RESPONSIVENESS

Figure 3: A Scheme for Profiling Children Based on Their Levels of Social-Conversational Participation (taken from p. 70, Fey, 1986)

The language samples were analysed for their conversational acts and for a broad categorisation of topic flow (Fey, 1986) (see Aooendix K). Then two continua (assertiveness and responsiveness) were calculated.

a) Assertiveness

This was calculated by adding all the RQ and AS acts that the child produced (see Appendix K) and then divided this number by the total number of RQ and AS acts (i.e. the child's and the caregiver's) multiplied by 100. The optimal percentage of assertiveness is about 50% since it shows a balance between communication partners when expressing their ideas and opinions and when making requests. Assertiveness was also measured by examining the topic flow within the conversation, in terms of proportion of topics that were initiated and extended, rather than maintained.

b) Responsiveness

This was measured by counting the number of RS acts of the child and dividing it by the number of RQ acts of the caregiver, multiplied by 100 to get a percentage. Acts are only meant to be counted if they are verbal, and non-verbal responses such as nodding or shaking the head do not normally count. Since there is value in knowing if a child is totally unresponsive as opposed to responding only non-verbally, the analysis calculated both verbal only, and verbal plus non-verbal responsiveness. Conducting the analysis in this way would not only show the child's degree of involvement in the interaction but might also show a difference between children with hearing loss and the matched controls.

3.4 Statistical Analyses

Much of the data was descriptive of the nature of communication and associated factors concerning these children. However it was possible and desirable to make certain comparisons and to test if these showed significant differences where ordinal measures were used and/or where standard scores existed for the speech and language tests. There were two age groups of children with hearing impairment, one group with two sets of measures a year apart, and two control groups for the original two groups of children with hearing impairment. This allowed some measures to be compared by age group, hearing status (loss vs no loss) and change over time.

All data that fitted statistical analysis possibilities were analysed using the Statistical Package for Social Sciences Software (SPSS, version 22). The scores for the children in all groups (divided by hearing condition and by age) were subjected to Kolmogorov-Smirnov testing (Sheskin, 2004) to see if the scores were normally distributed. All the subtest scores for both the hearing impaired children and the matched controls in all age groups yielded p values above 0.05, indicating the scores were normally distributed. The equality of variances was checked using Levene's test. For a few subtests, the p value was less than 0.05; for these dependent variables, 'equal variance not assumed' results are reported.

Children were grouped by hearing loss versus typically hearing. To see if there were differences between these groups, Independent Samples T-Tests were used. Since the Parents' Evaluation of Aural/Oral Performance of Children (PEACH) (Short version) and the Auditory Behaviour in Everyday Life (ABEL) have ordinal scoring, Non-Parametric tests were used. To compare inter and intra groups based on hearing status, the Mann-Whitney Test and to see changes during a year, the Wilcoxon Signed Ranks Test were used.

Correlations between some aspects of speech and language were also calculated and the Spearman or Pearson tests of coefficients regarding the types of variables were conducted to examine the strength of any possible correlation.

Chapter 4: The Child in Context, Hearing Loss, Family and Development

4. Introduction

This study is mainly concerned with the speech and language development and status of children with hearing loss. However as indicated in chapter 1, understanding the wider context of the children helps understand the relationship between their hearing loss and their communication skills. This wider context was examined using interviews with the caregivers and with the AoDCs. The AoDCs provided a view from outside the family but from an informant who knew them well. The interviews asked about a range of factors, such as child related factors (e.g. history of development, confounding conditions, specific disability), family factors (size, experience with hearing loss, etc) and social and demographic factors (such as socioeconomic status and ethnicity) (Crowe & Mcleod, 2014; Kumar et al., 2008; Tobey et al., 2003; Yoshinaga-Itano, 2003b). The results give a richer picture of the children as a whole, within their contexts.

4.1 Background

Background factors may influence children's speech and language development. This chapter will be a combination of a review of the literature regarding these factors and a report of this study's data on the children's hearing and health, family characteristics, hearing aids, hearing behaviours, children's development, rehabilitation and educational services, children's personalities and characters and finally parents' hopes.

4.1.1 Hearing and Health

The type of hearing loss, its causes, and the existence of other disabilities or health issues are significant to children's speech and language development (Allum, Greisiger, Straubhaar, & Carpenter, 2000; Bacciu et al., 2009; Cupples et al., 2014; Davis et al., 1986; Lieu, Tye-Murray, Karzon, & Piccirillo, 2010; Priwin, Jönsson, Hultcrantz, & Dranström, 2007; Tharpe & Bess, 1991). They can have effects on speech and language features and their development, children's educational achievements and their quality of life. Several authors have reported that even minimal hearing loss (such as unilateral or conductive hearing loss) will have deleterious effects on children’s speech and language, their educational achievements and quality of life (Aithal et al., 2008; Borton, Mauze, & Lieu, 2010; Davis et al., 1986; Lieu et al., 2010).

Other health and ability issues can make speech and language learning harder for people with hearing loss. Much of this literature has focussed on children receiving cochlear implants who have multiple disabilities (Bacciu et al., 2009; Bertram, 2004; Fukuda et al., 2003; Hamzavi et al., 2000; Holt & Kirk, 2005; Isaacson, Hasenstab, Wohl, & Williams, 1996; Sarant et al., 2009; Stacey, Fortnum, Barton, & Summerfield, 2006; Waltzman, Scalchunes, & Cohen, 2000). These studies found - after cochlear implantation – that children with hearing loss and multiple disabilities had slower and less stable auditory and language development than those children with hearing loss but without any other disabilities. Often norm-referenced tests were not possible with these populations and observational and criterion-referenced tools were recommended.

There is considerably less research into health and other disability issues in children who have other types of hearing aids, therefore little sense of the possible significance of health and other disability issues in this group.

The families and their AoDCs reported on the causes of the children’s hearing loss as they understood them. The researcher did not have access to medical records for this study, so these reports could not be verified. However, as Table 5 shows, the majority of the children were thought to have hearing loss as a result of genetic factors, as evidenced by close family members also having hearing loss. This table also indicates something of the complex social worlds of some of these children, with the probability of child abuse being a causative factor for the hearing loss of one of them.

Table 5: Family and Adviser reports of the probable causes of the Children's Hearing Loss

Participant	*Type of Hearing Loss*[*]	*Probable Cause / Evidence*	*Additional Disability or Health Problems*
Julia	1 (atresia[**])	Genetic (Trisomy 18 syndrome)	Foot Problems, Growth Hormone Problems, Heart Condition
Nemo	2	Genetic (Siblings with similar problems)	Asthma, Eczema, Hay Fever
Sara	2	Genetic (Adviser's report) (Father/ Mother has hearing loss, Caregiver's report)	Recurrent Otitis Media
Eris	2	Asphyxia at Birth	Asthma, Eczema
Myra	2	Genetic (Mother and grandmother with hearing loss)	None
Jack	2	Unknown	Cleft Lip, Kidney Problems
Kiana	2	Shaken baby syndrome + Asphyxia	Asthma
Kim	2	Genetic (Sibling with hearing loss)	Non-accidental Brain Damage, Recurrent Otitis Media
Paul	2	Unknown	Recurrent Otitis Media
Cheryl	2	Genetic (Sibling with hearing loss)	None
Hannah	2	Genetic (Sibling with hearing loss)	Asthma

[*] Type of Hearing Loss: 1 = Conductive Hearing Loss and 2 = Sensory-Neural Hearing Loss.

[**] Atresia refers to a partially or completely absent of external auditory canal (Adunka & Buchman, 2010)

Bilateral and permanent hearing loss typically results in significant delays in language development and educational accomplishment for children, regardless of the degree of loss, in that such consequences have been reported in children with hearing loss from mild to profound (Briscoe et al., 2001; Davis et al., 1986; Sarant et al., 2009; Stelmachowicz, Pittman, Hoover, Lewis, & Moeller, 2004; Tuller & Delage, 2014). However few studies have provided convincing evidence which indicates that slight-mild bilateral sensorineural hearing loss has adverse effects on language and educational achievement (Wake et al., 2006).

The children in this study all had bilateral and permanent hearing loss, although the severity varied. The children's audiograms are seen in Figure 4 and Figure 5. The researcher asked for both aided and unaided audiograms but neither the AoDCs nor the children's caregivers had copies of the children's aided audiograms.

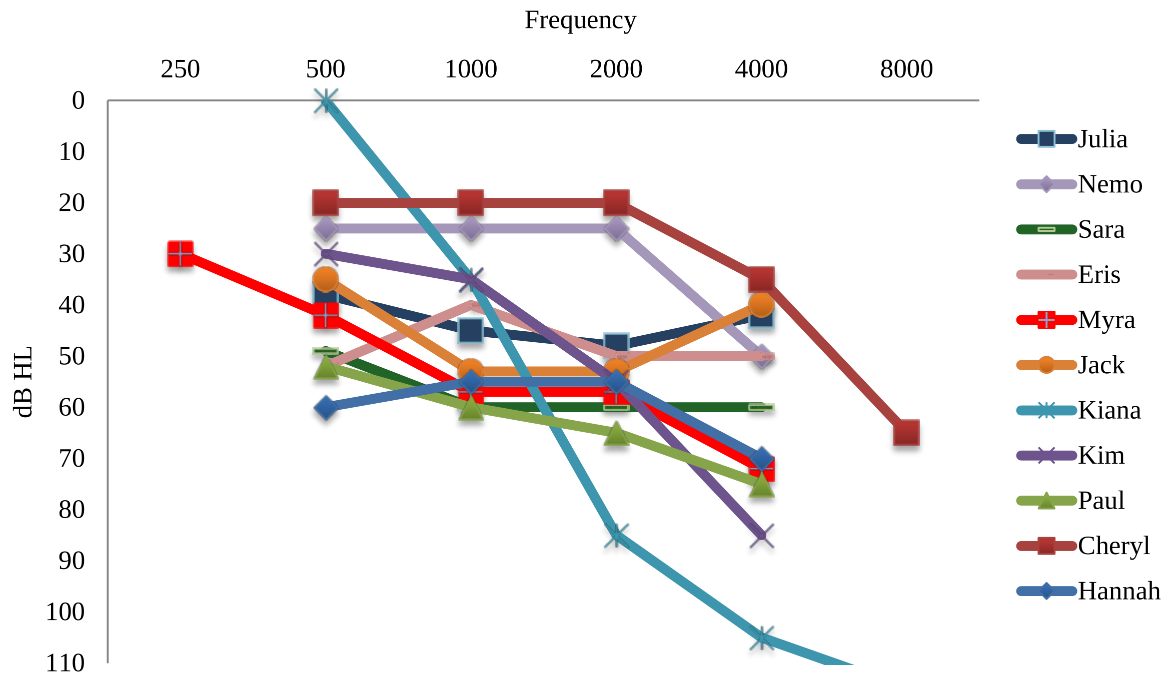

Figure 4: Pure Tone Audiometry Results of the Children's Right Ears[13].

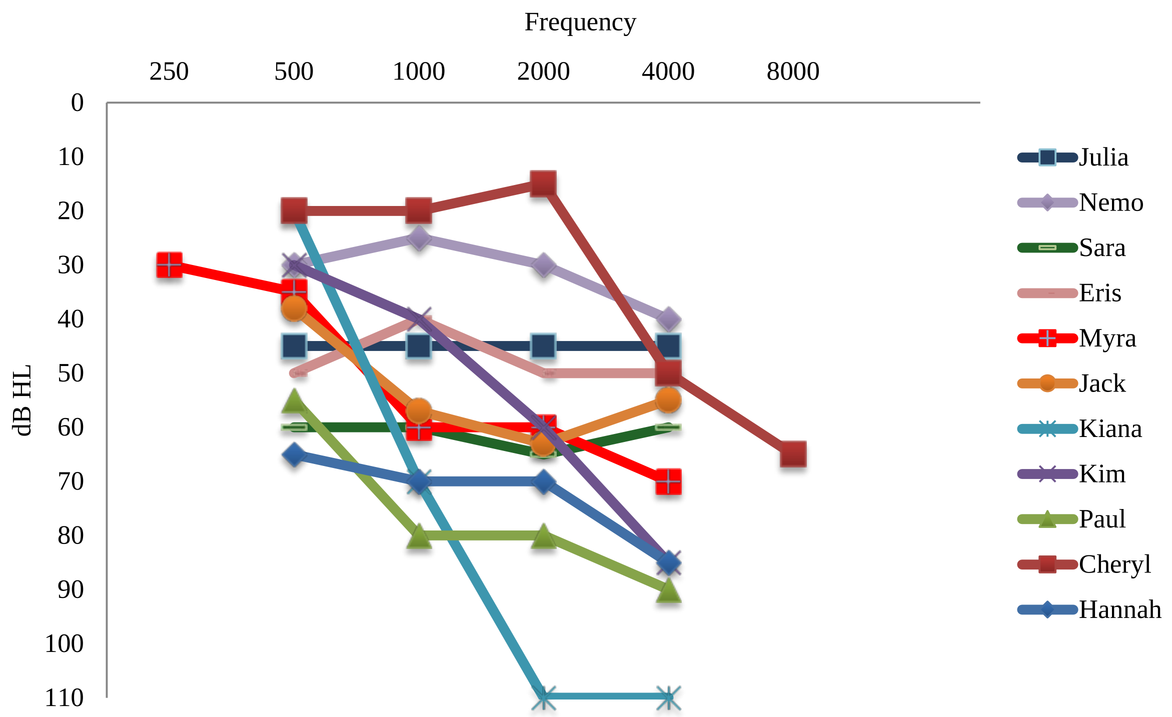

Figure 5: Pure Tone Audiometry Results of the Children's Left Ears.

[13] In audiograms, the convention is for the right ear to be shown in red and the left ear in blue. To make these graphs easier to follow each child's audiogram has been drawn using a different colour.

The audiograms indicate all of the participants had better hearing in the low frequencies than the high frequencies, and for most, the two ears had similar patterns. For the low frequencies, the losses ranged from mild (Kiana, Cheryl, Nemo, Kim, Myra, Jack and Julia) to moderate (Eris, Paul, Sara and Hannah) and for the high frequencies from mild (Nemo and Cheryl) through moderate-severe (Julia, Eris, Myra, Sara, Paul, Hannah, Kim and Jack) to profound (Kiana). Three of the children, Paul, Kim & Sara, had recurrent otitis media which required treatment. This may have delayed the diagnosis of their sensorineural hearing loss (as their caregivers reported), and may have had some effect on their development (Schönweiler et al., 1998).

The only child whose audiogram was known to change over time was Myra (Figure 6). Her initial audiogram had been done two years earlier (February 2011) than the second (February 2013). Her hearing loss was progressive, and changed from moderate-severe to severe-profound over this period of time.

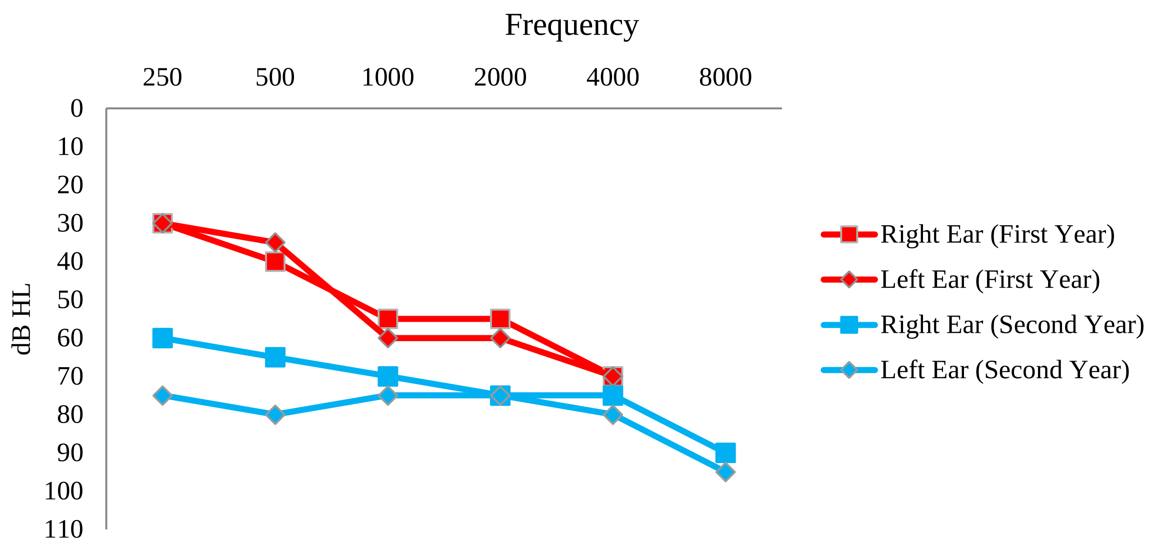

Figure 6: Myra: Pure Tone Audiometry at year 1 (age 2;10) and year 2 (age 4;10)

In this group, only Julia had conductive hearing loss due to ‘atresia’. All the other children had different types and degrees of sensory-neural hearing loss. In chapter 2, there was discussion about the effects of different types of hearing loss on children's speech and language, so there might be differences between Julia and the other children in the matter of speech and language. These differences will be discussed in chapter five.

Nine of the 11 children had at least one other health issue. Four of these nine had asthma, which is very common in NZ children. Nevertheless, four in 11 is around a third of the group, and the condition represents a problem in addition to hearing loss.

4.1.2 Family Characteristics

Some general data on family characteristics was gathered in these interviews. Other studies have indicated that the following range of factors can affect outcomes in children with hearing loss (see Table 5):

Table 6: Studies Related to Family Characteristics

Factor	*Research*
Socio-Economic Status	(Geers, 2003; Geers et al., 2003; Geers et al., 2003a; Tobey et al., 2003)
Family Size	(Geers et al., 2003; Geers et al., 2002; Geers et al., 2003a; Tobey et al., 2003)
Parents' Hearing Status	(Stacey et al., 2006)
Education Levels of Parents	(Ching et al., 2010; Ching & Dillon, 2013; Cupples et al., 2014; Fitzpatrick et al., 2011; Geers et al., 2002; Pipp-Siegel et al., 2003; Sarant et al., 2009)
Ethnicity	(Cohen, Fischgrund, & Redding, 1990; Lai, Serraglio, & Martin, 2014; Mapp & Hudson, 1997; Pipp-Siegel et al., 2003)

As an example, Lai et al. (2014) found in Australia that children from minority ethnic groups took significantly longer to enrol in early intervention programmes than their dominant culture peers.

Most of these factors are interrelated. Pipp-Siegel et al. (2003) found in America that there were correlations between ethnicity, maternal education, children's general competence and expressive language quotients. Specifically, they found that children from white families (compared to those from African-American, Asian-American, Hispanic, Native American and

Mixed ethnicities) were more likely to have more highly educated mothers and to live in families with higher incomes. They also found, as expected, that mothers with higher education had higher incomes.

This study further found that children who attained higher expressive language scores were most likely to be white, younger without any additional disabilities, enrolled for intervention programmes earlier and to have attained higher scores in a range of ‘mastery motivation scales’ (maternal perception of the child’s persistence including object-oriented persistence, social/symbolic persistence, and gross motor persistence, maternal perception of her child’s mastery pleasure, and mother’s perception of the child’s general competence). Some ethnicities, including Australian Aboriginal, have higher incidences of some diseases and disorders, such as otitis media (Homøe et al., 1996; Morris et al., 2007). Gillborn & Mirza (2000) concluded that children with hearing loss from minority groups are likely to have lower levels of achievement than their dominant culture peers.

Socioeconomic status has been found to have some effect on children’s speech and language outcomes. Children from higher socioeconomic groups have been found to have better communication skills and higher educational achievement in both the general population and among those with hearing impairment (Gillborn & Mirza, 2000; Kluwin, 1994; Tobey et al., 2003). Tobey et al. (2003) found that socioeconomic status was a significant independent predictor of children’s speech production outcomes, in that children from higher socioeconomic backgrounds obtained higher speech production scores. They also found that the size of the family was an independent predictor variable of speech production scores in children with hearing loss. Children from smaller families and with higher intelligence quotients attained higher scores in speech production measures. Geers and her colleagues (2003) also found that family size was a predictive variable for speech perception skills in children with cochlear implants .

In the United Kingdom, among many other places, people from ethnic minorities have higher unemployment rates than dominant culture groups, and on average have lower incomes (Stacey et al., 2006). Fortnum, Marshall, and Summerfield (2002) found that children with cochlear implants were mainly from families from higher socioeconomic groups and they also found the percentage of children with hearing loss at all levels of severity increased when affluence decreased. Blanchfield et al (2001) in the United States found that people dealing with hearing loss had lower family incomes, less educational level and were less likely to be employed than the general population. Hence a number of socioeconomic factors seem to be implicated in better outcomes in speech and language for children with hearing loss.

In some studies (Ching et al., 2010; Ching & Dillon, 2013; Fitzpatrick et al., 2011; Musselman & Kircaali-Iftar, 1996) maternal education was found to be a predictive variable for children's language and speech skills. Education levels are also related to socioeconomic levels. However not all studies have confirmed a relationship between speech and language outcomes and ethnicity and maternal education (Mayne, Yoshinaga-Itano, & Sedey, 1998; Mayne, Yoshinaga-Itano, Sedey, et al., 1998) or between language outcomes and socioeconomic status (Ching et al., 2010; Pipp-Siegel et al., 2003; Stacey et al., 2006) or even between socioeconomic status and access to early intervention (Lai et al., 2014). Higher socioeconomic status did not guarantee that caregivers will have less stress when faced with hearing loss. Mapp & Hudson, (1997) found that higher levels of education and income did not necessarily decrease the level of stress that parents experienced, and that there were significantly fewer coping strategies such as *Distancing*[14] and *Escape-Avoidance*[15] among these parents.

There is some evidence then that some background factors may influence the speech and language outcomes of children with hearing loss. Thus these factors may be important to consider in rehabilitation and developmental programmes for children and their families. However, these concepts are interrelated and drawing definitive conclusions about the impact of any one of them is not possible.

Table 7 shows some of these factors as reported for the children in this study. The table reveals that five of the 11 children (45%) were identified by their families as Pakeha (dominant culture NZ), three (27%) as Māori, one as Pacifica (9%) and two as mixed ethnicities (18%). These numbers are small, but the proportion of Māori in the NZ population overall is around 11% and that of Pacifica around 6%, so they would appear to be slightly over represented in this group of children with hearing loss. Similarly the mean decile ranking of the group (socioeconomic grouping) was 3.6 on a scale of 1-10 where 10 is the highest, and the range was 1-6, indicating

[14] "Cognitive efforts to detach oneself and to minimize the significance of the situation"(Mapp & Hudson, 1997).

[15] "Wishful thinking and behavioural efforts to escape or avoid the problem"(Mapp & Hudson, 1997).

that the group was below average socioeconomically for the country.

The caregivers' educational levels, however were comparable to those of the wider society. Seventy six percent of the caregivers of the children with hearing loss had at least a secondary school qualification [16] such as School Certificate (indicating at least 3 years of secondary schooling). The NZ census data in 2013 indicated 76% of adults (age 25-64) in NZ had at least a secondary school qualification and that 26.1% of adults had a bachelor degree or higher (Statistics New Zealand, 2013b) while a total of 43 % of the caregivers (11/21) in this study had tertiary qualifications such as an apprenticeship or university qualification. This difference is because of the use of different types of certificates in each calculation (the census included only bachelor degrees while this study included any qualification after high school).

[16] In New Zealand, secondary school refers to the second level of compulsory education. Secondary schools offer three levels of a qualification called the National Certificate of Educational Achievement (NCEA). New Zealand students must attend school until they are 16 years old. They start secondary school when they are 12 or 13 years old and will be there for about five years, from Year 9 to Year 13. The other names for secondary schools are *high school* and *college* (New Zealand Qualifications Authority, 2014; Statistics New Zealand, 2014).

Table 7: Family and Demographic Factors

Participants	*Ethnicity*[1]	*Decile*[2]	*Caregivers' Hearing*[3]		*Caregivers' Highest Education Level*[4]		*Caregiver Health Issues*	*Family History of Hearing Loss*	*Number Customarily Living in the Home*
			Mother	*Father*	*Mother*	*Father*			
Julia	1 & 3	4	N	N	6	6	No	No	2
Nemo	2	2	N	N	3	2	Mum: Asthma + Hay Fever	Older Brother	4
Sara	1	6	N	N	5	4	No	No	5
Eris	1	4	N	N	5	5	No	No	4
Myra	1	4	D with CI	N	4	4	No	Mum & Grandma both have CIs	2
Jack	1	5	N	N	6	3	No	No	4
Kiana	3	4	N	N	2	2	No	No	3
Kim	1, 2, 3	2	N	-	3		Heart problems	Older sister	4-12
Paul	2	1	N	N	3	3	No	No	5
Cheryl	2	2	N	N	2	2	No	Older Brother and Cousins	8
Hannah	1	6	N	N	3	3	No	Older Sister	5

Ethnicity Codes: 1 = Pakeha, 2 = Māori, 3 = Pacifica. (By family report)

Decile Ranking: Based on the area in which child is living. Ranking is 1= low, 10= high ((New Zealand Ministry of Education, 2014))

N = Normal and D = Deaf

1 = Less Than 6 Years at School (No High School); 2 = 2-4 Years High School; 3 = High School Qualification (eg., School Certificate); 4 = Apprenticeship Qualification; 5 = Tertiary Certificate or Diploma (eg., Tech); 6 = University Degree.

The caregivers were asked about hearing loss in themselves or their wider family, which might have contributed to their understanding and experience of it. Five children in all (45% of the sample) had first degree relatives (parents, siblings or first cousins) with hearing loss (Nemo, Myra, Kim, Cheryl and Hannah). Hence knowledge about hearing loss and experience with the support services (e.g. rehabilitation and education) might be greater in this group than in the general population.

Myra was the only child whose mother was deaf (her mother had a unilateral cochlear implant and communicated verbally). It has often been reported or assumed that children with hearing parents have greater access to verbal language, and therefore achieve better educational outcomes (Stacey et al., 2006). This was not the case with Myra. A possible explanation is that she was counted as an at-risk baby, so received earlier diagnosis and intervention, and had the further advantage that her mother was well informed, and could accept and manage the situation better than those parents who had no knowledge of or experience with hearing loss.

The numbers of people living in a home can indicate who the child has available to interact with, a factor which may be relevant to their language development. However most of the children in the sample spent much of their day in day-care, and their family may not have been relevant to language development in that circumstance. The number of people in the home may also indicate overcrowding. Overcrowding can be an indicator of poverty, and has been listed as a risk factor in studies of poverty in NZ (Boston & Chapple, 2014). Two of the families, those of Cheryl and Kim, might be considered to have a somewhat crowded home. Cheryl had five siblings plus her mother and father. Kim lived with his great grandmother, his sister, and a step sister, however he had his grandfather and his family (four members) living nearby and they were almost always at his home. Kim’s family also had a lot of visitors coming to and going. A further two families did not match what might be called the traditional nuclear family. Julia spent two weeks with her mother and then two weeks with her father. Myra’s father worked overseas, but he joined the family every two weeks for a weekend. In comparison, all of but one of the control group children came from small nuclear families. No definite conclusion can be drawn about these features from this study, but it does help indicate the varied social and economic circumstances of the families of children with hearing loss. It raises the need for further investigation as to whether this variation is greater in this group than in the families of their non-hearing impaired peers.

Most of the caregivers judged themselves as being without health problems, The two exceptions were Nemo’s and Kim’s care givers. For Nemo this was not likely to have affected him very much. However, Kim’s caregiver was his Great-Grandmother and her serious heart disease led to her having concerns about the future. All caregivers of the matched controls had normal hearing, and reported no health or disability issues.

4.1.3 Hearing Aids

The AoDCs and the children’s caregivers provided information on when the child’s hearing loss had been suspected, the ages at which hearing aids were fitted, and the fitting and subsequent use of the hearing aids (see Table 8). Some of this data were reported by these informants precisely and some were approximations as they could not remember precise dates, the latter is indicated by the use of ‘c.’ (circa).

Who first detected a possible hearing loss can show how much a child’s development had been monitored and by whom. Caregivers were the first to pick up a possible problem for seven children (Julia, Nemo, Sara, Kiana, Kim, Paul, and Hannah) (64%). Three children had red flags or at-risk conditions and were checked by an audiologist (Eris, Myra, and Cheryl) (27%). One child’s hearing loss (Jack) was picked up by his general practitioner. This reinforces the literature that caregivers tend to be the referrers for their children with hearing loss (Digby, Kelly, & Purdy, 2011; Digby et al., 2013; Digby et al., 2014; Harrison & Roush, 1996).

Table 8: History of Diagnosis and Use of Hearing Aids

Participant	*Current Age (Months)*	*Age of concern (Months)*	*Age of Diagnosis (Months)*	*Age of Fittings (Months)*	*Months of Usage*	*Type of Aid*
Julia	43	0.5	3-4	6	37	Bone Anchored Hearing Aids
Nemo	43	c.24	36	37	6	2 HAs1
Sara	43	22	25	27	16	2 HAs + FM2
Eris	43	3	3	3	40	2 HAs + FM
Myra	48	5 days	10	11	37	2 HAs + FM
Jack	53	14	20	20	33	2 HAs + FM
Kiana	53	18	30	32	21 HA 6 CI3	One HA Unilateral CI
Kim	48	c.24	30	30	18	2 HAs + FM
Paul	55	c. 24-36	c. Over 36	42	13	2 Has
Cheryl	51	c. 24	c. About 40	45	6	2 Has
Hannah	58	c. 24	c. 24	29	29	2 HAs + FM

HA = In the Ear Hearing Aids
FM = Frequency Modulated System
CI = Cochlear Implant

This data revealed some of the heterogeneity there is in this group. The range in the age at which someone first became suspicious about hearing loss in these children was from less than a week old to 24 months, with a mean of 16 months. The mode however was at around 2 years of age (reported by 6 caregivers) indicating that without newborn hearing screening, it is often the point at which children are expected to be showing significant verbal output (i.e. to be talking beyond just a few words) that concern about their hearing may emerge.

The age at which hearing aids were first fitted ranged from 3 months to 45 months, with a mean of 25 months, which is considerably later than the newborn hearing screening goals (Ministry of Health, 2013; Yoshinaga-Itano, 2003a, 2003c). The absence of hearing aids in the early years of life could have negative consequences for children with hearing loss.

Coppens, Tellings, Van Der Veld, Schreuder, and Verhoeven (2012) found a significant negative relationship between absence of hearing aids (along with some other factors such as the onset of hearing loss, educational placement, use of sign language at home and intelligence) and lexical competency in children with hearing loss (age 10;11 old, at Nijmegen, The Netherlands). Three children were fitted at under a year old (Eris, Julia and Myra) but then there is quite a gap to the next age, which is 20 months. If the three early ones are not counted, the mean age of fitting becomes 33 months, or over 2 ½ years. Seven of the 11 children (64%) were over the age of 2 years when they were fitted with hearing aids, and three (27%) were over three years old (Cheryl, Paul and Nemo). We know that a significant amount of language learning has normally occurred by this time in hearing children (Rice, Taylor, & Zubrick, 2008; Whitehead, 2007). In spite of the gap between the mean age of first concern (16 months) and the mean age of diagnosis (25 months), closer examination of the data shows that in most cases the age of diagnosis was close to the age when hearing aids were prescribed and fitted.

This study did not collect data on the reasons for the difference between age of first concern and the fitting of hearing aids, but it seems likely there are multiple factors involved. However the information that was gathered indicated that the 5- month gap for Julia was because the family were highly proactive, and took time to search for what they felt was the best system and services. Nemo, Cheryl and Jack had a long gap between the age of first concern and the age of fitting of hearing aids, in spite of the fact that Nemo & Cheryl both had siblings with hearing loss. The parents reported that their children had many hearing tests before they received their hearing aids, and it took time for the families to accept that their children needed hearing aids.

Other highly individual factors operated in this group. Myra passed the newborn hearing screening test, but since her mother and grandmother had hearing loss, the newborn hearing screening team repeated the test three months later. It was not a completely successful test, so they did a further follow up and at 10 months of age, hearing loss was revealed and hearing aids were fitted. Kiana's gap was 14 months due mainly to her being in the transition period of adoption. Her new caregivers realised something was wrong, but it took them time to find out about the hearing loss. No specific reason was given for Paul's gap of approximately 18 months. The lives of children with hearing loss and their families are complex, and decisions and issues about disabilities cannot be assumed to follow a single pathway (Feher-Prout, 1996; Young & Tattersall, 2007).

All of the children had binaural in-ear hearing aids, except Kiana who had one cochlear implant and one hearing aid (bimodal stimulation) and Julia who had a Bone Anchored Hearing Aids (BAHA). Most of these children did not meet the criteria for government funding for cochlear implants.

The agent of testing and diagnosis was also relevant in that it can show how much time caregivers spent to find the right person to make such a diagnosis. Julia, Sara and Hannah went to private ENTs and audiologists; Nemo, Eris, Myra, Jack, Kiana, Kim, Paul, and Cheryl were examined by audiologists in the public system.

Hearing aids are only of value to the children's development if they are effective and consistently used. Walker et al. (2013) reported that in their study population of 272 parents of children with hearing loss aged between 0;05 and 7;03 (an average of 40 months) in the United States, the degree to which hearing aids were used varied according to the degree of hearing loss, the children's age and the parents' education levels. The more consistent usage of hearing aids was related to older age, higher degree of hearing loss and higher parental education levels. They also found that parents overestimated the amount of time their children used their hearing aids.

Table 9 shows some of the information families and AoDCs in this study supplied on the children's use of their hearing aids and the impact the families felt the aids had.

Table 9: Caregiver Report of the child's Usage of Hearing Aids

Child	*Wearing HA in Waking Hours*		*Success of Hearing Aids*	*Behavioural Effects*	*The function of Has*	*Hearing Aid Problems*	*Hearing Aid Changes*
	At First	*Now*					
Julia	100%	100%	"Amazing"	"More alert and makes more sounds"	"Very good"	Broken	No
Nemo	<50%	50%	"Good job"	"He says a lot more than before, he talks more and clearer"	"Well"	Broken Wrong mould 2x Lost	Adjustment
Sara	100%	100%	"Good"	"Listening and picking things up, hearing difficult sounds"	"Well"	Lost	No
Eris	100%	100%	"Very Successful"	"She responded and turned to the noises when she was previously visual"	"Well"	No	No
Myra	100%	100%	"Very Successful"	"Reacting to the sound, talking more"	"Well"	Hooks broken twice.	Change to a less powerful one
Jack	100%	100%	"Very much"	"He noticed airplane and something like that because he was so young to pick up language"	"Well"	No	Adjustments
Kiana	100%	100%	"Huge Differences"	"She started hearing and when you said something she turned and she understood what you said."	"Both Well"	No	No
Kim	100%	100%	"Good"	"When you called him, he would respond, before that if he wasn't looking at you and you called him there was no response."	"Well"	No	Mould has been changed and got a new one with FM
Paul	50%	100%	"Very"	"He can hear me, he says to me now I can't hear when he's got them off."	"Well"	Twice lost Unfit Mould Lost Mould	Programming
Cheryl	<50%	<50%	"Not very successful"	"She could finally get some sounds of speech"	'Pretty Well"	No	Adjustment
Hannah	50%	100	"Really	"She responded to us a lot easier, she was more involved in	"Well"	No	Adjustment

%	Good”	family activities and she found it easier to communicate”

Table 9 shows that those parents who reported their children used their hearing aids 100% of their waking hours were more satisfied about hearing aid successes and they had better histories of keeping and maintaining them at home.

With the exception of Cheryl's family, all of the families reported that the hearing aids were successful for their children. But a difference is apparent between those children who received the hearing aids earlier in life and those who received them later. This difference is related to stage of development. The earlier aided group (Julia, Eris, Myra and Jack) was reported to have changed their reactions to the sound and responses to their names, whereas the later aided group (Sara, Nemo, Kiana, Kim, Paul, Cheryl and Hannah) was reported to have produced more speech sounds, more words, and to have engaged in group activities. Cheryl's caregiver did not feel the hearing aids made a big difference in the first year, but Cheryl still wore them consistently at school hence they were of value to her there.

Hearing aids are not without their problems. In the first year assessments, there was a range of problems that families had experienced with the hearing aids, from losing them to breakages. These problems did not necessarily go away during the second year, even though by then the children were wearing the aids more consistently. Paul and Cheryl still had problems with the ear moulds, and Hannah had required some fixing and replacing of parts in her hearing aids. Myra's hearing aids had been replaced with more powerful ones as her hearing loss progressed. These issues may have been related to the poorer use of the aids in preschool years; however, they seemed less significant once children were at school.

The prescription of hearing aids and the consistent use of them are not the same thing. Paul was only using one hearing aid at the time of his first assessment, as the other one was broken. Cheryl had neither of her aids in use during the first research visit because the batteries had run out and no one had provided new batteries. Her assessment was postponed until new batteries could be provided. Her assessment was eventually done with both hearing aids in place; however, she was resistant to using them all the time as they had high amplification and needed to be adjusted. Nemo also resisted putting his hearing aids on because the ear mould size was wrong, and amplification may also have needed adjustment. Both Cheryl and Nemo wore their hearing aids during the assessment and then took them off.

Paul, Cheryl and Nemo were also the ones who were over 3 years of age when their hearing aids were first supplied. This may suggest that adjusting to them and using them consistently is easier if the children get used to them at a younger age. There may however also be issues of management of aids within families. No specific data were gathered on this point in this study; however gathering such data in future studies may be valuable.

There was a noticeable difference when the older children were re-assessed a year later. All the children had both of their hearing aids and used them both before and after the assessment sessions. It seemed that being at school had provided motivation for these children who had previously been inconsistent users of their aids. The caregivers reported that the children now asked to put on their hearing aids. Paul's caregiver mentioned that he kept asking questions about what other people said and he preferred to put his hearing aids on even when he was watching television. Cheryl's caregiver reported that Cheryl had found problems at school hearing her teacher's and others voices, so she almost always put on her hearing aids at school and when she was doing her homework.

The changes occurring apparently as a consequence of the child going to school also seemed to relate to how well the families maintained the aids. Although Julia, Eris, Myra, Kiana, Kim, and Hannah had good home records for maintenance of the aids from the start, in the first assessment Nemo's hearing aid maintenance was only fair, Sara had left her FM in the rain, had lost her hearing aids twice and had broken them a few times, Jack also broke his hearing aids a few times, Paul often broke them and had lost them or part of them three to 4 times; and Cheryl rarely wore them. However, the following year all of the caregivers reported maintaining the hearing aids very well at home. For example, Paul's and Cheryl's caregivers had contacted their audiologists and asked for appointments and support.

4.1.4 Communication Modes & Intelligibility

Children with hearing loss may need augmentative systems to help make up for their loss of information from the aural signal. They may use lip reading, gesture, sign language, or other languages to communicate, as they may also come from bilingual or multilingual backgrounds. Geers and Brenner (2003) found that communication mode is positively related to the school setting of children with cochlear implants (children who used verbal communication were more likely to go to private schools, and higher intelligent quotient scores were associated with more emphasis on speech) but is negatively correlated with the use of signs in therapy. Children who used spoken language as the only way of communicating had better educational achievements than children who used other communication modes. Other researchers found better speech and language skills were correlated with communication mode. Children who used verbal communication had better outcomes (Geers et al., 2002; Geers et al., 2003a; Musselman & Kircaali-Iftar, 1996). Tobey et al. (2003) also found that children who were in mainstream schools which used auditory oral modes had better speech production skills. It should be kept in mind that these findings belong to children with cochlear implants and any generalization to children with other types of hearing aids should be done with caution.

However, the effect of communication mode has been investigated in children with other types of hearing aids and other degrees of severity of hearing loss, mainly in the school years. Coppens et al (2012) found a negative relationship between the use of sign language at home and children's lexical competencies. Kyle and Harris (2010) found that among 29 children with hearing loss, those children who communicated through speech, had been diagnosed earlier and had less severe degrees of hearing loss had a small to moderate delay in their reading skills. Snik et al. (1997a) found that children who were in total communication mode schools had a slower rate of speech perception development than those who were in oral- aural programmes.

Sign language is commonly found in deaf communities, and there is evidence that they evolve there naturally (Sacks, 1990), but there are not many studies in favour of sign language for children with hearing loss. The lack of published papers in support of sign language seems to relate to the strong support for cochlear implants and the assumptions that children with hearing loss should speak. There are a few studies that support the use of signs, for example Davidson, Lillo-Martin, and Chen Pichler (2013) in a study of five children with cochlear implants who had deaf signing parents compared to five hearing children with deaf signing parents in the United States with showed that there was no detrimental effect from natural sign language on spoken language after implantation and it might even decrease the adverse effects of auditory deprivation in early stages. In addition, using sign language has some other positive effects that cannot be ignored. Mapp and Hudson (1997) found that parents whose children used sign language more fluently had lower levels of stress than those parents whose children did not use sign language or knew it only a little. Recently, Fitzpatrick and her colleagues (2013) began a systemic review protocol about the influences of using sign language on spoken language outcomes when it is combined with oral language intervention. This review will include those studies where the participants were identified early and received early intervention. In a private communication (Purdy and Yoshinaga Itano, 18/8/2014) about the effects of sign language, Yoshinaga Itano said that she and her team had not found any speech and language differences between those children who used sign language and those who did not. Perhaps because instruction was free many of the families in their programme even chose sign language before Cochlear Implantation. She mentioned biased studies where the speech and language skills of hard of hearing children were compared to those of children who used sign language who were profoundly deaf. Because hard of hearing children have a better hearing threshold they will have better speech and language outcomes so it is not a fair comparison with the children using sign language. Also, many other factors should be included for interpretation such as socioeconomic status, intelligent quotient and intensive therapy. (For a review of different communication modes and their effects on the language development of deaf and hard of hearing children see Lederberg et al. 2013).

New Zealand Sign Language (NZSL) is one of the official languages of NZ, along with English and Te Reo Māori. However, knowledge and use of NZSL is highly variable in the hearing impaired population as there are many variables affecting its usage, such as having access to it, receiving education for it, involvement of interpreters and native users of Sign Language, and precise and clear approaches to using Sign Language to teach academic skills such as reading and writing. The most important barrier is that many hearing impaired children are born to hearing parents who do not know sign language (Henning et al., 2011; New Zealand Ministry of Education Special Education, 2010). In this present study, the mode of communication was only investigated to find out about the availability of sign language to our participants and to interpret any possible differences in speech and language outcomes between those children who used sign language and those who did not.

Table 10: Parent and Adviser Report of Communication Modes at Home and Preschool/School

Participants	*Speech Intelligible at Home*	*Lip Reading*	*Signs or Gestures*	*NZ Sign Language*	*Parents Using NZSL*	*Communicate at the Pre/School*	*Communication Mode*	*Language Spoken*
Julia	Yes	Yes	Yes	Yes	Yes	Yes	Sign + Oral	English
Nemo	"Sometimes"	"he used to but not so much now"	"Sometimes"	No	No	Yes	Oral	English
Sara	Yes	Yes	Yes	Yes	"The whole family know and use it"	Yes	Oral	English
Eris	Yes	Yes	"Sometimes"	No	No	Yes	Oral	English
Myra	Yes	Yes	Yes	No	No	Yes	Oral	English
Jack	Yes	"I assume so"	No	No	No	Yes	Oral	English
Kiana	Yes	Yes	No	No	"A few basic signs"	Yes	Oral	English
Kim	"Most of the time"	No	Yes	No	No	"he prefers to be alone"	Oral	English
Paul	Yes	No	Yes	No	No	Yes	Oral	English
Cheryl	Yes	"Sometimes"	No	No	No	Yes	Oral	English
Hannah	Yes	Yes	Yes	No	"some of the basics"	Yes	Oral	English

Table 10 shows that all of the children communicated in the oral mode, in English. Only Julia and Sarah had been taught NZSL and their caregivers could communicate in it as well. Some of the other caregivers knew some basic NZSL but not at a communicative level. In the last set of assessments, Jack and Hannah had started to learn sign language at school. Sign was therefore not highly represented in this group.

Speech perception has been assumed to be an auditory modality but as it has been showed by studies (Barker & Tomblin, 2004; Patterson & Werker, 1999, 2003) it is a bimodal system that engages both visual and auditory pathways. Woodhouse, Hickson, and Dodd (2009) in their review of the literature showed that speech reading (which includes lip reading, facial expression of the speaker, and residual hearing) can be used by hearing people and these speech reading cues may be significant. Even infants can recognise lip movements and match speech sounds and at about four months of age they have specific speech reading skills. Lip reading can be used as a supportive tool for those people who have been trained to use spoken language (Gravel & O'Gara, 2003). It is also a good strategy that children with hearing loss can use to make their speech more intelligible (Ghergut & Paduraru, 2011).

However, only six of the caregivers were able to answer a clear ‘yes’ as to whether their children used lip reading. Two caregivers said outright that their children did not use lip-reading (Kim and Paul). Two others gave variations of ‘sometimes’ (Nemo and Cheryl) and Jack’s caregiver assumed he did, but did not really know. Cheryl, Paul and Nemo were the children with late diagnosed hearing loss, and Kim’s was not very much earlier. The idea that children with hearing loss will ‘naturally’ use lip reading has received little support in this study, however, it is not always noticeable in its use, and Jack’s caregiver may have given a reasonable response by indicating she really did not know if he used it or not.

Communicative gesture is also often assumed to be an aid to hearing loss which develops naturally. Three caregivers stated their children did not use communicative gesture, six said that their child did use it, and the remaining two indicated ‘sometimes’. After a year at school, one child in the older group (Kiana) was reported by her caregiver to use signs and gestures if others did not understand her. It is not clear from this data alone if sign and gesture was of use to these children in their communication. However, it does indicate that it is not consistently perceived by these caregivers, and/or not consistently used by the children.

In the interviews, caregivers were asked if they understood their children (which mostly they did – see Table 10). There are some apparent discrepancies between the judgements on intelligibility reported in these interviews and those in the CDI scales. The difference is explained by the way the questions were asked. In the interview, the question was specifically targeted to the caregivers (did they understand their child?) whereas in the CDI they judged more generally if their children's speech was hard to understand. Caregivers generally can understand their children best, but they may notice that others have difficulty. In this interview data, their caregivers sometimes found Nemo and Kim to be unintelligible, whereas on the CDI, Nemo, Sara, Jack, Kiana, Kim, and Paul's caregivers all reported their children's speech was difficult to understand. Kim's caregiver said "sometimes I think I'm the only one who can understand".

The interview also asked about the preschool context, and how successful a communicator the children were there. All but one of the caregivers reported that their children were able to communicate easily at preschool with their teachers and age mates. Kim's caregiver said that he preferred to be alone and did not play with others. However, a year after starting school Kim started participating in group activities including performing in a school show. Jack and Kiana were reported to have started to use signs and gestures as a supportive tool while at school. All the matched controls' caregivers reported that their children talked "in a way they can understand".

These results together paint a picture of these children as primarily successful, oral communicators, at least as perceived by their caregivers. However, the role of signs, lip reading and communicative gesture is in need of more investigation, and perhaps is a neglected area of assessment and potential intervention.

4.2 Hearing Behaviours

The caregivers filled out two questionnaires about their children's auditory behaviours: the Parents' Evaluation of Aural/Oral Performance of Children (PEACH) and the Auditory Behaviour in Everyday Life (ABEL). These tools are both designed to look in more depth at how children behaved in terms of their hearing, which is not the same as measuring hearing acuity (as in audiograms) or perception. In fact they are complementary tools to give a better picture about the benefits of hearing aids and children's hearing functions in daily activities.

Studies have shown that parents find these to be quick and simple tools to rate their children's auditory behaviour in everyday life and can reveal the benefits of auditory-oral intervention/ rehabilitation, the appropriateness of hearing aids and educational/rehabilitation programs, and children's progress (Purdy et al., 2002; Souza, Osborn, Gil, & Iório, 2011).

4.2.1 PEACH:

a) The routine of device usage

The first question on the PEACH was how often the children wore their hearing aids or /and cochlear implants with the last week taken as the example. The caregivers could choose 100%, 75-100%, 50-75%, 25-50 % or 0-25%. This provided a double check on the informal interview data, and was consistent with it in that most of the children were reported to wear their aids between 75% and 100% of their waking time. The exceptions were Kim (50-75%), Nemo (25-50%) and Cheryl (0-25%).

In the second year assessment, the main change was for Cheryl who was reported to use her hearing aids almost always (75% - 100%), and Paul who was reported to use them often (51-75%). However Cheryl's caregiver made the following comment "Cheryl mostly wears her hearing aids at school; she leaves them there to make sure they are there for learning." This is an interpretation of 'always' which does not include home. The demands of school apparently led Cheryl to find a specific, but not a general use for her hearing aids.

Paul's results may not be valid. In the assessment at the 4-5 year time point, Paul was not wearing his aids for most of the assessment visits (one of them was broken and the other one was only provided for the assessment times), however the report on the PEACH was that he wore them 100% of the time. In contrast, on the assessments at 5-6 years, he was consistently wearing the aids, but the PEACH response was that he wore them 75% of the time. This is an example of how parents can overestimate the use of hearing aids by their children (E. A. Walker et al., 2013). Similarly at both time periods, Kim's hearing aids were only provided for the assessments (at his home all sessions were on weekends) at request of the researcher. The family kept them in a box "in a safe place". It was unclear how much he used them at preschool.

So far, Nemo, Kim, Paul and Cheryl showed a combination of more moderate rather than severe hearing loss (although there is some variation to this), later diagnosis, and lower socioeconomic and parental education levels than the group as a whole, along with less consistent use and care of the hearing aids and perhaps less overall conviction about their value. Whether these issues are reflected in their speech and language results, and if so in what way, will be indicated in chapter five.

b) Loudness comfort

The second question was about how often their children complained about or been upset by loud sounds during the last week. This question was mainly designed for audiological management to indicate how comfortable children are with their hearing aids or cochlear implants. If unpleasant background noises or strong sound enhancement were caused by the aids, they may need to be adjusted. Most of the children were evaluated to never or rarely complain of loud sounds. The only children who did complain about loud sounds were Kiana and Cheryl. Given Cheryl rarely wore her hearing aids, this might be either because the contrast was too great when she did wear them (i.e. she was not used to hearing sounds at that level) or they needed adjustment. However in the following year, when Cheryl wore her hearing aids much more consistently at school, she no longer complained about loud sounds.

The main important point from these reports could be that both the children with hearing loss and the matched controls sometimes complained about loud sounds even if rarely. However some children with hearing loss, namely Julia, Jack and Paul, never complained about loud sounds. It would be easy to assume that this had to do with hearing acuity or hearing behaviour (attention) but equally it could be about environment. Julia and Jack lived in homes that were very quiet, especially Jack who lived on a big farm. He had his own tree house and spent much of his time in that quiet area. Paul on the other hand did not live in an especially quiet environment, and other results indicated he did not wear his hearing aids very much. His hearing loss may well account for his not complaining about loud sounds. Mostly, this question seems to indicate that the hearing aids allowed normal hearing behaviour concerning loud sounds for the children with hearing loss.

Given that the responses from the matched controls were not particularly different to those for the children with hearing loss on this question, and that the noise situation for individual children could be very different, it may not be clear what this question taps. It may be that it is best seen as a criterion-referenced assessment of change for a child with hearing loss between changes in aiding, which may indicate problems with the hearing aids.

a) Quiet, noise and overall scores

The remaining 11 questions in this questionnaire were about children's behaviours (oral & aural) in quiet and noisy environments. Its overall scores as averaged for typical hearing children start with about 50% for infants and increase gradually to 85% for children aged 50 months and older. In fact, at around 40 months it is expected that children with typical hearing have a near-perfect score in this questionnaire (Ching & Hill, 2007). Children with greater degrees of hearing loss have slower developmental growth rate and it is only after 50 months that they reach a score of about 80%.

The overall scores derived from the scores in noisy and quiet environments are presented in Figure 7. All of the children scored above 50% but there were many individual differences. Some of them (Kim) scored at the 2-year-old level and some (Hannah) scored as well as children with typical hearing. On average, the children with hearing loss were below -2 SD of their age mean.

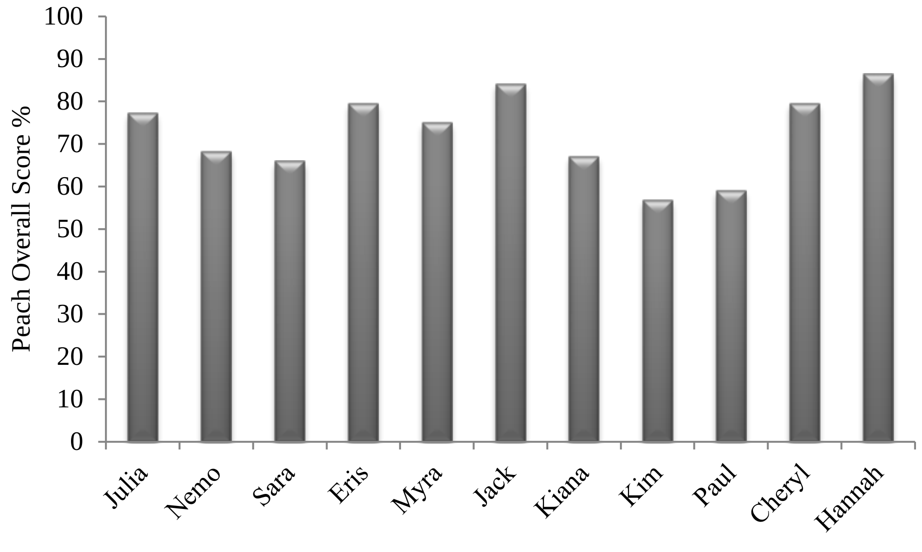

Figure 7: PEACH Scores for Children with Hearing Loss

To see what made their scores so different from each other and also from the typical hearing children, the subscales were examined. As expected, most of the children functioned less well in noisy environments. As a group the mean for noisy conditions was 67 while it was 77 for quiet conditions. There were some interesting individual differences such as Paul and Kim. Their functioning was reported to be better in noisy environments, Paul around 2% and Kim around 15%. This was unexpected. However, it is worth comparing the children's usual environments to the assumptions the instrument might be making. For example, if children expect noise, or perhaps if it stimulates them to pay attention, then they might do better in noisy environments. Individual situations may present particular variations to general expectations, and may need to be examined with this in mind. This is supported by the fact that two of the older matched controls also gained higher scores in noise than in quiet (Pete and Cherish).

Another possible explanation is development. Based on the reported performance of the younger matched controls, while Sue had similar scores for both quiet and noisy environments, the other three participants on average scored more than 10% better for the noisy environments. As this is similar to Paul and Kim in the older group, it may be that this is a developmental issue. Greater numbers of younger children may need to be assessed to check this possibility.

There was a blank page in each questionnaire in which caregivers could comment. In the first year reports, some of the caregivers from both groups provided useful comments (see Table 11).

Table 11: Caregivers' Comments on Their Children's Auditory Behaviour

Caregiver of	*Written Comment*
Eris	"If she doesn't understand you the first time she says 'ha' or 'pardon'. Sometimes have to repeat ourselves often depending on the situation and how present she is in the conversation".
Myra	"I am sure that she hears me every time but sometimes she chooses not to respond/hear me."
Kiana	It also depends a lot on mood and what time of day. Afternoon is a lot worse in most situations. In noisy situations Kiana gets uncomfortable."
Paul	"Paul enjoys listening to music with or without headphones
Cheryl	"results differ when Cheryl wears her hearing aids"
Kim	"Kim has a tendency to play ignorant a lot of the time…. He can be very stubborn."
Hanne (control)	"She has a strong personality and will sometimes choose to pretend not to listen."

So it seems from the families' perspectives, some factors other than hearing and hearing aids such as children's personality, their mood, their interests and the rate of participation in the conversation had an effect on the child's auditory behaviour.

4.2.2 Auditory Behaviour in Everyday Life (ABEL)

The ABEL instrument examined the caregivers' opinions of their children's auditory verbal skills (Purdy et al., 2002) (see Appendix H). The ABEL has three subscales: Auditory-Oral, Auditory Awareness, and Conversational/Social skills, and gives a total score.

A higher score (to a ceiling of 6) in each subscale and in the overall score indicates a better performance. With the exception of question 4, which deals with social-conversational skills, wherein a lower score means better performance.

The children's scores are presented in Table 12. There was a big range in the overall score, from 2.08 to 5.46. None of the participants achieved a full score in any subscale, an outcome that was predictable from their ages. The lowest scores in all bands belong to Kim, and then to Nemo and Sara. Paul only got a low score in his conversational/social skills and the other subscales were similar to those of his peers with hearing loss.

When comparing these children's overall scores and the results reported by Purdy et al. (2002), Eris, Myra, Jack, Cheryl and Hannah scored similar to children with Aided Mild- Moderate hearing loss, Julia, Nemo, Sara, Kiana and Paul scored similar to children with Aided Severe-Profound Hearing Loss and Kim had a score similar to children with profound hearing loss before cochlear implant. Only Eris, Myra, Jack, and Cheryl were in a category that matched with their actual hearing loss.

Table 12: ABEL Scores for Each Participant

Group	*Participants*	*Auditory-Oral*	*Auditory Awareness*	*Conversational-Social Skills*	*ABEL Overall Score*
3-4 Years Old	Julia	4.27	3.80	3.60	3.96
	Nemo	3.54	3.40	4.20	3.61
	Sara	3.90	3.80	3.00	3.69
	Eris	4.90	4.60	4.00	4.61
4-5 Years Old	Myra	4.72	4.80	3.20	4.46
	Jack	4.72	5.50	3.80	4.84
	Kiana	3.54	3.80	3.00	3.53
	Kim	1.81	2.40	2.00	2.08
	Paul	4.81	4.00	1.80	3.92
	Cheryl	5.27	5.40	4.60	5.19
	Hannah	5.45	5.40	5.60	5.46

Caregivers consistently gave the lowest scores on the 'conversational-social skills' subscale (with the exception of Nemo). The questions in this subscale often related to talking with relative strangers or less-known people, and it may not be expected culturally that young children would do this. In some cases children lost scores because of a higher frequency of inappropriate vocal noises, a problem which can be related to their hearing problems (most of these children had sensorineural hearing loss which means they could not accurately monitor their loudness). Sometimes the score appeared to relate to low attention levels in conversation.

The auditory-oral subscale however indicated that these children could initiate a conversation or gain the attention of others with verbal skills, although they did not use their verbal skills so much to respond to their communicative partners. This is consistent with the conversational behaviour of young children, at around 2-2½ years (Fey, 1986), but may also relate to how well these children have heard the conversational partner. This aspect of their communication behaviours will be examined in more detail in chapter 5.

4.2.3 Hearing Behaviours after a Year

The behaviours reported on the ABEL and PEACH are expected to change over time (see Figure 8 and Figure 9). The group of children who were re-assessed a year later Myra kept her scores for auditory behaviour at almost the same level as reported by her caregiver. Jack and Cheryl showed a drop in their scores, however since the questionnaires were designed to assess the individual's auditory behaviour over the previous week, they could not be generalised to an overall decline for the whole year. Perhaps it was just some temporary behavioural changes during that week. The other children showed increases in their scores for auditory behaviours from their caregivers' perspective. Paul's caregiver's report on his hearing behaviour showed a marginal increase, and Kim's caregiver gave him a much better score on the ABEL for the second year. Perhaps better expressive language and speech perception, as well as production skills (see later) contributed to this difference. However, although both children had an increase in their auditory behaviours' scores, they still scored below 70% which was below the normal range.

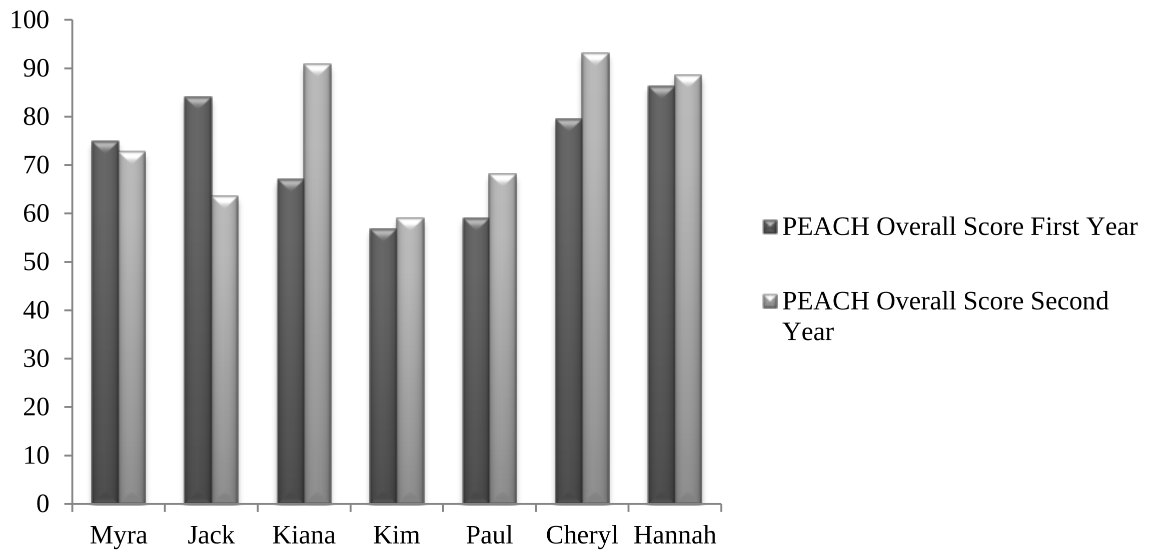

Figure 8: Hearing Behaviour Scores on PEACH One Year After

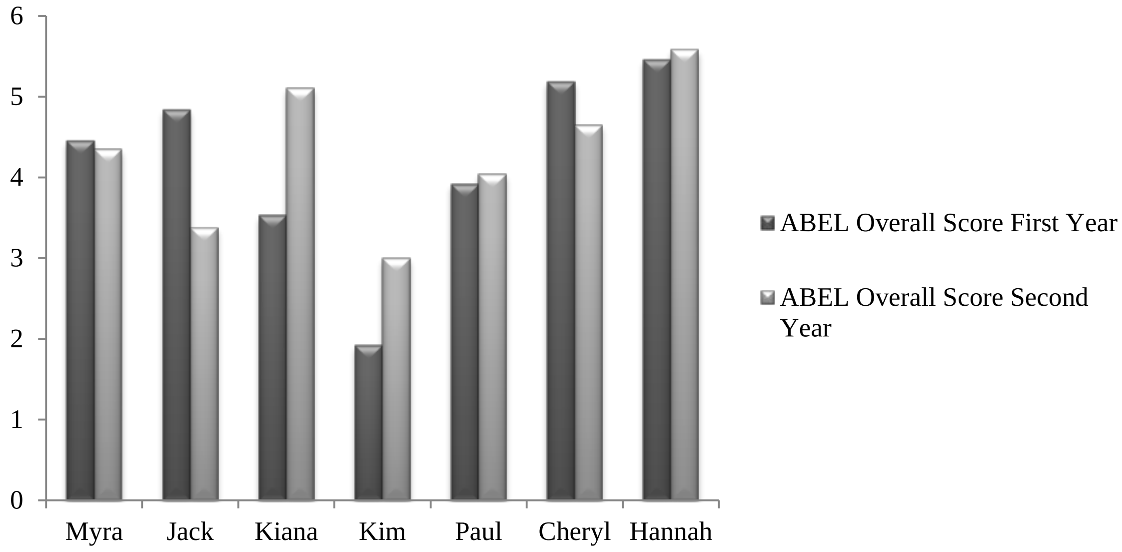

Figure 9: Hearing Behaviour Scores on ABEL One Year After

To summarize, not all children with hearing loss had problems with the skills measured on the ABEL. In chapter 5 it will be seen that although some of the caregivers underestimated their children's abilities there was an agreement between what caregivers reported here and what the speech and language assessment tools revealed. The ABEL also showed that some skills related to the use of language (pragmatic skills) were at risk and may need to be considered for intervention. However, these problems only appeared in the 4-5-year-old group, suggesting that intervention for language use might best begin before the age of 4.

4.3 Children's Development

The Child Development Inventory (CDI) was used to give a profile of the children's general developmental level, and the areas within it. This could show the strengths and possible problems which could then be compared or contrasted with communication development. Other areas of development have been shown in some studies to be problematic for some children with hearing loss, for example motor skills (Inoue et al., 2013; Livingstone & Mcphillips, 2011), social skills (Antia, Jones, Luckner, Kreimeyer, & Reed, 2011; Brown, Bortoli, Remine, & Othman, 2008; Punch & Hyde, 2011), and reading and writing skills (Geers, 2003; Park, Lombardino, & Ritter, 2013; Timms, Williams, Stokes, & Kane, 2014; N. Walker & Wigglesworth, 2001). However, there is a clear relationship between social skills, literacy, and oral communication, so these areas would be expected to show some relationship (Kyle &

Harris, 2010). This inventory also considers the judgments of speech and language from the caregiver's perspective.

The CDI does not give standard scores as such, but does allow a child's score to be given a broad range in relation to the scores of age peers. Table 12 shows whether the subscores for each child fell within the normal range, between -1.5 and -2.0 SD below the mean for age (defined by the CDI as "mild delay"), or below that again (defined by the CDI as "significant delay").

Table 13: Children's Status on Each Subscale of the Child Development Inventory

Participants	*Social*	*Self Help*	*Gross Motor*	*Fine Motor*	*Expressive Language*	*Language Comprehension*	*Letters*	*Numbers*	*General Development*	*No. of Possible Problems*
Julia	n	a	b	n	n	b	n	n	n	3
Nemo	n	n	n	n	n	a	a	b	n	14
Sara	b	n	b	n	b	b	b	b	b	2
Eris	n	n	n	n	b	b	n	n	n	3
Myra	n	n	a	n	n	n	n	n	n	1
Jack	n	n	n	n	a	a	n	n	n	4
Kiana	b	n	n	n	b	b	n	b	b	5
Kim	b	b	b	b	b	b	b	b	b	17
Paul	b	b	n	b	b	b	b	b	b	3
Cheryl	n	n	n	n	n	n	n	n	n	3
Hannah	a	n	n	n	n	n	b	a	n	4

n = Scores Within the Normal Range for age

a = Between -1.5 and -2 SD of the Normal Range for their Age: Mild Developmental Delay

b = Below -2 SD of the Normal Range for their Age: Developmental Delay

Seven of the 11 participants obtained General Development scores within the normal range for their age on the test norms. Their scores were not all even however, as although most got scores almost in the normal range for Social, Self Help, Fine Motor, Letters and Numbers skills, only Myra, Cheryl and Hannah had scores in the normal range for the Language subscales.

Four children (Sara, Kiana, Kim and Paul) were scored as below the normal range for their age in general development (scoring in the range for developmental delay) . However, they presented different profiles within this. Kiana was within the normal range on the Self Help, Fine Motor, Gross Motor and Letters subscales. Sara was within the normal range on the Self Help and Fine Motor subscales. Paul was in the normal range only on the Gross Motor subscale and Kim was not in the normal range for any of the subscales. None of this group was within the normal range for the language subscales.

The CDI along with other tools could show the effects of hearing loss. Language skills clearly showed as an area of weakness regardless of development in other areas. For example, Eris scored in the normal range for her age for all subscales except language skills. Because she had an early diagnosis and had hearing aids fitted and had used them consistently since she was 3 months old, it would be expected that her language skills had almost as much chance of falling within the normal range as those of her hearing peers. However, this was not the case. Conversely Kim did not score in the normal range of his age for any area of development on the CDI, so with Kim we are confronted with a complex not a linear causal effect and his rehabilitation would not only include auditory, speech and language programs, but interventions for other areas of development.

Even where language skills were reported to be developmentally appropriate, patterns related to language development may appear. Hannah scored within the normal range for most subscales including oral language skills; however, she was below the normal range Letter and Number knowledge, and Social subscales. These three areas are based on the verbal language system, so this may indicate the consequences of hearing loss for children's later achievements.

In the longitudinal part of the study, the children with hearing loss who had been 4-5years old at the first assessment were re-examined on the CDI when they were aged 5-6. Kim and Paul were still reported by their caregivers to be below -2 SD of their age mean on the global score of General Development. However Kiana's General Development score had significantly improved so that she was now within the normal range for her age and had improved her scores relative to her peers in all scales. The remaining four children in this age band had maintained their status within the normal range for the global score (see Table 14). However, the Social skills subscale was showing some signs of sensitivity to development, in that although Kiana was now reported to be within the normal range, Hannah's score had worsened, and Jack had moved from the normal range in his first assessment to below it in the second year assessment. Kim and Paul had both maintained this subscale as among their worst performing. However, both Kim and Paul had made considerable gains in the “Letters” subscale, indicating that their preschool and school education programs may have borne fruit. As these results were reported to the families and the AoDCs after the first set of assessments, it is possible that decisions had been made to target Letter knowledge, as it was a clear goal that could be tackled.

Table 14: Children’s Scores in Child Development Inventory One Year Later

Participants	*Social*	*Self Help*	*Gross Motor*	*Fine Motor*	*Expressive Language*	*Language Comprehension*	*Letters*	*Numbers*	*General Development*	*Possible problems*
Myra	n	n	n	n	n	n	n	n	n	1
Jack	b	n	n	n	n	a	n	n	n	3
Kiana	n	n	n	n	n	n	n	n	n	2
Kim	b	b	b	b	b	b	n	b	b	8
Paul	b	a	n	n	b	b	a	b	b	1
Cheryl	n	n	a	n	n	n	n	n	n	0
Hannah	b	n	n	n	n	n	n	n	n	1

n = Scores Within the Normal Range for age

a = Between -1.5 and -2 SD of the Normal Range for their Age: Mild Developmental Delay

b = Below -2 SD of the Normal Range for their Age: Developmental Delay

There is a complementary section in the CDI where caregivers can report any possible problems in regard to their children. In the first year of our assessment, the main reported problems for children with hearing loss were (obviously) a hearing problem, and then speech intelligibility problems, and not talking at age level. The highest number of reported problems was for Nemo and Kim. These children who were reported to have higher numbers of behaviour issues were not high scorers in speech and language assessments either Children with hearing loss have been previously reported as having more behaviour problems than children with typical hearing (see Moeller (2007) for review). Stevenson, McCann, Watkin, Worsfold, and Kennedy (2010) reported that behavioural problems in children with hearing loss can be a consequence of their poorer speech and language skills.

In the longitudinal part of the study, the caregivers of the children reported fewer problems when their children were 5-6 years old than they had a year previously. Cheryl and Kiana's caregivers did not report any problem with hearing, which is interesting as the children still had hearing loss. It may be that this hearing loss was now not perceived as a problem because the children were doing well, and the hearing loss was well managed. It could also be however that this was such a given they did not feel the need to note it. The problems reported for other children were mainly restricted to hearing problems. The only children who had behaviour problems in their reports were Jack, Kiana and Kim (their caregivers reported them as 'demanding' 'strong willed' and 'disobedient'). Kim had other behaviour problems and still had the highest number of reported problems, but fewer than were reported the previous year and that could be a sign of progress.

To conclude, it seems the children with hearing loss were a heterogeneous group, not only in their general development but also in their strengths and weaknesses. The longitudinal element indicated these children made clear progress and reported fewer problems, but also some of them (for example, Jack, Kim and Paul) still had ongoing difficulties in oral language or related skills.

4.4 Rehabilitation and Educational Services

Once diagnosed with hearing loss, children in NZ come under the Advisor on Deaf Children service from the NZ Ministry of Education. They may also receive speech language therapy, either from those services that specialise in children with hearing loss or general SLT, and preschool or school resource teachers for deaf children, also from the Ministry of Education (Ministry of Education, 2012a). Audiologists would also normally be involved, to assess the children's hearing, and prescribe the appropriate aids. All these services are designed to maximise the child's development, especially in communication, to enable them to progress as well as their peers at school and beyond.

Table 15 shows the extent of these services for the children in this study (as reported by a combination of information from the caregivers and AoDCs). The table shows that for a variety of reasons there was variability in the services the families received. The reasons included family resources, time of diagnosis, and where people lived.

Table 15: Rehabilitation Services for Children with Hearing Loss

Participants	*Initial Treatment*	*SLT** before Hearing Aids*	*SLT after Fitting the Hearing Aids*	*The Interval Between 1st and 2nd Assessments*	*After 5 Years Old*
Julia	AoDC* & Hearing Aids Prescribed	No	Since she started the Preschool, she had SLT for an hour each week.	NA	
Nemo	AoDC & Medical Assessments and Fitted with Hearing Aids	Referral made when he was 2½ years but he did not get SLT until after he was aided (3 years old) .	He had a block of therapy from a contractor but was not receiving SLT at the time of assessment	NA	
Sara	AoDC & audiologist, ENT***, and SLT	No	She had some SLT for sign language and verbal language. At the time of assessment she was in [illegible]	NA	
Eris	AoDC & Hearing Aids Prescribed	No	Seen weekly by a SLT in the Hearing House for an hour	NA	
Myra	AoDC & Hearing Aids Prescribed	No	Seen weekly by a SLT in the Hearing House for an hour	SLT services from the Hearing House fortnightly for an hour, and she also had a special group program (School Readiness Sessions) in the Hearing House every fortnight.	A Resource Teacher of the Deaf****
Jack	AoDC & Hearing Aids Prescribed	No	SLPfortnightly for an hour SLP and a resource teacher twice a week	Regular meetings with AoDC, audiologist	A Resource Teacher of the Deaf (three hours a week)
Kiana	AoDC & Hearing Aids Prescribed	No	Weekly seen by a SLT in the Hearing House for an hour	Weekly services from the Hearing House	A Resource Teacher of the Deaf (once a week)

Kim	AoDC & Hearing Aids Prescribed	No	Seen weekly by a SLT since he was four, and a resource teacher	SLT program weekly for an hour	A Resource Teacher of the Deaf three times a week
Paul	AoDC & Medical Intervention and Hearing Aids Prescribed	No	Seen by a SLT and a teacher aid fortnightly for an hour	AoDC, a SLT, a Communication Support Worker, and a Resource Teacher of the Deaf	AoDC, a SLT, a Communication Support Worker, and a Resource Teacher of the Deaf
Cheryl	Medical & Audiologist	No	No	No	No
Hannah	AoDC and Hearing AidS Prescribed	No	Seen weekly since the second semester of 2011 by a Resource Teacher of the Deaf and three weeks after fitting hearing aids seen by a SLT in Hearing House	The SLT or AoDC	A Resource Teacher of the Deaf fortnightly for two hours

* AoDC = ‘Adviser on Deaf Children; ** SLT = Speech Language Therapy; ***ENT= Ear Nose and Throat specialist; **** When children go to school, the Ministry of Education provides a Resource Teacher of the Deaf to support children with hearing loss. They evaluate children and then they give support to them in close cooperation with teachers (Ministry of Education, 2012b).

All these children were receiving services from the AoDCs as that was how they had become involved in the study. Hence the questions focused mainly on speech and language therapy (SLT) services, given that speech and language development is at the greatest risk as a result of hearing loss in young children. The experience of SLT in this group was highly variable. None of the children had any consultation or services from a speech and language therapist before they received their hearing aids. Cheryl did not have any SLT even after she got her hearing aids, Nemo had one block of therapy only, and SLT started for Kim only when he turned four. Jack's caregiver mentioned that at the time of assessment he had not received any SLT for months.

This data indicates that for those children who had speech and language problems the intervention services were ongoing, while for those who showed almost age appropriate speech and language skills, these services ceased. It could be argued that AoDC and resource Teachers of the Deaf are both trained to work with speech and language skills with children, and therefore specialist SLT services are not needed. This study was not able to comment directly on this possibility. However there was a great deal of interest in the SLT reports that came out of this study, and two advisors mentioned spontaneously in their second year interviews that they used the reports from the first year speech and language assessments to devote resources to the children. It may be that there is space for greater collaboration than appeared to be the case in this study.

There is little evidence in the literature about the efficacy of speech and language intervention for speech and language outcomes in children with hearing loss. Where studies do exist, they concentrate on children with cochlear implants (e.g. Tobey et al. (2003); Geers et al. (2003a); Geers (2003); Geers et al. (2003) and Geers et al. (2002)). These studies did not show any significant correlation between intensity of intervention and speech and language outcomes or between speech and language therapists' experience and the speech and language outcomes. It seems that the main possibility for failure to show any correlation between these variables could be the concurrence of many active factors for these children (especially children with cochlear implants). Therapy is a complex issue, and there is no simple relationship between number of sessions, their duration, and the speech and language therapist's experience (among other factors) and progress in the non-hearing impaired population with communication difficulties either (Kamhi, Nippold, & Hoffman, 2014).

However it will be seen in later chapters that those children with a history of consistent speech and language intervention had better speech and language outcomes than those children who had no such history.

4.4.1 Preschool Experience

Attendance at child care centres and kindergartens gives children the opportunity for free play, and structured and designed activities to develop their cognitive and imaginative skills. They also get to interact with peers which enhances social skills and provides a context for meaningful communication and stimuli for its development (Bowler, 1996; Brown et al., 2008; Shim, Herwig, & Shelley, 2001; Weisel, Most, & Efron, 2005).

Attendance at preschool, especially those preschools with specialist support for children's communication development, has been found to have the potential for positive effects on communication and other developmental outcomes for children (Burchinal, Roberts, Nabors, & Bryant, 1996; Burchinal et al., 2000; Caniato, Alvarenga, Stich, Jansen, & Baune, 2010; Stanley, 2008). These studies showed positive relationships between higher-quality child care and better cognitive and language development. Children who were in higher-quality child care had positive relations with their peers, teachers and adults, showed fewer behaviour problems, and had better relationships with their mothers (Owen, 2004).

All the participants in the present study went to a preschool. However, they varied greatly in how long they had been going (from 4 to 44 months) and how many days a week they went (from 3 to 5 days a week) (see Table 16). All caregivers reported their children attended regularly and all of them except Kim's caregiver thought they were doing well there.

Table 16: Caregivers Report of Children with Hearing Loss Social Life in Preschool

	Preschool						*School child will go to1*
Partici pants	*Any ?*	*What Kind*	*How Long? Months*	*How Often?*	*Regular ?*	*Child's Function?*	
Julia	Yes	Private Day Care + Kindergarten	29	Every day	Yes	"Good"	"not sure"
Nemo	Yes	Day Care	7	3 days	Yes	"Quite Good"	MSS*
Sara	Yes	Montessori	20	4 days	Yes	"Very Good"	MSS
Eris	Yes	Day Care + Kindergarten	20	4 days	Yes	"Very Good"	MSS
Myra	Yes	Private Preschool	18	Every day	Yes	"Very Good"	MSS
Jack	Yes	Day Care	19	Every day	Yes	"Pretty Good"	MSS
Kiana	Yes	Early Childhood Centre	42	Every day	Yes	"Well"	MSS
Kim	Yes	Kindergarten	30	Every day	Yes	"No"	MSS
Paul	Yes	Day Care	44	Every day	Yes	"Very Well"	MSS
Cheryl	Yes	Day Care	4	Every day	Yes	"Very Well"	MSS
Hannah	Yes	Kindergarten	18	Every day	Yes	"Really Good"	MSS

* Mainstream State School

The matched controls also went to a day care or kindergarten. Again there was a wide range of preschool attendance from three months to 43 months, with a mean of about 22 months. Most of them attended their preschools regularly.

As is typical in NZ, most of the caregivers of both the hearing impaired and control children expected their children would go to mainstream primary education. Only Keyna (control group) was expected to go to a private school, and Julia's mother was not sure about the school she would go to.

Going to mainstream schools has been shown in some studies to result in better speech and language outcomes for children with hearing loss (Musselman & Kircaali-Iftar; Westerveld, Gillon, & Miller, 2004). However the contrast here is not with private schools, but with special schools, those catering specifically for children with hearing loss. Coppens et al. (2012) found a significant negative relationship between lexical competency and special educational placement.

The numbers in this study are too small to draw any meaningful correlations between preschool attendance and other factors. It is clear that some children doing well had attended a lot of preschool (e.g. Julia) but some who were not doing so well also had a lot of preschool time (e.g. Paul). The data is not sensitive or detailed enough to consider exactly how preschool attendance might have helped these children's development. However it is an excellent sign that generally preschool attendance was high, making the possibility of school readiness greater for these children. The exceptions were Nemo and Cheryl. Nemo was in the younger group so was not seen again, but Cheryl was in the longitudinal group, and her start at school was perhaps a little less positive than some of the other children, providing a suggestion that preschool attendance might enhance development.

4.4.2 School Experience

The follow up of the older children with hearing loss after they had entered school included some questions to the caregivers about the children's experiences at school (Table 17). All of the children were at mainstream state schools. The caregivers of all but Cheryl and Kim felt their children could easily communicate at school. The only problems reported were about Cheryl forgetting to take her hearing aids. All except Kim's caregiver were able to indicate the strengths their children had. Clearly by this time Kim was standing out as falling behind his peers. However he had only just started school, so he probably needed more time to show his potential. The caregiver stated that the teachers were happier with Kim than they had been with his older sister, who also had hearing loss. The relationship with school experience and the child's use of their hearing aids has been mentioned previously, and the relationship with their communication skills will be discussed in chapter 5. In both cases, change was noticeable after this transition.

Table 17: Caregivers' Reports on the Social Life at School of Children with Hearing Loss

Participants	*Child's Function?*	*Can Child Communicate Easily at School?*	*Any problems*	*Child's Strengths*
Myra	"well"	Yes	No	"she knows what she wants"
Jack	"very good"	Yes	No	"Friendly, kind, caring, and very good at reading"
Kiana	"well"	Yes	No	"she is very good at memory and she is visual"
Kim	"good"	"sometimes they can understand him and he got better" "he is alone and plays alone"	No	"nothing"
Paul	"awesome"	Yes	No	"polite, well-behaved, and teamwork"
Cheryl	"pretty good"	"she began to""	"just when she forgot her hearing aids"	"keen to learn"
Hannah	"very well"	Yes	No	"she is eager to participate"

* Mainstream State School

4.5 Children's Personality and Character

The questions about the children's personality and character as perceived by their caregivers are best seen as a way of indicating temperament[17]. As can be seen in the definitions developed by Sanson and colleagues (see footnote) children's temperament is a complex topic. However temperament has been found to have an impact on how well children develop and learn, especially in adverse situations, hence it is a topic of interest in regard to this research group. The temperament of children has been found to have an impact on their social competence (Sanson et al., 2004), their learning, (Dixon Jr. & Salley; Hwang, Soong, & Liao, 2009; Teglasi, Cohn, & Meshbesher, 2004) and perhaps their management of their hearing loss. Temperament has different dimensions and there is no consensus about how to measure it. For

[17] "Temperament is of individual differences in emotional, motor and attentional reactivity to stimulation, and in patterns of behavioural and attentional self-regulation (Sanson, Hemphill, & Smart, 2004)". It has three aspects: *Reactivity* or *Negative Emotionality* (that includes irritability, negative mood and high-intensity negative reactions, and can be differentiated into distress to limitations (irritability, anger) and distress to novelty (fearfulness)); *Self-Regulation* (this one includes two subcomponents, the effortful control of attention (e.g. persistence, non-distractibility) and of emotions (e.g. self-soothing); and *Approach-Withdrawal* that has been known with other labels such as *Inhibition* or *Sociability* (this one describes the tendency to approach novel situations and people or conversely to withdraw and be wary) (Sanson et al., 2004).

example Teglasi et al. (2004) in their review of literature about temperament and learning disabilities indicated that in one model temperament had 15 dimensions[18] to describe positive and negative Reactivity and Self-Regulation.

Sanson et al. (2004) in their review of research on the relationship between temperament and social development found strong evidence for an association between negative reactivity and externalising behaviour problems, between inhibition and internalising behaviour problems, and between attention regulation and school functioning. Low reactivity and high self-regulation (as positive aspects of temperament) had association with prosocial behaviour and social competence. They also mentioned the findings of some studies which showed connections between inhibition and later withdrawal from peers as well as connections between negative emotionality and poor peer relationships.

Parent-child interaction could also be influenced by temperament. Sanson et al. (2004) found that temperamental irritability and difficultness are typically associated with negative parenting, whereas child positivity and self-regulation are associated with parental responsiveness. They also found that externalising behaviour problems could be predicted from a combination of irritable, difficult child temperament with poor, especially punishing, parenting.

Temperament could have a major impact on children's function at school. It could affect their reactions to the learning environment, their behaviour in the classroom and playground, and their relationships with teachers and peers (Sanson et al., 2004).

This study did not investigate temperament in any systematic way, but it did ask caregivers to describe their children's personalities, and much of what they replied is relevant to considering temperament (see Table 18).

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[18] These 15 dimensions are: *Positive Anticipation, Smiling/Laughter, High Intensity Pleasure, Activity Level, Impulsivity, Shyness, Discomfort, Fear, Anger/Frustration, Sadness, Soothability, Inhibitory Control, Attentional Focusing, Low Intensity Pleasure, and Perceptual Sensitivity* (Rothbart, Ahadi, Hershey, & Fisher, 2001).

Table 18: Caregivers' Descriptions of Their Children's Personality and Characters

Children With Hearing Loss	*Their Description First Year*	*Their Description Second Year*	*Matched Controls*	*Their Description*
Julia	"Funny, energetic and clever"	NA[1]	Josie	"she is bright, cheeky, shy and she knows what she wants"
Nemo	"stubborn, bossy, if he doesn't want to do something, he won't"	NA	Nick	"clever, shy, funny, lovely boy"
Sara	"cheeky, kind, determined, no fears, she knows what she wants and she goes for it"	NA	Sue	"good sense of humour, stubborn, determined"
Eris	"she is strong willed, stubborn, happy, very active, and loves music"	NA	Erina	"effective, funny, lovely"
Myra	"full of energy, talkative and loveable"	"she is bossy, outgoing, confident, bright"	Myron	"she is pretty bright, independent, happy"
Jack	"quite a BOY, cheeky, emotional, funny"	"he is a bit crazy, very happy, and kind"	Jasper	"very bright, emotional, BOY type"
Kiana	"aggressive, independent, and she wants to do first by herself"	"energetic, lovely, funny"	Keyna	"very active, fast learner"
Kim	"he is like a girl, loving and caring"	"great personality, gets better with people"	Kenny	"very challenging, funny, outgoing"
Paul	"normal, active, loves cuddles, playschool, rugby boy"	"awesome, lovely"	Pete	"smart, lovely, kind of independent"
Cheryl	"quiet, withdraws and takes time to talk"	"independent"	Cherish	"outgoing, independent, confident, funny"
Hannah	"stubborn, playful, determined, she wants everything"	"cheeky monkey, determined, and she wants to do in her own way"	Hanne	"very outgoing, strong willed, competitive, talkative, lovely"

[1]. Not Applicable

Looking at the words that caregivers in both groups used to describe their children shows that most of them described at least some positive qualities. Most caregivers when they wanted to answer this question looked at the child and smiled and then answered. Three of the hearing impaired group were described in wholly positive terms (Julia, Myra and Paul) as were seven of the control group. However the words in bold in the table could indicate some negative temperament features (such as “aggressive”, “bossy”, “stubborn”, “shy”), and some could be equivocal, such as “strong-willed”, “determined”, “challenging” and “cheeky”, which might be positive, but also could be euphemisms for ‘defiant’ and ‘disrespectful’. If we count all of these possibilities, there were 11 such descriptors used of the hearing impaired group (first year only) across six of 11 children, and seven descriptors of the control group across five of 11 children. If we consider the bolded terms only, there were seven in the hearing impaired group across five children (of which three were “stubborn”), and four in the control group across four children (of which two were “shy”). Hence the hearing impaired group were more likely to have a negative temperament descriptor used in regard to them than were their hearing peers, and those terms were more likely to be about noncompliance.

Most of the children who had negative descriptors also had positive ones, such as Eris (“strong willed, stubborn, happy, very active, and loves music”). Only Nemo received almost wholly negative descriptors. . It was notable that those children whose caregivers described them as ‘stubborn’ took more sessions to finish assessments. Nemo was perhaps the most difficult, and he took six sessions to complete the tasks. For at least two sessions I observed struggles between the caregiver and Nemo to put on a jacket and socks (it was very cold but he resisted putting on the clothes). He only cooperated with the assessments because his caregiver threatened him with a punishment (going without his favourite programme). The usual reinforcements such as chocolate or peanuts were not effective. His caregiver reported about 14 problems in her CDI report.

However, arguably the most negative descriptor was used about Kiana, whose caregiver used the term ‘aggressive’. The researcher’s experience was that the assessment sessions with Kiana were postponed twice because she was screaming, crying, rolling on the ground and hitting her caregiver. When the assessment sessions were finally able to be held, however, she did not throw tantrums, but was quite cooperative. In the following year, after starting school, she was described much more positively as “energetic, lovely, funny”, and this more positive behaviour was also seen in the assessment sessions. Most of the children were described more positively in the second year. The exception was Myra who was given the descriptor ‘bossy’. This feature was obvious when she was playing with her mother, as she took the leadership role and her caregiver was a follower. But it did not have any negative effect on the assessment sessions.

The only impact noted during the assessments for the matched controls was that Nick and Josie, described by their caregivers as ‘shy’, were both very softly spoken. None of the other matched controls showed any temperament issues in the assessments. The word 'stubborn' was applied to different characteristics in children with hearing loss from those of the matched controls. Sue's caregiver described her as "stubborn", but she was completely cooperative and took only two sessions to do the assessments.

The impact of temperament cannot be seen from this data alone. However it is possible that for some children (such as Nemo and Kiana) it is a significant issue, which may impact on their learning including their speech and language, which were delayed in various ways on the CDI. However other children, such as Paul, had significant delays but no temperament issues appeared in this data. There were more points of issue for the children with hearing loss than for the matched controls, and the term 'stubborn' appeared more frequently compared to "shy" for the controls. It is possible that not hearing, and/or habits of not paying attention to the auditory signals, could result in behaviour that adults label as 'stubborn'.

However it could also represent more negative reactive behaviour in this group. More study would be needed to investigate these issues.

4.5.1 Children's Attention Spans

Another important feature that could have an effect on how well the children performed in assessments was their attention span. Brown et al. (2008) divided attention states into 5 levels: 'inattentive', 'alert', 'sustained', 'focused' and 'divided' and they regard it as an important feature for the evaluation of children's social competence. Sanson et al. (2004) in their review of the literature found that children's capacities for attention regulation seemed to be a key factor for functioning in the school context. Brown et al. (2008) found children with hearing loss were significantly more distractible in social contexts, and they achieved significantly lower scores for alert, sustained and focused attention.

This study did not investigate attention in depth, but caregivers were asked about it, and the attention shown by the children was observed during the assessment process. The caregivers of Julia, Nemo, Eris, Paul, and Cheryl said their attention depended on what the child was doing. Sara, Kiana and Kim's caregivers estimated their attention span at about 15-20 minutes, Myra's caregiver said she had a short attention span, and Jack and Hannah's caregivers said their children had good attention spans, possibly an hour. During assessments, Julia, Nemo, Sara, and Eris (all in the younger group) were the only children who lost attention and needed the tasks to be completed across more sessions. Myra lost attention during assessments and the researcher had to keep her focussed by tokens.

The older children with hearing loss who were re-assessed at 5-6 years of age were reported by their caregivers to have good attention spans although most felt it depended on what they were doing. Kim was the exception, with his caregiver saying he did not have long attention span. For all these children, the assessment tasks were completed in two sessions.

The reports by caregivers of the matched control children came up with similar results. Most caregivers said that their children had good attention spans, with two (Keyna and Kenny) saying their children's attention spans were not so long probably around 5-15 minutes.

Practically, Josie, Nick, and Kenney lost attention during the assessments and their caregivers had to keep them focussed by using special tokens.

The attention spans of the children with hearing loss therefore did not stand out as different to their peers at least in the opinions of their caregivers. The younger children had shorter attention spans in the research tasks, as would be expected.

4.6 Parent's Reactions to their Child's Hearing Loss

The number of parents who had normal hearing and had children with hearing loss were consistent with the percentages reported by Lederberg (2006) and by the National Institute on Deafness and Other Communication Disorders (2010). Only one parent had hearing loss and she had received a cochlear implant. Except for the caregivers who had experience with hearing loss (from their older children or some family members), for the rest of the caregivers hearing loss was new. So their reactions when they heard about their children's problem can provide useful information about the amount of support and information they need to help their children and themselves.

In the interview with caregivers, they were asked: "What did you do when you were told about hearing loss?" This question might be seen to be a practical, action question, and indeed was interpreted that way by many (e,g, see Table 18, Julia, Jack, Eris) but the majority of caregivers also reported how they felt, and the dominant emotions of the time (see Table 18, e.g., Sarah, Jack, Kiana, Hannah). Some of the caregivers showed grief, some had mixed grief-acceptance and some had a reaction of acceptance.

Jack's, Hannah's and Sara's caregivers used negative emotional words (e.g. 'sad' and 'disappointed'). These were similar to the feelings reported by parents who participated in Gilliver, Ching, and Sjahalam-King (2013) research. They all at the same time however talked about looking for supportive services, so saw themselves as active participants, indicating a degree of acceptance of their children's problem.

Some caregivers showed relief that their child's problem had finally been diagnosed, as it meant they could get the problem recognised and get help for their children, and were not so frustrated. Kiana's caregivers were in this category, and right after the diagnosis they put all their efforts into helping her to achieve better results. Kim's caregiver did not report relief, but her response did indicate she felt vindicated, and she made big changes in her life style after her opinion about her child's hearing was confirmed. They had been living in the countryside but to have better access to the supportive services they moved to the city and she had to tolerate significant changes until she was able to settle down properly. Myra's caregiver was unique in that she expected to have a baby girl with hearing loss, based on her family history. She was not surprised except when Myra initially passed the hearing screening.

Julia and Eris were both diagnosed very early, and it is probably that less frustration was felt by the caregivers as a result. Their reports were about going straight into action to get the best possible services. Cheryl and Nemo's caregivers previously had children with hearing loss, and they showed less emotional reaction in their reports than many of the others. It was perhaps less of a shock to them.

Paul's caregiver (see Table 19) showed she was not familiar with the problem and Nemo's caregiver was not aware of the available facilities. It seems for such families there is a need to provide information about the problem and how to manage it. Perhaps this lack of knowledge about hearing loss and its consequences was the reason that it took longer to persuade Paul's family to accept the situation and use the hearing aids.

Table 19: Parents' Reaction to Their Children's Hearing Loss

Caregiver of	*"What did you do when you were told about hearing loss?"*
Julia	"I started to learn sign language and looking for possible services such as speech therapy"
Nemo	"I didn't do anything, I was relieved because then it was not so much confirmed because we only knew he had a hearing loss, but we knew he's gonna get [she pointed to the hearing aids] the help that he needed for schooling and something like that. I have tried to find other resources to help him, but it's, it's actually quite hard"
Sara	"What did I do?! I felt sad for Sara, but just make sure that we will be well informed and Sara had all of the needs and requirements and the subsidies and everything for her, so we make sure that we got her special need advisor, and she's got her kindy help, special aid worker at kindy"
Eris	"Just saw whatever help we could get, so we saw AoDC and we saw a specialist just to make sure that it wasn't just physical thing that could be operated on and check that if it was for genetic thing or it was from # and then he referred us to hearing house, so we get auditory verbal therapy for her from hearing house"
Myra	" I was kind of expecting her if I had a girl, when I was pregnant I didn't know what I was having, but I knew that if she was a girl there was a great possibility that she could carry the gene and but when at five days old she had the new born screening, and they told me that she passed, I was thinking oh my God, I was actually quite shocked at the fact that she passed, but at three months old, they told me oh well there is a chance that she has hearing loss"
Jack	"There was nothing really we could do, we just had everything pretty much sorted but yeah it was quite sad
Kiana	"We went YAY! Because we were frustrated. We knew something was wrong. Everybody kept telling us there was nothing wrong. We knew there was something wrong, when they found and said yes, we were like "Yes" and then we were like "Oh we shouldn't be happy" but we were happy, because we knew what was wrong, so then we can help to try to fix or help her cope with the difficulties that she's gonna have"
Kim	"I just chased it up; I mean I did that right the time that the doctor was saying it was an infection, I knew that there had to be something wrong. For them not being able to speak and the first thing that come to mind was hearing. If you can't hear you're not learning, so I just kept pushing it and pushing it"
Paul	"Well I asked them whether it is permanent and whether it gets better, but apparently not, it is permanent and he forever needs hearing aids. And then also I tried to talk about what supports he can have at that stage and then I think [AoDC] came after that"
Cheryl	"What did I do?! Nothing really. Just do what they said to do"
Hannah	"It was really, well I was a little bit disappointed because I knew from [first child] what Hannah would have to go through to be able to keep up with everything but we just we knew also that the hearing aids would be great help and we also knew that have support through her advisor and from ministry of education and the kindy you know when she eventually went to kindy we knew that she will have support there because [first child] went to the same kindy. So it was not too bad."

This study was not a systematic examination of caregiver emotions, but it adds another dimension to thinking about the whole context around the child, and allows the caregiver voice to be heard a little more. The data suggests that being familiar with hearing loss might not decrease the amount of emotional reaction (depression, grief, or stress) that the caregivers experienced as a result of their children's problem, and that all caregivers regardless of their degree of experience with hearing loss should be supported.

4.7 Parents' Hopes

A number of studies have examined the influence of a child with hearing loss on their family (Doğan, 2010; Kurtzer-White & Luterman). It has been shown that diagnosis of hearing loss and the presence of a child with hearing loss places a lot of pressure on hearing parents and it will usually be a source of potential stress for them (Kurtzer-White & Luterman). It has also been found that parents who have a child with some limitation such as hearing loss, will be more at risk of experiencing psychiatric/psychological symptoms such as stress, anxiety or depression (Doğan, 2010), as discussed previously. It is possible that caregivers become more anxious about their children, or that their expectations become lowered because of the disability. So we asked the caregivers to tell us about their desires, hopes and wishes for their children, to see if there was any difference to the matched controls, or if they mentioned the child's hearing loss in their answers.

The most common response from both the caregivers of the children with hearing loss and those of the matched controls was that they wanted their children to be happy and to reach their goals. Most mentioned their own role as a supporter. When they wanted to talk about their children's futures they focussed on their children's strengths and not on their weaknesses, or they hoped their weaknesses would not affect their children's future with the support that they might get from society or from their other strength. Below are two examples of how they recounted their children's strengths and weaknesses.

Kenney's caregiver (control group): "he can find teachers who can understand him, he might struggle with school because it requires him to sit down for so long" [here she showed her concerns about Kenney's attention span and behaviours and the importance of having a teacher who understood him], "but I think he will have a solid life because he's outgoing, social and got good people skills [thus she concluded with a reference to the child's strengths]".

Hannah's caregiver (hearing impaired group): "She's quite determined so she's probably gonna go a long way, she's got quite a strong personality and I suspect she's gonna do what she wants to do, go and do it, keep everybody in line" [this caregiver only mentioned strengths and extrapolated a future based on them].

Table 20 shows the answers given by the caregivers of the children with hearing loss. None of them directly mentioned their roles in their children's life. They also did not directly talk about the hearing loss and its possible effects. However, some of them pointed these out indirectly and may have indicated anxieties at some level. For example Sara's caregiver said: "(that) she goes to school, a happy healthy normal child". This is a short-term goal, and normally it could be assumed a child would go to school so to mention it is to indicate it may not be taken for granted in this case. It may be too that to mention 'healthy' and 'normal' is to indicate there is some anxiety about these things. It will be seen in later chapters that Sara had a number of speech and language problems, and as mentioned before, it took some time for the AoDC to persuade her caregiver to put Sara's hearing aids on her consistently, but her caregiver did not include any of these problems in her answer.

Table 20: Caregivers' Hopes for Their Children's Future

Child	*First Year*	*Second Year*
Julia	"I want her to be confident", "happy", "confident of her abilities", "be proud of herself", "self-confident"	NA[1]
Nemo	"He will catch up with his age and reach to his normal peers"	NA
Sara	"She goes to school, happy healthy normal child"	NA
Eris	"A normal life, be able to try everything"	NA
Myra	"Get whatever she wants, (if?) she reaches her dreams and she'll be happy"	"to do whatever she wants, to be happy"
Jack	"He just be a normal person, the same opportunities that everyone has, to be happy"	"to be happy and to have a normal happy life"
Kiana	"She can be everything "	"anything she puts her heart to be, because now she got foundations, and now she can be anything, she can be a prime minister, she can be a police officer, she can be anything she puts her mind to, now she got the tools and she looks like a sponge"
Kim	"I think he's going to do well in his life"	"they get the best of their life"
Paul	"Treated the same everyone else, to be able to be understood, responded to"	"happy and healthy life"
Cheryl	"She will do very well, she is very determined, she really wants to finish what she starts, at the same time she is lazy ☺"	"earn lots of money, she is clever, strong willed and independent"
Hannah	"I just want her to have opportunities to be able to do whatever she chooses or she wants to do and to be able to follow whatever area or dreams she might have, I think she will do very well, because she is stubborn and persistent"	"I just want her have all opportunities and be able to chase whatever she wants to do"

[1]. Not Applicable

Nemo's caregiver showed she felt there were some gaps between her child and his peers and her wish was for him to close this gap. Nemo had only a mild hearing loss but in later chapters it will be seen that he had a number of speech and language problems and was in the same category as Sara, so the caregiver's modest hopes were founded on realistic concerns. Only Paul's caregiver mentioned anything that could be directly about hearing loss, in that she said "… to be able to be understood, responded to". However, some of them (e.g., Jack's and Hannah's caregivers) wanted their children to have opportunities like others, which the caregivers of the matched controls did not say. This may be because they assumed that their children would have opportunities in life as normal, whereas perhaps the caregivers of children with hearing loss had some doubts. Winton, Turnbull, and Blacher (1985) in their study of expectations for and satisfaction with public school kindergartens investigated the perspectives of caregivers of children with and without handicaps (equal numbers from each group, n = 50). They found that both expectations and satisfaction levels were different between the caregivers who had a child with a handicap, and those who did not. This trend seems to be reflected in this study.

4.8 Conclusion

The data presented in this chapter has shown that there was considerable heterogeneity in this group of children, and highlights that they cannot be treated as one. They had different severities of hearing loss which means there might be different speech and language profiles. Those children with a history of otitis media might show more problematic speech and language. There are hints that ethnicity might be an issue, which is consistent with the literature, and more may need to be done in NZ to follow up this issue. Cultural concerns including applications of Te Tiriti o Waitangi may need to inform research more visibly with this population.

Not all of our participants were from similar socioeconomic backgrounds and their caregivers did not have similar education levels. On one hand this showed that hearing loss does not belong to a specific family type, group, social class or ethnicity. On the other hand the heterogeneity rules out simple relationships between socioeconomic and educational factors and outcomes. This is not surprising, but it does not mean that such information should not be considered; merely that it needs to be seen as part of a complex whole.

The wide range of hearing support systems and usage histories was of considerable interest. This range may have a great deal to do with variations in outcome, and more study of these issues in NZ may help inform future intervention.

The lack of use of sign language in NZ was clear in this group of participants. The issue of deaf culture and access to signing is a much bigger issue than can be taken up here, and it could perhaps be seen as positive that two of these children learned and used NZSL even though they did not have severe or profound hearing loss and were not part of a deaf community.

Children with hearing loss had lower auditory behavioural performance in noisy conditions.

This may not be surprising, but it can indicate the weaknesses of hearing aids and possibly the need to upgrade them to enhance children's ability to hear in noisy environments.

A small set of issues that less commonly appear in discussions about children with hearing loss were of surprising interest in this study. They include children's temperament and attention span and caregiver emotions, stresses and hopes and goals for their children. They appear peripheral issues if the hearing loss itself is considered the central one. However a more social approach that considers the child in context, thus the whole family system and the long-term view, would consider these issues more significant. For example, support groups for caregivers might be more routinely provided as part of the holistic approach to intervention.

Caregivers' and children's quality of life, the factors influencing their expectations and their special needs, and the information and help they received, were not investigated. Perhaps further study on these subjects would be an effective way to allocate services and resources for children with hearing loss.

Finally, there are many factors which could have a relationship to the speech and language outcomes of these children. This is a small group, and such results can be suggestive only. Many of these factors were not examined in depth, but give rise to suggestions for future research, such as examining in more depth the issues of the attitudes, hopes and fears of families, and the temperament of children. Such detailed studies may be of great value in intervention.

The data in this chapter highlights the value of looking at the wider contexts of the child, rather than focussing on the disability alone. Too many research projects with these children, it could be argued, take too narrow a view of what matters and what might make a difference to long term outcomes. Wider social perspectives and concerns need to be more routinely reported and considered to gain a more real view of the people and to plan better and potentially more effective services.

Chapter 5: The Speech and Language Characteristics of the Children with Hearing Loss

5 Introduction

This study was motivated by a desire to understand in more depth the communication skills of children with hearing loss in NZ. The aim was to see if we could produce data which could enable services to plan better for the ongoing needs of these children, and enable outcomes for these children to improve. Because the study looked broadly at a description of these children, chapter 4 described a wide range of features and discussed their possible relevance to the children's progress in communication, looking at the child in context. Chapter 5 will focus more directly on the children's communication skills. It will see if an in-depth description of these skills enables us to uncover new points and make different suggestions for management of these children's development.

We had seen in chapter 4 that there was considerable variability within this small sample. As analysis of these communication skills progressed, and including the information in chapter 4, it began to seem that there may be three groupings within this variation. The first group was children who were clearly doing well or reasonably well. These children were Julia, Eris, Myra and Cheryl. For example, they all scored within the normal range on the CDI for both the General Development score and the Expressive language score (see Table 13). The next clear group was those who were struggling in one or more areas of their development. These children were Nemo, Sara, Kim, Kiana and Paul. All children in this group except Nemo scored below -2.0SD on the CDI for the General Development score and the Expressive language score (see Table 13). Nemo however appeared to have considerable difficulties in the parent interview, and this and other scores, to be discussed later, warranted his inclusion in this group. The remaining two children, Jack and Hannah, seemed to be more on the borderlines, and were not clearly in either group.

The rest of this chapter will describe the children's communication skills, reporting on the results of the range of tools that were outlined in Chapter 3. In each case, the results will be examined to see if the groupings that I have outlined above were robust through this range of assessments.

5.1 Language Comprehension

In chapter 2, an examination of the literature made it clear that language comprehension is a critical part of communication skills, and has an ongoing impact on learning and school success. The development of language comprehension is at risk of being compromised for individuals with hearing loss. Therefore a measure of it in this study is an obvious first step. There were two sources of data, the New Reynell Language scales and the Child Development Inventory.

5.1.1 The New Reynell Comprehension scale

It was noticeable on the language scales of the CDI that fewer children were rated as ‘n’ by their caregivers. This was particularly so for language comprehension, where only Myra, Cheryl and Hannah were rated ‘n’. However this is a parent rating measure, and a comparison with the New Reynell Developmental Language Scales (Edwards, 2011) which provides standardised normative scores would enable further refinement of the understanding of the children’s comprehension skills. It could be argued that these norm-referenced tests are not always applicable to NZ children, and in particular to those with a hearing loss, but it does provides a norm-referenced score, however imperfect, with which to compare caregiver judgements.

The standard score results on the comprehension scale of the New Reynell, can be seen in Table 21. The three groupings indicated in the introduction are borne out on these measures. There were 4 children who fell within the normal range of scores for their age, Julia, Eris, Myra and Cheryl. Julia and Eris were 3-4 years old and Myra and Cheryl were 4-5 years old. There were 5 children who fell below -1 SD below the mean, Nemo, Sara, Kim, Kiana and Paul. Nemo and Sara were 3-4 years old and Kim, Kiana, and Paul were 4-5 years old. Sarah, Kim and Paul were -1.5 SD below the mean, which is the common cut-off score for diagnosed language disorder. Nemo and Kiana were between -1.0 and -1.5 SD below the mean. Lastly, there were Jack and Hannah. Both were in the 4 - 5 year old age bracket. Jack was at the lower end of the normal range for comprehension on the Reynell, whereas Hannah was -1 SD below the mean. These initial scores might have placed Jack in Group 1 and Hannah in Group 2, but subsequent scores revealed a different pattern to others in both of the other two groups (see later in this chapter). The higher performing group was dubbed Group 1, the group containing those performing below the normal range as Group 2, and those on the border as Group 3. A Mann-Whitney-U test showed there was a significant difference between the mean scores of groups 1 and 2 (p=.014).

Table 21: Standard Scores on the New Reynell Developmental Comprehension Scale

Participant	*Standard Score (Mean = 100; SD= 15)*	*Grouping*
Julia	97	Group 1: Higher Performing Group
Eris	95	
Myra	104	
Cheryl	87	
Mean	95.75	
Nemo	78	Group 2: Lower Performing Group
Sara	69	
Kiana	79	
Kim	72	
Paul	69	
Mean	73.40	
Jack	85	Group 3: Group with Variable Performance
Hannah	80	
Mean	82.50	

The language comprehension of these children is therefore around what we would expect for their age for around 36% of the group (4/11) if we take just group 1 who were within 1 SD of the age mean. As far as standard scores are concerned however, the common cut off of -1.5 SD (SS 77.5) would indicate that eight children or 73% were within the normal range, which is a much less problematic result. Sarah, Kim and Paul however were of concern in the area of language comprehension.

5.1.2 Caregivers' Reports in the CDI

The CDI (as reported in Chapter 4) included a caregiver's judgement of the child's language comprehension. This judgement was converted into a language quotient via calculation tables available in the CDI manual (see Table 22). In group 1, Myra and Cheryl's caregivers' descriptions of their children's language comprehension resulted in a language quotient slightly above the mean for their age. On the other hand, Julia and Eris's caregivers reported their children's language skills 1.5 or 2 SD below the mean for their age, which indicated a developmental delay. These language quotients do not correspond with the New Reynell comprehension scale scores, which place all four of these children within the normal range for their age. It may be that Julia and Eris' caregivers had high expectations of their children's language, perhaps unrealistically so. Conversely however, all of the caregivers of the children in Group 2 rated them as outside of the normal range for comprehension, with Sara's caregivers rating her particularly low, which was also the case in the New Reynell score. Caregivers of Group 3 children however had no qualms about their children's comprehension, rating them more solidly in the normal range for age than the New Reynell did.

Table 22: Caregiver Judgement of Comprehension (CDI Quotient)

Group	*Participants*	*Quotient (mean for age 100, SD = 15)*
Group 1: Children with Higher Performance	Julia	62
	Eris	65
	Myra	104
	Cheryl	99
	Mean	82
Group 2: Children with Lower Performance	Nemo	73
	Sara	47
	Kiana	58
	Kim	57
	Paul	74
	Mean	62
Group 3: Children with Variable Performance	Jack	95
	Hannah	97
	Mean	96

These figures indicate that caregivers may not always be accurate in their estimate of their children's language comprehension skills, at least insofar as a comparison with standardised tests results is a judge. This study did not enable this discrepancy to be investigated further, but it might be a useful future research project.

5.2 Expressive Langauge

5.2.1 The New Reynell Expressive Scores

Children's expressive language skills were assessed with a standardised test, as well as by using spontaneous language sample analysis. The standardised test was the Expressive Language Scale of the New Reynell, and the results can be seen in Table 23. The children in group 1 were again in the normal range for their age. They achieved better scores in the expressive scale than in the comprehension scale, the reasons for which are not clear at this stage.

In contrast, the children in group 2 gained very similar standard scores on the expressive scale to those they had gained for comprehension. Paul and Sara were -2.0 SD below the mean and the other three participants were -1.0 SD below the mean.

The two children in the ‘variable’ group had less clear results. Jack’s standard scores were again on the border of -1.0 SD below the mean for age Hannah scored higher on the expressive scale than the comprehension scale, but in both cases was within the normal range. In both caregivers’ reports and standardised tests, Hannah’s score for expressive language was higher than her score for language comprehension and Jack’s score for comprehension was marginally higher than his score for expressive language.

Table 23: Standard Scores on the New Reynell Expressive Language Scale by Group

	Participants	*Expressive Language Standard Score (SD=15)*
Group 1: Children with Higher Performance	Julia	100
	Eris	93
	Myra	106
	Cheryl	98
	Mean	99.25
Group 2: Children with Lower Performance	Nemo	71
	Sara	69
	Kiana	75
	Kim	71
	Paul	69
	Mean	71.00
Group 3: Children with Variable Performance	Jack	83
	Hannah	90
	Mean	86.50

5.2.2 Caregivers’ Reports on Expressive Language Skills

The CDI (reported on in Chapter 3) included a caregiver’s judgement of the child’s language expression. This was converted into a language quotient via tables in the test manual, and can be seen in Table 24. These quotients are interesting in comparison to the other findings. Myra and Cheryl’s caregivers described their children’s expressive language as being above that expected of their age, as did the New Reynell. Eris's caregivers reported their child's language skills in a way that amounted to 2 SD below the age mean, which is consistent with the way Eris did not match the group for many of the LARSP measures, in spite of her New Reynell Expressive language score being within the normal range. Julia's expressive language, however, appeared to be underestimated by her caregivers. The language quotient for her came out at below -1 SD, or a significant delay, which does not match any of the other measures seen so far.

Table 24: Caregiver Judgement of Their Child's Expressive Language (CDI Quotient)

Group	*Participants*	*Quotient (mean for age 100, SD = 15)*
Group 1	Julia	75
	Eris	65
	Myra	104
	Cheryl	101
	Mean	86
Group 2	Nemo	82
	Sara	43
	Kiana	58
	Kim	38
	Paul	72
	Mean	59
Group 3	Jack	91
	Hannah	101
	Mean	95

However, there was a clear difference by group between these caregiver reports. Even with the lower figures from Eris and Julia's caregivers, the mean Expressive Language Quotient of 86 for Group 1 was considerably higher than that of Group 2, at 59. Nemo, Kim, Kiana, and Paul's caregivers reported their children's expressive language skills at 2 SD below the mean for their age, while Sarah's was 1.5 SD below. Kiana, despite performing better than expected in the language sample analysis measures, has a CDI report in agreement with the language standardised test result. The Group 3 caregivers put both children within the normal range for expressive language.

5.2.3 Mean Length of Utterances (MLU)

A simple measure of language development using syntax is the length of utterances that children produce. Children's MLU has been used to trace children's language development based on Brown's stages (Shipley & McAfee, 2009). The MLU for the children in this study was calculated from the language sample that was taken with the children in interactions with their caregivers, and the results can be seen in Table 25. The mean for Group 1 is at Brown's Stage III, whereas that for Group 2 is Stage I and Group III measures at Stage II, which generally supports the proposed groupings. However Eris in Group 1 and Kiana in Group 2 stand out as different to their peers. If the group means are calculated without these possible outliers, the means are 2.81 and 1.63 respectively. This does not change the Brown's stage allocation, but does increase the difference between the groups.

Eris' MLU is unexpectedly short given that her standard score results were within the normal range for her age. MLU can vary greatly depending on the nature of the interaction, and it will later be considered if this provides an explanation for Eris' MLU result. Kiana's MLU also does not appear consistent with the rest of the group, and her further results will also be examined to see if this is explained by other factors.

Table 25: Mean Length of Utterance

Group	*Participants*	*Total No. utterances*	*MLU*	*Brown's Stages*	*Normal Age (Months) Range for Brown's Stage*
Group 1	Julia	169	2.44	Stage II	27-30
	Eris	68	1.88	Stage I	12-26
	Myra	153	3.32	Stage IV	35-40
	Cheryl	138	2.69	Stage III	31-34
	Mean	132	2.58	Stage III	31-34
Group 2	Nemo	144	1.44	Stage I	12-26
	Sara	197	1.47	Stage I	12-26
	Kiana	185	2.98	Stage III	31-34
	Kim	160	1.84	Stage I	12-26
	Paul	200	1.79	Stage I	12-26
	Mean	177.20	1.9	Stage I	12-26
Group 3	Jack	251	2.69	Stage III	31-34
	Hannah	159	2.22	Stage II	27-30
	Mean	205	2.45	Stage II	27-30

5.2.4 Expressive Morpho-Syntax in a Language Sample

The second way that expressive morph-syntactic skills were considered was by analysis of the children's spontaneous language samples using the LARSP (Language Assessment, Remediation and Screening Procedure; (Crystal et al., 1989) (see Figure 2). Although LARSP is a descriptive, developmentally–referenced analysis tool, not a norm-referenced one, a comparison could be made of the same analyses of the matched controls' samples (see chapter 6).

The LARSP analysis deals with clause, phrase and word levels, and also with some aspects of the interactional nature of the sample which may influence syntax. The first part of the analysis, sections A-C, involves this interactional aspect (see Figure 2).

a) Sections A-C

Section A concerns utterances which cannot be analysed. Higher proportions of these utterances indicate greater language problems. Table 26 shows the proportions of the language samples which fell into these categories.

Even for Group 1, the proportion of unanalysable utterances is high. The proportion of unanalysable utterances in the matched controls as a group was around half that of the higher performing hearing impaired group. Table 26 also shows that there is no particular pattern within these utterances however, and it related to some extent to what the children were doing in their language samples, which will be discussed in more detail in Chapter 7.

The types of unanalysable utterances are very different to each other. Incomplete, Repetitions and Unintelligible utterances were the main types. Incomplete utterances occurred most commonly when their communication partners interrupted them, e.g. when they were not getting the answer they wanted, or when a child struggled to find a word, or when they started an utterance but, because they did not get enough attention from their partners, they left their utterances incomplete (see examples in Table 27). Again, the interaction patterns were clearly involved here, and will be discussed further, as indicated above. However the second of the reasons relates to the child's language skills. Word Finding Difficulty may reflect a smaller vocabulary than necessary, or may be a specific language difficulty independent of hearing loss. Either way, it also may hint at a particular difficulty with language for these children, even though they scored well on the norm- referenced test.

Table 26: The Percentage of Unanalysable Utterances in the Language Samples

Group	*Participants*	*Raw No.*	*Unintelligible*	*Symbolic noise*	*Deviant*	*Incomplete*	*Repetition*	*Abnormal*	*Total**
Group 1	Julia	44	2.83	0	3.77	7.08	3.77	3.3	20.75
	Eris	13	8.64	0	0	4.94	3.7	0	17.28
	Myra	21	0.57	0.57	0.57	8.62	1.72	0	12.07
	Cheryl	46	1.63	0	0	10.87	11.96	0.54	25
	Mean	31	3.42	0.14	1.09	7.88	5.29	0.96	18.77
Group 2	Nemo	52	2.55	2.04	0	0	20.92	1.02	26.53
	Sara	22	4.15	0	0.92	0.92	3.69	0.46	10.14
	Kiana	29	1.4	6.54	0.47	3.27	1.4	0.47	13.55
	Kim	21	4.42	1.66	0.55	0.55	3.31	0.55	11.6
	Paul	52	3.17	0	1.59	1.98	11.51	2.38	20.63
	Mean	35	3.14	2.05	0.71	1.34	8.17	0.98	16.49
Group 3	Jack	38	2.08	2.08	1.38	5.19	1.38	0.69	13.15
	Hannah	16	0.57	0	1.71	6.29	0.57	0	9.14
	Mean	27	1.33	1.04	1.55	5.74	0.98	0.35	11.15

*May include very small percentages of other types

Group 2, the lower performing group, had a percentage of total unanalysable utterances of about 16.5% which was a little lower than that of group 1. In this group Repetition, Unintelligible and Symbolic Noise were, in descending order, the main types of unanalysable utterances. Incomplete does not figure as much as it does with Group 1, and those types that do figure may relate more to poorer language levels, rather than interactant patterns. Again however, there is a lot of variation between individual children.

Table 27: Examples of Incomplete Utterances in Context

Speaker	*Utterance*
Interruption	
Example 1: From Myra's Sample	
Myra	"one,= …",
Caregiver	"=hang on! hey!" [child tried to do her Mum's turn, but was interrupted by her. So she could not count to three.]
Example 2: From Cheryl's Sample	
Caregiver	"do you know what this called, this game"?
Cheryl	"yes"
Caregiver	"what"?
Cheryl	"when you do ="
Caregiver	"=what's it called? what's the name of the game?"
Cheryl	"depend ="
Caregiver	"=hopscotch"
Word Finding Problems	
Example 1: From Myra's Sample	
Myra	"so I need push that little …" [button was the missing word]
Example 2: From Cheryl's Sample	
Cheryl	"not like …." "not with …." [Cheryl was struggling to find the name of the horses in a merry-go-round]
Lost Attention	
Example 1: From Myra's Sample	
Myra	"you have to" "you could .." (no attention from caregiver so the child did not complete what she wanted to say)
Example 2: From Cheryl's Sample	
Cheryl	"I have …" "I walked on the …" (no attention from caregiver so the child did not complete what she wanted to say)

'=' indicates 'latched' or immediately following utterances with no pause

Repetition was seen in all groups, but it was for different purposes. Some caregivers took the game as an educational session, for example Nemo's, Paul's, Cheryl's, Hannah's and Keyna's caregivers. They were trying to teach new words or concepts like counting or naming new objects, or correcting the child's pronunciation (see Excerpt A and Excerpt B). Keyna and Nemo had over 40 utterances which were repetitions.

Excerpt A: Talk between Keyna and Her Caregiver

Speaker	*Child's Utterance Number*	*Utterance*
Caregiver		One, two, three, four, five How many umbrellas? (Child showed her cards) Five umbrellas, say it baby! Five umbrellas
Keyna	40	Five umbrellas
Caregiver		Umbrellas
Keyna	41	Umbrellas
…		
Caregiver		Soft ball
Keyna	68	Soft ball
Caregiver		Soft ball
Keyna	69	Soft ball
Caregiver		Soft ball
Keyna	70	Soft ball

Excerpt B: Talk between Nemo and His Caregiver

Speaker	*Child's Utterance Number*	*Utterance*
Caregiver		One
Nemo	16	One, six
Caregiver		Two
Nemo	17	Two
Caregiver		Three
Nemo	18	Three, Five
Caregiver		Four
Nemo	19	Four
…		
Caregiver		Five
Nemo	21	Five

Group 3 had on average around 11% of their utterances unanalysable, but the small numbers means that the mean is relatively meaningless. No particular pattern distinguishes this group from the others on this category. The most important categories were Incomplete, Deviant and Unintelligible, and finally Repetition and Symbolic noises.

Sections B and C indicate the broad nature of the remainder of the child's language sample which could be analysed (see Table 28). For Group 1, some (20%)of these utterances were grammatically Full Major (i.e. complete sentences). Those for the matched controls as a group were around 30%, which is a 50% increase on the children with Hearing Loss. Again however, this may be telling us about the interaction patterns, which may influence what language the children get to produce, rather than about the children's syntactical capability. With the exception of 'Minor' utterances, the most common type was 'Elliptical', which is the normal grammatical form produced in an answer or response, as the remainder is in the question or preceding form (e.g. "where are you going?" answer "home" – which is elliptical for "I am going home"). A high number of elliptical utterances (more than the matched controls which was 35%) indicate that the interactant was probably asking a lot of questions. This might reflect the effects of the hearing loss on the interaction patterns and the caregiver's talk. A high number of minor utterances also commonly indicates a lot of questions, as minors include "yes" and "no" and similar responses. Only the full major and some of the minors are clear indicators of child-led talk.

Reduced major included those utterances where some of the elements have been left out because of the children's language immaturity. The proportions of this were low only in the group 3 children - 3.05- (even less than that of the matched controls which was 3.4%) this is a small proportion of the analysable utterances. This is a good sign, as it indicates this group of children were not producing a large number of ungrammatical utterances. The other two groups (1 and 2) however had about 5% and 8% respectively of this type in their language samples which means they had more ungrammatical utterances when compared to the matched controls and the group 3 children.

Table 28: The Percentage of Analysable Utterances by Type

Group	*Participants*	*Raw No.*	*Total of Elliptical Major (1, 2, 3+)*	*Reduced*	*Full Major*	*Minor*
Group 1	Julia	169	47.02	4.76	20.24	27.98
	Eris	68	44.12	5.88	14.71	35.29
	Myra	153	21.57	3.27	34.64	40.52
	Cheryl	138	70.29	5.80	13.77	10.14
	Mean	132	45.75	4.93	20.84	28.48
Group 2	Nemo	144	16.67	9.03	6.94	67.36
	Sara	197	21.54	8.21	8.72	61.54
	Kiana	185	14.59	9.19	38.92	37.3
	Kim	160	18.13	7.5	18.75	55.63
	Paul	200	39.50	6.00	9	45.5
	Mean	177.20	22.08	7.98	16.47	53.46
Group 3	Jack	251	17.53	3.59	27.49	51.39
	Hannah	159	16.98	2.52	20.13	60.38
	Mean	205	17.25	3.05	23.81	55.89

Group 2 had a mean of 16.5% Full Major utterances and 54% Minor, compared to 21% and 28% respectively for Group 1. This meant there were relatively fewer utterances that could be analysed in the higher stages of syntax development (because so many were Minor, Elliptical or Reduced). The percentage of reduced major in this group was twice that of the matched controls, although the numbers were small for both.

More than 55% of Group 3's analysable utterances were 'Minor', but they had a mean of 23% Full Major and all types of Elliptical Major utterances were less than 20%. Although they had a lot of Minor utterances in their language samples, the percentages of the other two types were still high and they could be analysed in higher stages of syntax development. The percentage of Reduced Major in this group was less than the matched controls although again small for both groups.

A comparison of sections B and C can show the proportion of a child's utterances that were responses to the interactant, versus those that were initiated by the child ('spontaneous' on the LARSP chart).

Table 29 shows that all of the children except for one (Sara) had more spontaneous (initiated) utterances than responses. Jack can also be considered as an exception because he had the lowest percentage of responsiveness. The proportion of responses/initiation for matched controls was 35/65.

Children in group 3 had similar proportions, while the other two groups had more responses. The meaning of these figures will become clearer when the socio-conversational analysis results are presented later in this chapter.

Table 29: The Proportion of Child's Utterances which Were Responses vs Initiations

Group	*Participants*	*Proportion Responses/Initiations*
Group 1 Children with Higher Performance	Julia	42/58
	Eris	48/52
	Myra	32/68
	Cheryl	40/60
	Mean	40/60
Group 2 Children with Lower Performance	Nemo	50/50
	Sara	56/44
	Kiana	30/70
	Kim	43/57
	Paul	49/51
	Mean	45/55
Group 3 Children with Variable Performance	Jack	26/74
	Hannah	42/58
	Mean	35/65

The LARSP profile includes a small amount of information about the interactants' utterance types, specifically the number of questions they asked versus other stimuli (such as comments) (see Table 30). An average of about 100 different stimuli (e.g. questions, instructions and commands) was offered to each of the children in Group 1 during the 15 minute samples, indicating a fairly verbal environment (however as the purpose was to gather a language sample, this may not reflect typical activities at home for the families). Myra produced more full majors, and had more non-question stimuli than other children in group 1. On the other hand, Julia had an overwhelming number of questions from her interactant, and yet still produced the highest proportion of 'full major' utterances. This might reflect the nature of those questions addressed to her (i.e. ones that required a full answer, compared to a simple yes/no or one or two word answer) or perhaps it was a result of her own language level which consistently produced more than the minimal response. This will be discussed further below.

The Group 2 interactants delivered on average more stimuli than those in Group 1 (about 25% more). Nemo and Sara received a lot of 'Other' stimuli, but Kiana, Kim and Paul received similar numbers of both types of stimuli. This may reflect the difficulty of getting them to talk, or the interactants doing more work to get the child engaged.

Group 3 were again in-between the other two groups. Jack received more questions which would increase the probability of Minor and Elliptical utterances; whereas for Hannah it was mainly 'other' stimuli the result of which can be a more varied language profile.

In Table 30, based on the mean for each group, Group 1 had a balance between questions and other stimuli received from their caregivers. In Group 2, other stimuli were predominant in their interaction and group 3 received more questions. The figures for the matched controls were 55% questions and 45% other stimuli, which means group 1 had a similar interactional environment to them.

Table 30: Proportion of Interactants' Stimuli that were Questions vs 'Other'

Group	*Participants*	*Number of Interactant Questions*	*Number of Interactant Other Stimuli*	*Total*
Group 1	Julia	99 (83%)	21 (17%)	120
	Eris	30 (40%)	45 (60%)	75
	Myra	31 (38%)	50 (62%)	81
	Cheryl	61 (50%)	61 (50%)	122
	Mean	55 (56%)	44 (44%)	99
Group 2	Nemo	32 (19%)	136 (81%)	168
	Sara	51(36%)	92(64%)	143
	Kiana	50 (48%)	54 (52%)	104
	Kim	32 (42%)	44 (58%)	76
	Paul	85 (51%)	83 (49%)	168
	Mean	50 (38%)	82 (62%)	132
Group 3	Jack	75 (68%)	35 (32%)	110
	Hannah	46 (47.5%)	51 (52.5%)	97
	Mean	60 (58%)	44 (42%)	104

b) Morpho-Syntactical Patterns

Stage I

The main part of the LARSP analysis deals with the clause, phrase and word structures the children produced. Stage I concerns only those utterances with one element; Minors, specifically a Response (yes, uhuh), a Vocative (Mum!, hey!…), or other (thank you, counting etc.); and one-word utterances (categorised as Majors in stage I) which can be called a noun, or a verb-like unit, and some other categorises. These Major utterances can also be categorised by function, i.e. a ‘command’, a ‘question’, or a ‘statement’ (e.g. ‘up’ could be a command (meaning pick me up) a question (did that go up?) or a statement (that went up). All speakers use some one-word utterances in their repertoire (e.g. we all say “no”, “hello”, or “blue” in answer to “what colour did you want?”). The numbers and distribution by types can be seen in Table 31. The table shows that Groups 2 and 3 relied more on one-word utterances than Group 1. In all three groups the percentage of Minor utterances was greater than the percentage of Majors. Group 1 used Minor utterances 1.5 times more than Majors while in group 2 it was about 5 times more and for group 3 it was about 11 times more. The results of the matched controls were similar to those of Group 1, they used Minor utterances (33.63%) about 1.8 times more than Major ones (17.75%) in stage I. The total percentage of utterances in stage I for the matched controls was about 51% which is again close to that of Group 1 (46%).

Eris (from Group 1) had about 59% of her analysable utterances in stage I, which left relatively fewer available for the higher stages. There were not Stage VI or VII structures which could be explained somewhat by her age. The other explanation for such a pattern could be her role in the conversation. She was a follower and her caregiver chose to make a cake which may not have been an activity that would stimulate a 3 year old child to talk.

Table 31: The Number and Percentage of Utterance Types in Stage I

Group	Participants	*Minor*				*Major*						*Total in Stage I*
		Response	*Vocative*	*Other***	*Total of Minor*	*Com-mand*	*Ques-tion*	*Statement*			*Total of Major*	
								Verb	*Noun*	*Other*		
Group 1	Julia	27 (16%*)	2 (1%)	18 (11%)	47 (28%)	0	0	0	17 (10%)	11 (7%)	28 (17%)	75 (44%)
	Eris	12 (18%)	3 (4%)	9 (13%)	24 (35%)	2 (3%)	0	0	3 (4%)	11(16%)	16 (24%)	40 (59%)
	Myra	21 (14%)	2 (1%)	39 (26%)	62 (41%)	1 (0.7%)	0	0	2 (1%)	4 (3%)	7 (5%)	69 (45%)
	Cheryl	8 (6%)	1 (0.7%)	5 (4%)	14 (10%)	2 (2%)	0	1 (0.72%)	32 (23%)	2 (2%)	37 (27%)	51 (37%)
	Mean	17 (13%)	2 (2%)	17.75 (13%)	36.75 (28%)	1.25 (1%)	0	0.25 (0.18%)	13.50 (10%)	7 (7%)	22 (18%)	58.75 (46%)
Group 2	Nemo	26 (18%)	3 (2%)	68 (47%)	97 (67%)	3 (2%)	1 (0.7%)	1 (0.69%)	1 (1%)	4 (3%)	10 (7%)	107 (74%)
	Sara	52 (26%)	7 (4%)	61(31%)	120 (61%)	3 (2%)	2 (1%)	1 (0.51%)	6 (3%)	14 (7%)	26 (13%)	146 (74%)
	Kiana	31 (17%)	7 (4%)	31 (17%)	69 (37%)	3 (2%)	1 (0.5%)	0	0	1(0.5%)	5 (3%)	74 (40%)
	Kim	44 (28%)	0	45 (28%)	89 (56%)	0	6 (4%)	0	2 (1%)	8 (5%)	16 (10%)	105 (66%)
	Paul	51 (26%)	19 (10%)	21 (11%)	91 (46%)	0	0	0	19 (10%)	19(10%)	38 (19%)	129 (65%)
	Mean	40.8 (23%)	7.2 (4%)	45.2 (27%)	93.2 (53%)	1.8 (1%)	2 (1%)	0.4 (0.2%)	5.6 (3%)	9.2 (5%)	19 (10%)	112 (64%)
Group 3	Jack	41 (16%)	76(30%***)	12 (5%)	129(51.39%)	0	0	1 (0.4%)	1 (0.4%)	11 (4%)	13 (5%)	142 (57%)
	Hannah	48 (30%)	14 (9%)	34 (21%)	96 (60%)	0	2 (1%)	0	1 (0.6%)	5 (3%)	8 (5%)	104 (65%)

	Mean	44.5(23%)	45 (20%)	23 (13%)	112.5 (56%)	0	1 (1%)	0.5 (0.2%)	1 (0.5%)	8 (4%)	10.5 (5%)	123 (61%)

* % of Analysable Utterances

** Some children had a significant score in this column because there of counting and interjections such as ‘ah’ ,or ‘oh’.

*** This child and his caregiver were playing in parallel, and when they wanted to get each other’s attention, they called each other, often a number of times.

Julia and Myra had 45% of their analysable utterances in Stage I. Many of these were Minor Responses and one-word Statements used mainly to answer their caregivers' questions. This could be a good example of the cooperation between themselves and their caregivers during the conversation, a kind of mutual exchange. They had a good distribution over other stages as well, around 55%, along with different types of structures. Myra had six utterances at stage V, with different clause structures. Both Julia and Myra even had some examples in stages VI and VII, as 'Initiator' and 'comment clause' (such as "I think").

Cheryl had the smallest percentage of utterances in stage I. Statements that related to the game she and her caregiver were playing (e.g. guessing what pictures might be in the next page of a book) made up 37% of her sample. She therefore used a more limited variety of clause structures beyond stage I.

Group 2's samples included a greater proportion of Minor or Elliptical utterances. This was a result of their interactants' questions and other stimuli. For the two 3-4 year old participants (Nemo and Sara), 74% of their analysable utterances were in stage I which left only 26% of their utterances at stages II-V. Kim and Paul had about 65% of their utterances at the one word stage, and the only child with less than 50% (approximately 40%) of her utterances in stage I was Kiana. The main categorization for their one word utterances were Minors, Responses and Other, rather than one word Major utterances.

Over 60% of the Group 3 children's utterances were in stage I. The vast majority of these were Minors, which included a higher number of Vocatives than the other groups, especially for Jack. It may be that this group had to make more attempts to gain their partner's attention.

Stages II-V

There is a great deal of detail in LARSP profiles. The profile for each group can be seen in Appendix M, Appendix N, and Appendix O. The results seen in Table 32 and Table 33 are the numbers of phrases, clauses, connectors and combinations that were produced at each stage by each participant. The numbers do not mean anything by themselves, but the pattern of distribution shows whether there were elements at each stage and whether there are signs of development as seen in the expansion lines and the use of clausal connectors. (Expansion lines will be explained later in this chapter).

As expected, most of the utterances were 'statements'. The only child with more than a few questions in stages II-V was Julia, who asked 11 questions. Most of children in this study used 'eh?' with a rising tone at the ends of statements to indicate a question (e.g. "you didn't saw it, 'eh?'" from Hannah's sample or "this not the same, 'eh?'" from Paul' sample). This tag is common in NZ English, and functions as a tag, but LARSP is a syntactical analysis and 'eh?' is syntactically not a tag questions as it does not have the structure of 'Verb-before-Subject". Questions, vocatives and commands are syntactical structures associated with assertive communication which could therefore show a child's willingness to initiate.

Table 32 shows that all groups made most use of Stage III clauses (all had around half of their clauses at this stage). The common SVO, SVO, SVC clauses fall into this group. However Group 1 had fewer Stage II clause structures (mean 7%[19]) relative to Stage IV and V clauses (mean 8%) when complex clauses appeared. Group 2 in contrast had Stage II more highly represented (mean 9%), than Stage IV and V together (mean 5%). Group 3 had the fewest percentage of clause structures in stage II (mean 5%) and the highest percentage of clause structures in stages IV and V (mean 12%). The matched controls had similar patterns to Groups 1 and 3 but with higher means (stage II: 8%, stage III: 18% and stages IV and V: 15%).

Stage V structures consist of coordinated clauses (e.g. the boy went home and had an icecream) and subordinate and postmodifying clauses (e.g. the boy went home because he wanted an icecream; the boy who wanted an icecream went home). These structures considerably expand the potential for expressing complexity of meaning. Included in this stage is the use of clausal connectors. The most common of these is 'and', which forms the majority of the connectors in these samples, but others such as 'but', 'because' and the 'wh' connectors such as 'who' are represented too. It is probable that all task-oriented and contextualised talk (as these language samples were) will contain a majority of clauses below stage V, although there is little normative data using the LARSP format to compare it to.

Within the groups however, there was a great deal of variability in the use of these clausal stages in their samples. Julia had more Stage IV than the rest of her group. Kiana stands out in Group 2 as her syntax profile for clauses was more similar to Group 1 than Group 2, in spite of her standard scores on the New Reynell. This could be an example of how relying on only formal speech and language assessments could be misleading for some children. The percentage of clause structures (out of analysable utterances in stages I-V) did not reach 100% because some of the analysable utterances

[19] This is a percent of total analysable utterances in stage I-V

were classified at the phrase level only.

Table 32: The Number and Percentage of Clauses & Connectors Used at Each of the LARSP Stages II-V

Group	*Participant*	*Stage II*	*Stage III*	*Stage IV*	*Stage V*	*Total*	*Connectors*
Group 1	Julia	16 (10%)	27 (16%)	18 (11%)	0	61 (36%)	16
	Eris	4 (6%)	11 (16%)	1 (2%)	1 (2%)	17 (25%)	4
	Myra	7 (5%)	53 (35%)	9 (6%)	6 (4%)	75 (49%)	26
	Cheryl	11 (8%)	20 (15%)	3 (2%)	7 (5%)	41 (30%)	13
	Mean[1]	9.5 (7%)	28 (20%)	8 (5%)	4 (3%)	49 (35%)	15
Group 2	Nemo	18 (13%)	10 (7%)	4 (3%)	0	32 (22%)	0
	Sara	20 (10%)	15 (8%)	4 (2%)	0	39 (20%)	0
	Kiana	13 (7%)	58 (31%)	15 (8%)	7 (4%)	93 (50%)	14
	Kim	9 (6%)	23 (14%)	8 (5%)	1 (1%)	41 (26%)	2
	Paul	14 (7%)	13 (6.5%)	7 (3.5%)	2 (1%)	36 (18%)	8
	Mean	15 (9%)	24 (13%)	8 (4%)	2 (1%)	48 (27%)	5
Group 3	Jack	14 (6%)	52 (21%)	28 (11%)	2 (1%)	96 (38%)	17
	Hannah	7 (4%)	23 (15%)	18 (11%)	2 (1%)	50 (31%)	19
	Mean	10.5 (5%)	37.5 (18%)	23 (11%)	2 (1%)	73 (35%)	18

[1]. Rounded to nearest 0.5

The number and proportions of phrase structures used by the children can be seen in Table 33. As already mentioned actual numbers are not themselves highly significant to LARSP, and even proportions can be misleading. Stage III phrase numbers are often inflated due to the inclusion of pronouns, which can be used in very high numbers (again common in task-oriented and contextualised talk). The number of auxiliary verbs used can also be high. The pronoun, as counted in LARSP, was the most common phrase structure for all the children. Although pronouns and auxiliary verbs make the sample skewed, it is also the case that they are important elements in language. They are one of the most important tools for cohesion, they prevent repetition and they are a prime representation of deixis. However, a high use of demonstrative pronouns (such as 'that', 'this' …) and the 3rd person personal pronoun 'it' can be indicative of word finding problems.

Auxiliary verbs also have many additional roles to play in language, such as tense, aspect, voice, modality, and emphasis. They are widely recognised as markers both to language development and of language disorders when children struggle with them (Owens, 2012).

Group 1 had a good distribution of phrase structures from stage II to stage IV which means they used an acceptable percentage of phrases in each of the stages when compared to the other two groups (see Table 33). Kiana again stands out as being more like Group 1 than Group 2 in LARSP. The distribution of phrases over different stages of group 1 was also similar to the matched controls. whose distribution for phrase structures was: stage II: 38 (25%), stage III: 113 (68%), stage IV: 13 (7%) and stage V: 0.4 (0.2%). This compares to the Group 1 means of: stage II: 41(29%), stage III: 91(66%), stage IV: 7 (5%), and stage V: 1 (1%). The Group 2 means were slightly more biased to the earlier stages and lacking in the upper ones, but these figures were not greatly different: stage II: 33(31%) stage III: 69(64%), stage IV: 4 (4%), and stage V: 0 (0%).

Table 33: The Number and %[1] of Phrases and Expansions Used at Each of the LARSP Stages II-V

Group	*Participant*	*Stage II*	*Stage III*	*Stage IV*	*Stage V*	*Total phrases*	*Expan-sions II-III*	*Expan-sions III-IV*
Group 1	Julia	55(33.5%)	101(61.5%)	8(5%)	0	164	9	17
	Eris	12(23.5%)	37(72.5%)	2(4%)	0	51	3	6
	Myra	33(18%)	142(79%)	7(3%)	0	182	3	9
	Cheryl	64(39%)	83(51%)	13(8%)	3 (2%)	163	10	15
	Mean[1]	41(29%)	91(66%)	7 (5%)	1 (1%)	140	6	12
Group 2	Nemo	6(24%)	17(68%)	2(8%)	0	25	3	2
	Sara	20(33%)	40(66%)	1(1.5%)	0	61	4	4
	Kiana	63(25.5%)	172(70%)	11(4.5%)	0	246	9	57
	Kim	26(26%)	72(73%)	1(1%)	0	99	2	12
	Paul	50(48.5%)	46(45)	7(7%)	0	103	13	11
	Mean	33(31%)	69(64%)	4 (4%)	0	107	6	17
Group 3	Jack	63(25%)	169(68%)	18 (7%)	0	250	6	65
	Hannah	14(10%)	117(87%)	3 (2%)	1(1%)	134	4	14
	Mean	39(18%)	143(77%)	10.5(5%)	0.5(0.4%)	192	5	39.5

[1] Rounded to nearest 0.5

The 'expansion lines' in LARSP indicate when phrase structures expand clause elements (such as Subjects (S), Objects (O) and Verbs (V)) in 2-element (e.g. SV) and 3-element clauses (e.g. SVO) to beyond only a headword. An example from Nemo's language sample is "it broken", which is an SV structure, but without phrase expansions. In contrast, an example from Julia's language sample is "that one is moving", which is also an SV structure, but with expansions for both the S and the V clause elements. Julia's utterance would score 2 expansions on the LARSP chart between stages II and III (see Figure 2). Expansions show integration of clause development and phrase development, and can expand the length of utterances considerably. Use of them varies according to the purpose and context of the talking as well as the language development of the speakers. Task-oriented and contextualised talk does not greatly promote the use of expansions as here-and-now and concrete referents tend to predominate, for this reason use of pronouns and simple verbs is common. If talk becomes decontextualized (such as when telling a story about something not present), expansion is more likely, as the speaker needs to specify more detail about what they are talking about or what was happening; e.g. "the blue box" rather than "that" or "was running: instead of "goes". There was a low representation of expansions in these samples generally, but the exceptions were Kiana and Jack. The reason for this might be the nature of the games that these children had chosen to play with their partners. Kiana chose to play with a Parking Tower that included many different cars and Jack chose to make cars, bikes and motors with his Legos. Both games needed complex structures in comparison with baking a cake or counting items, as some of the other samples were about.

There is a range of actual structures within each stage of the clause, phrase and word parts of LARSP. Each of these structures are capable of expressing different meanings for speakers, such as 'SVO' expressing who does what to whom/what (as in Jack's language sample: "we can make pattern of light" or "he need a suitcase") and 'SVC' expressing something about the subject (as in Myra's language sample: "that's my birthday cake" or "I'm purple"). The researcher wanted to see what clause and phrase structures the children used within each stage. There are no criteria in the literature for achievement of specific structures in a child's system, but following general practice in developmental language studies a conservative criterion was used, whereby a structure was considered 'achieved' in a child's expressive syntax if there were at least three examples of that particular structure in their sample. So Myra would need "that's my birthday cake", "I'm purple" and "that is my Teddy" for her to meet the criterion of having 'achieved' the SVC structure. This is conservative, as it biased against the chances of a child being considered to have 'achieved' a low frequency structure such as a postmodifying clause since they would appear less frequently in all samples. However in the absence of existing criteria for each structure, this enabled some sense of the children's syntactical repertoire. Table 34 shows which clause structures met the criteria for each child.

Table 34: Clause Structures Achieved at Each Stage

Group	*Participant*	*Stage II*	*Stage III*	*Stage IV*	*Stage V*
Group 1	Julia	SV, AX, VO	SVC, SVO, SVA	VXY+, QVS, VS(X+), SVOA	
	Eris		SVC, SVO		
	Myra	VX	SVC, SVO, SVA	SVOA	
	Cheryl	SV	SVC, SVO		
Group 2	Nemo	SV, SC, NegX, QX	VXY	QVS	
	Sara	SV, AX, NegX	SVO		
	Kiana	VX, SV	SVC, SVO, SVA	+S, QVS	Subord. A 1
	Kim	AX	SVO, SVA	SVOA	
	Paul	SC, AX	SVC, SVO, QXY	+S, QVS	
Group 3	Jack	SV	SVC, SVO, SVA	+S, SVOA	
	Hannah		SVC, SVO	VS(X+), SVOA	

There is much commonality in the particular structures the children used. However, there was a bias in the samples, in that the more talk the children produced, the greater the chance they would use a variety of structures and reach the criterion of 3 for that type. Kiana and Jack, with the highest number of clauses produced overall, also show a good distribution of different types of clause structures across stages II-IV. Possibly this suggests that the criteria would provide a fairer comparison if a sample of the same number of clauses per child was taken, which might be a suggestion for other studies. Few Stage V structures reached criterion, which is perhaps also an artefact of these structures being fewer in all samples, and it may be worth considering lower criteria for this stage. Kiana had the largest number of Stage V clause structures, as well as being the only one to reach criterion. There was no real difference between the groups in the distribution of clause structures.

The phrase structures achieved by each of the children at each stage can be seen in Table 35. Stage 3 phrases structures predominated particularly because, as indicated previously, of the large number of pronouns produced. Copula and auxiliary verbs (both ‘modal’ and ‘other’ auxiliary, e.g. “gonna go” and “is walking”) were also present. The latter, however, seemed to be represented differently in the groups, in that both structures met criterion for all the children in Groups 1 and 3 except Eris and only for Kiana in Group 2. These exceptions are the same ones seen in most of the LARSP results. It seems that the verb phrase may be an area of weakness for the Group 2 children. Stage IV phrase structures (which are generally not frequent in the conversation) met criterion for all of the Group 1 children (except, again, Eris) but for none of the Group 2 children (except again, Kiana). This advanced level of phrase structure appeared to also possibly differentiate by group. Noun Phrases and their relative, the Prepositional Phrase, however, did not differentiate between the groups, as ‘PrDN’ (e.g. from Jack’s language sample “on his head” or from Kiana’s sample “on my pull truck”) and/or ‘DAdjN’ (e.g. from Myra’s language sample “my favourite colour” or from Kim’s language sample “a big table”) reached the criterion for 2 out of the 4 Group 1 children, 3 of the 5 Group 2 children and both the Group 3 children, and therefore showed no particular pattern.

Table 35: Phrase Structures Achieved at Each Stage

Group	*Participant*	*Stage II*	*Stage III*	*Stage IV*	*Stage V*
Group 1	Julia	DN, PrN	Pronp, Prono, Cop, Auxm, Auxo	cX+, XcX	
	Eris	DN, AdjN	Pronp, Prono, Cop, Auxm		
	Myra	DN, Vpart	PrDN, Pronp, Prono, Cop Auxm, Auxo	NegV	
	Cheryl	DN	DadjN, Pronp, Prono, Cop Auxm, Auxo	NPPrNP, NegV, XcX	
Group 2	Nemo	AdjN	Pronp, Prono, Cop		
	Sara	DN, IntX	Pronp, Prono		
	Kiana	DN, AdjN, Vpart	PrDN, Pronp, Prono, Cop Auxm, Auxo	NegV	
	Kim	DN	DadjN, Pronp, Prono, Cop		
	Paul	DN, AdjN	PrDN, Pronp, Prono, Cop Auxo		
Group 3	Jack	DN, PrN, Vpart	PrDN, Pronp, Prono, Cop Auxm, Auxo	NegV ,NPPrNP	
	Hannah	Vpart, IntX	Pronp, Prono, Cop, Auxm, Auxo		

LARSP has a ‘word’ section which is about the commoner morphological endings, mostly syntactical morphemes such as ‘–ing’ and past tense endings, abbreviated auxiliary verbs, and plural endings. It includes the later developing lexical morphemes of comparatives and superlatives (-er and -est in whatever form). The results in the ‘word’ section for these language samples can be seen in Table 36. The Group 1 mean number of these morphemes was higher than that of Group 2 (36 vs 20), but again

Group 3 had the highest mean (45). This continues the trend of Group 3 showing more syntactical structures in a language sample than the standardised test results would have anticipated, and in this case it is Jack scores which stand out particularly, and as the group is so small, variability is not absorbed. The Group 1 mean being higher than Group 2 again supports the legitimacy of those groupings. Eris in Group 1 and Kiana in Group 2 continue to stand out as different from their respective members on these measures, but the slightly larger group size absorbs these variations. Again however, the longer the sample, the more chances of a morpheme being exhibited which may bias the picture. Most of these items are unstressed elements at the end of words and many involve high frequency sounds (such as plurals and 3s forms) which might be expected to disadvantage children with hearing loss. The matched controls' mean for these structures was 50, and they had figures in almost all columns. In descending order, '3s', 'pl', 'ed' and ''cop' morphemes were the most common structures that the matched controls used. For children with hearing loss in all groups, this order began with '3s' but then it was followed by 'cop', and 'ed' or 'ing'. The 'pl' was among the least used structures in their language samples.

Table 36: Numbers of Morphological Endings

Participants		*'ing'*	*'pl'*	*'ed'*	*'en'*	*'3s'*	*'gen'*	*'n't'*	*'cop*	*'aux'*	*'est'*	*'er'*	*'ly'*	*Total*
Group 1	Julia	9	0	6	1	12	0	0	6	3	0	2	0	39
	Eris	0	0	1	1	0	0	0	3	0	0	1	0	6
	Myra	2	4	21	2	18	0	3	17	9	0	0	1	77
	Cheryl	0	0	5	0	9	0	2	6	0	0	0	0	22
	Mean	3	1	8	1	10	0	1.3	8	3	0	1	0.3	36
Group 2	Nemo	1	0	0	3	4	0	0	3	0	0	0	0	11
	Sara	5	0	1	1	1	0	1	0	0	0	0	0	9
	Kiana	4	3	0	3	17	0	5	9	2	0	0	0	43
	Kim	1	0	7	0	2	0	1	3	0	0	0	0	14
	Paul	0	0	5	3	7	0	1	3	3	0	0	0	22
	Mean	2	1	3	2	6	0	2	4	1	0	0	0	20
Group 3	Jack	14	4	8	2	11	0	9	9	6	0	3	0	66
	Hannah	1	0	4	0	4	0	3	4	6	0	0	2	24
	Mean	7.5	2	6	1	7.5	0	6	6.5	6	0	1.5	1	45

Stage VI: Error Analysis:

LARSP emphasises the syntactical repertoire of the child, in developmental progression, and does not have an emphasis on syntactical errors. It recommends not focusing on forms different to the adult form until the child's development is well down the LARSP chart, as developmental forms are not 'mistakes', but representative of the syntactical rules being worked out in the child's linguistic system (Crystal et al., 1989). However, if a child's syntactical repertoire is well down into stages IV and V, or there is reason to consider the possibility of something interfering with normal language (such as aphasia or hearing loss), there is value in examining those forms different from the adult form. Stage VI in LARSP allows the child's forms to be examined as errors, based on the columns of 'connector', 'clause', 'phrase' and 'word'. An utterance could have one error, or several. The numbers and frequencies of these errors in the samples from children with hearing loss can be seen in Table 37. Examples can be seen in Table 38.

Table 37: The Number and % of Errors of Each Type

Group	*Participant*	*Clause*	*Phrase*	*Word*	*Total no. utterances with errors*
Group 1	Julia	8(5%)	12 (7%)	4 (2%)	22 (13%)
	Eris	6 (9%)	7 (10%)	3 (4%)	14 (21%)
	Myra	6 (4%)	9 (6%)	0	10(7%)
	Cheryl	15 (11%)	6(4%)	4(3%)	17(12%)
	Mean	9(7%)	9%(7%)	3(2%)	16(13%)
Group 2	Nemo	13(9%)	12(8%)	0	19(13%)
	Sara	20(10%)	35(18%)	4(2%)	32(16%)
	Kiana	18(10%)	49(27%)	2(1%)	52(28%)
	Kim	8(5%)	13(8%)	1(1%)	15 (9%)
	Paul	13(7%)	18(9%)	5(3%)	23(12%)
	Mean	14(8%)	25(14%)	2(1%)	28(16%)
Group 3	Jack	24(10%)	50(20%)	15(6%)	58(23%)
	Hannah	6(4%)	7(4%)	4(3%)	11(7%)
	Mean	15 (7%)	29(12%)	10(4%)	35(15%)

% of the analysable utterances that had such an error

Table 37 shows that all three groups of children with hearing loss had about 13-16% of their analysable utterances containing syntactical errors. However, there are some individual exceptions and they are Eris, Kiana, and Jack with over 20% of analysable utterances with errors. The mean of analysable utterances with errors for matched controls was 10 (6%), which was obviously two or three times less than the means for children with hearing loss in different performance groups. Their means for clause, phrase and word errors were in sequence: 6 (4%), 5 (3%) and 1 (1%). It is worth mentioning that children who were in matched controls rarely had utterances that included more than one type of error, while children with hearing loss (especially in Groups 2 and 3) often had utterances with more than one error. These results suggest that the standard scores and the main part of the LARSP profile may not be enough to make any judgment about children's expressive syntax, and errors may be a point of weakness.

Eris had the lowest total number of clauses in Group 1 and therefore the higher proportions in higher stages, which seems to indicate advanced syntax compared to some others. But, at the same time, she had the highest percentage of clauses with errors, which may indicate more language difficulties than her standard scores suggested. Group 2 children were more likely to have two or three errors in an utterance than Group 1 children. Kiana, in spite of otherwise looking more like belonging to Group 1 than Group 2 in these measures, had the highest number of errors. The most common type of errors for Jack was subject-verb agreement for the third singular-present. He kept using 'he' with a wrong auxiliary 'do' or a main verb without an 's' and displayed imperfect use of 'to be going to'. These developmental patterns would be expected for a younger child. Given these features, it is possible that an examination of the relationship between stages of syntax used and the errors found might be a useful one for understanding more about the language development of children with hearing loss.

Table 38: Examples of Syntactical Errors

Speaker	*Utterance*	*Gloss*	*Error Type*
Julia	"let do again" "Daddy take them away"	'let's do it again.' 'Daddy took them away.'	Cl*: Objects deleted. Wd**: Irregular past tense
Eris	"two egg"	'two eggs'	Wd: Plural marker
Cheryl	"it's a clock bed drawer"	'it's a clock, a bed and a drawer.'	Connector deleted. Phr***: Determiners deleted.
Nemo	"this not truck"	'this is not a truck'	Cl: Copula deleted. Phr: Determiner deleted.
Sara	"my do it"	'I did it.'	Phr: PronP Wd: Irregular past tense
Kiana	"we can't go to [the] the up one."	'we can't go to the top floor'	Phr: Noun Phrase (possibly lexical)
Kim	"I want all there"	'I want all of them over there'	Phr: Preposition deleted Phr: Initiator and part of noun phrase deleted.
Paul	"and [and] the water like that" "blue horse fly in the movie"	'and the water comes out of it like that.' 'the blue horse flies (only) in the movies'	Cl: Verb deleted; Adverb deleted Phr: Determiner deleted Wd: 3s marker deleted, plural marker deleted
Jack	"You making a new one?"	'are you making a new one?'	Phr: Auxiliary verb deleted

* Clause; ** Word; *** Phrase

These error patterns do seem to reveal some things about the children's expressive syntax that may be useful for planning. For example, despite many studies focusing on morphological ending structures and their susceptibility to being damaged because of hearing loss (as discussed in Chapter 2), these examples showed that the main language structures (basic parts of clause and phrase structures) can also be vulnerable.

5.2.5 Interactional Communication Patterns

Language samples can be analysed to see how a child participates in a communicative interaction. There are many possible analyses here, but one of them, socio-conversational analysis (Fey, 1986), is based on speech act theory, and a small contribution from topic analysis. As indicated in chapter 3, analyses are made of proportions of Assertive speech acts, Responsive speech acts and how many topic initiations and extensions (assertive indicators) and topic maintainers (responsive markers) each interactant contributes. Socially equal participants in a conversation share assertive acts (e.g.

questions and comments) fairly equally, but where social roles are unequal (as in children with adults) the balance changes to be more like 25-40% (for the child) to a corresponding 75-60% (for the adult). Normal responsiveness calls for each interactant to respond to all of the acts of the other which require a response (e.g. a request for information (RQIN) such as what's the time? and a request for clarification (RQCL), such as what did you mean?). This means normal responsiveness approaches 100% (over 85% is usually accepted as a minimum). Other requestive acts, namely request for action ('RQAC' such as pass me the shoe) and request for attention ('RQAT' such as 'Sally!") may not require a verbal response, but may require a nonverbal one.

Young children (around the age of 2 years) are often low in communicative responsiveness (they tend to 'do their own thing' in the perception of adults) but high in assertiveness (they are becoming verbal and often have a lot they want to say). Other children may be reluctant to communicate at all, so may be low in both communicative assertiveness and responsiveness. Development in communication requires establishing a balance between these two criteria.

Table 39 shows the measures of assertiveness and responsiveness calculated from the sample analyses for each of the children. These figures show that there was no difference in measures of assertiveness and responsiveness between the groups, indicating that the speech and language problems found in Group 2 did not present a barrier for them to communicate with their caregivers. In relation to LARSP, Nemo, Sara and Paul who received a large number of stimuli in their samples, had lower assertiveness rates than Kim and Kiana. High numbers of stimuli may be because the interactants had to do more of the work to involve child in the conversation.

Table 39: Conversational Participation Measures on Socio-Conversational Analysis

Group	Participant	*Speech Acts*			*Topic*		
		Assertiveness %[1] (normal c30-45%)	*Responsive-ness % (verbal) (normal c90%)*	*Responsiveness (nonv.+ v.) (normal c90%)*	*Initiate*	*Maintain*	*Extend*
Group 1	Julia	39	66	83	39(19%)	144(69%)	26(12%)
	Eris	26	37	93	19(23%)	48(58%)	16(19%)
	Myra	44	43	81	21(12%)	69(39%)	85(49%)
	Cheryl	37	51	79	23(13%)	93(51%)	65(36%)
	Mean[1]	37	49	84	26(17%)	89(54%)	48(29%)
Group 2	Nemo	33	47	75	38(20%)	134(72%)	14(8%)
	Sara	32	66	93	36(18%)	144(70%)	26(13%)
	Kiana	49	51	75	25(12%)	97(46%)	90(43%)
	Kim	53	65	86	20(12%)	92(54%0	58(34%)
	Paul	30	58	80	21(9%)	165(68%)	57(24%)
	Mean[1]	40	57	82	28(14%)	126(62%)	49(24%)
Group 3	Jack	58	53	70	32(11%)	142(50%)	108(38%)
	Hannah	37	55	93	45(26%)	95(56%)	31(18%)
	Mean[1]	47	54	81	39(19%)	119(53%)	70(28%)

[1] Rounded to nearest 0.5%

Quite a number of the children were more assertive in interaction than expected, but this may be because they were interacting with someone they knew very well (their caregiver) and also because the caregivers knew the purpose was to gather a sample of the child's language, so may have encouraged or allowed them to be more assertive than usual. However, the other possibility is that coupled with a lower than expected Responsiveness measure for some, it presents a picture more typical of younger children (see the example of the typical 2 year old mentioned earlier), who are more likely to be following their own agenda than paying attention to their interactant. These scores have placed quite a number of this group in the 'Verbal non-Communicator' quadrant (see Figure 10) although Julia, Myra and Paul are marginal in the sense that they are not particularly low in responsiveness. Only Eris could be considered low in Assertiveness. In Group 3, Jack was noticeably lower in responsiveness than most of the children, and contrasted with Hannah, who was highly responsive. For both of them, however, around 40% of their responses were nonverbal.

ASSERTIVENESS	**EXPECTED**	**Active Conversationalist** + ASSERTIVENESS +RESPONSIVENESS ***Eris, Kim, Sara, and Hannah***	**Verbal Non-communicator** +ASSERTIVENESS -RESPONSIVENESS ***Julia, Myra, Cheryl, Nemo, Kiana, Paul, and Jack***
	LOW	**Passive Conversationalist** -ASSERTIVENESS +RESPONSIVENESS	**Inactive Communicator** -ASSERTIVENESS -RESPONSIVENESS
		EXPECTED	**LOW**
		RESPONSIVENESS	

Figure 10: Categories of Communicative Interaction for the Children

Most children had a predominance of ‘maintain’ moves in relation to topic flow, although those in Group 2 was noticeably higher than those in Group 1. Myra was an exception, in that she had a large number of Topic Extensions, which may indicate she was an engaged communicator who could sustain a longer conversation around a topic. Julia received a lot of questions from her caregiver and, perhaps as a consequence, she had a high proportion of Maintaining of Topic moves. Kiana and Kim who had higher rates for assertiveness also had more Extend Topic moves.

The matched controls had similar rates for assertiveness (42%), verbal responsiveness (45%) and total responsiveness (81%) as these three groups. The point that needs to be addressed is the percentage of nonverbal responses used by matched controls. They used more nonverbal responses than the children with hearing loss. This finding in particular suggests that children with hearing loss acted like typical hearing children. They employed nonverbal acts to answer their communication partners and this could be counted as a natural behaviour not a consequence of hearing loss.

In the case of discourse levels, however, there was a noticeable difference between children with hearing loss and their matched controls. In the samples from the matched controls, 15 (10%) of their utterances were Initiating Topics, 82 (50%) were maintaining topics and 67 (40%) were extending topics. The samples of the matched controls displayed balanced cooperation in their conversations, and were able to extend and sustain them. The samples from the children with hearing loss in all three groups had a predominance of Topic Maintenance in their interactions (see Table 39). They had more Topic Initiation than the matched controls but less Topic Extension, which may mean they are not as good at interacting with their partner's topics as the controls.

5.3 Speech Production

The development of speech is significant for young children. The degree to which they can be understood is important in regard to how much communication they can engage in successfully, and therefore to how well they learn. This is not just true for learning speech and language itself, but applies to all the other things children are engaged in learning, as so many of them are verbally mediated. Speech development was seen in chapter 2 to be particularly at risk in children with hearing loss, as their perception of speech is compromised. A higher incidence of developmental speech delay and speech disorders has been reported in this population (Ambrose et al., 2014; Gold, 1980). This study used a detailed speech assessment tool, the Diagnostic Evaluation of Articulation and Phonology (DEAP). It enables the child's phonological system to be evaluated in terms of what speech sounds are available to the child and how they are used, what developmental phonological processes are operating in their system, what disorder issues may be detected by examining consistency or inconsistency in speech, and how intelligible their speech is.

5.3.1 Phonemic Inventory

The Phonemic Inventory in the DEAP primarily deals with the consonants of English, distributed across syllable initial and syllable final positions in the speech string. The comparative neglect of vowels is because this is a clinical tool, and vowels are much more rarely problematic in children's speech than are consonants. Consonants in English do not distribute equally by syllable position, and syllable final inventories are commonly smaller and may consist of different phonemes in the developing phonological system. For example approximants do not appear in syllable final position in NZ English (the /l/ being glided as a normal allophone, and /j/, /r/ and /w/ are not found there at all). Table 40 and Table 41 show the syllable initial (SI) and syllable final (SF) inventories for the consonants in the children's speech on this assessment, which is a one-word picture naming task.

Table 40: Consonantal Phonemic Inventories for Syllable Initial Position

Group	*Participants*	*Nasals*	*Plosives*	*Fricatives*	*Affricates*	*Approximants*
Group 1	Julia	All[1]	All[2]	/f/, /v/, /s/, /z/, /ʃ/, /h/[5.]	All[3]	/w/, /j/, /l/
	Eris	All[1]	All[2]	/ʃ/, /h/	All[3]	/w/, /l/
	Myra	All[1]	All[2]	/f/, /v/, /s/, /z/, /ʃ/, /h/ [5.]	All[3]	/w/, /l/
	Cheryl	All[1]	All[2]	/f/, /v/, /ʃ/, /h/	All[3]	/w/, /j/, /l/
Group 2	Nemo	All[1]	All[2]	/f/, /ʃ/, /h/	/ʧ/	/w/, /l/
	Sara	All[1]	/p/, /b/, /d/, /k/	/z/, /h/	/ʧ/	/w/, /l/
	Kiana	All[1]	All[2]	/f/, /v/, /ð/, /h/	All[3]	/w/, /j/, /l/
	Kim	All[1]	/b/, /t/, /d/,/g/	/h/	/ʤ/	/w/, /l/
	Paul	All[1]	All[2]	/f/, /v/, /z/,/h/	-	All[4].
Group 3	Jack	All[1]	All[2]	/f/, /h/	All[3]	All[4].
	Hannah	All[1]	All[2]	/f/, /v/, /ð/,/ʃ/, /h/	/ʤ/	/w/, /j/, /l/

1. /m/, /n/; 2. /p/, /b/, /t/, /d/, /k/, /g/; 3. /ʧ/, /ʤ/; 4. /w/, /j/, /l/, /ɹ/, 5. missing only /θ/, /ð/, & /ʒ/

Group 1 children had more developed phonemic inventories in both initial and final syllable positions than those in Group 2. Julia and Myra had phonemic inventories which matched their chronological age (based on the criterion that 90% of children with typical hearing have that phoneme in their inventories, Dodd et al. (2002). Eris and Cheryl had smaller fricative inventories than the others. Eris had the greatest difference, particularly in the syllable final inventory, but she was also in the younger group (3½ years). Cheryl had high frequency hearing loss which may particularly have affected the fricatives, but then so did the other children in this group who did not have as few fricatives. Cheryl was known not to wear her hearing aids consistently, so this may be a factor in her case. Eris, again, stands out from the group as having poorer inventories.

The children in Group 2 had a lower number of phonemes in their inventories than those in Group 1. With the criterion of 90% as before, all of the children in Group 2 were delayed for some phonemes. Kiana and Paul were the most like Group 1, particularly in Syllable Initial Inventory. Gaps were more likely present in Syllable Final position and in Fricatives and Affricatives. Nemo, Sara and Kim had the lowest number of phonemes in their phonemic inventories. As with some of the language measures, a clear difference between Groups 1 and 2 is supported by this data.

Table 41: Consonantal Phonemic Inventories for Syllable Final Position

Group	*Participants*	*Nasals*	*Plosives*	*Fricatives*	*Affricates*	*Approximants*
Group 1	Julia	All[1]	All[2]	/f/, /v/, /s/, /z/, /ʃ/, /h/[5.]	All[3]	/w/, /j/, /l/
	Eris	All[1]	All[2]	/ʃ/, /h/	All[3]	/w/, /l/
	Myra	All[1]	All[2]	/f/, /v/, /s/, /z/, /ʃ/, /h/ [5.]	All[3]	/w/, /l/
	Cheryl	All[1]	All[2]	/f/, /v/, /ʃ/, /h/	All[3]	/w/, /j/, /l/
Group 2	Nemo	All[1]	All[2]	/f/, /ʃ/, /h/	/ʧ/	/w/, /l/
	Sara	All[1]	/p/, /b/, /d/, /k/	/z/, /h/	/ʧ/	/w/, /l/
	Kiana	All[1]	All[2]	/f/, /v/, /ð/, /h/	All[3]	/w/, /j/, /l/
	Kim	All[1]	/b/, /t/, /d/,/g/	/h/	/ʤ/	/w/, /l/
	Paul	All[1]	All[2]	/f/, /v/, /z/,/h/	-	All[4].
Group 3	Jack	All[1]	All[2]	/f/, /h/	All[3]	All[4].
	Hannah	All[1]	All[2]	/f/, /v/, /ð/,/ʃ/, /h/	/ʤ/	/w/, /j/, /l/

[1.] /m/, /n/; [2.] /p/, /b/, /t/, /d/, /k/, /g/; [3.] /ʧ/, /ʤ/; [4.] /w/, /j/, /l/, /ɹ/; [5.] missing only /θ/, /ð/, & /ʒ/

Group 3 phonemic inventories were more like those of Group 1, and much better than those of Group 2. The main restriction was in fricatives. Taking into account the criterion of 90% as above, these two children showed delay for some fricative sounds. They therefore fit in the 'variable' category as the initial grouping indicated.

5.3.2 Phonological Processes

Developmental phonological processes are those which are supported by a common appearance in child speech development, and also in the patterns of phonology across languages. For example, Cluster Reduction occurs commonly in speech development in English (e.g. a young child produces "pay" for "play"), and a number of the world's languages do not have consonant clusters (e.g., Te Reo Māori and other Polynesian languages). Other examples are Weak Syllable Deletion (e.g., 'efant' for 'elephant'), Fronting (e.g., 'tea' for 'key'), Final Consonant Deletion (e.g., 'cah' for 'cup'), Stopping of Fricatives (e.g., 'dun' for 'sun') and Assimilation (one consonant moving to the production of another nearby, e.g., 'ticket' becomes 'titet' while 'car' is normal). Other patterns can occur which are consistent in a particular child's phonology, and could therefore be called phonological rules or processes for them, but is these are not supported as normal developmental processes, they are often characteristic of greater speech sound difficulties (Bauman-Waengler, 2004). Examples of these are Initial Consonant Deletion (e.g., 'up' for 'cup'), and Backing (e.g. where a child said "key" for "tea").

Table 42 shows the Developmental Phonological Processes which, according to the DEAP criteria, were present for these children. These criteria are the occurrence of at least five instances of all except Weak Syllable Deletion, for which there needs to be only two instances (there are fewer opportunities for this process in the sample items). There are clear differences between the groups. Group 1 children's speech samples had on average two processes, of which Cluster Reduction was the most frequent (e.g. from Myra's assessment, /plaʃ/ for /splaʃ/). Eris again stands out from the group, with five active processes however, as she was younger than the other children, all of these were within the normal range for her age. Cheryl's speech had Stopping of Fricatives (such as /dɪdəd/ for /sɪzəz/), which was not appropriate for her age and is consistent with her low fricative repertoire seen in Table 40 and Table 41. All the group 2 children's speech samples had more than two processes each, with a mean of four. Cluster Reduction was again the most frequent (e.g. from Paul's sample: /lʌz/ for /glʌvz/), followed by Stopping of Fricatives (from Kim's sample: /tɪdə/ for /sɪzəz/ which had two phonological processes), and Final Consonant Deletion (e.g. from Sara's sample: /ti/ for /tiθ/, or deletion of /v/ and /f/ at the end of /faɪv/ and /naɪf/ from Nemo's and Sara's samples). Group 3 children were again somewhere in between, with a mean of 2.5, both of them had Cluster Reduction (e.g. from Hannah's sample: /neɪk/ for /sneɪk/) and Stopping of Fricatives (e.g. from Jack's sample: /dip/ for /ʃip/, or /tɪdəd/ for /sɪzəz/).

Table 42: Active Developmental Phonological Processes

	Participants	*Gliding*	*Deaffrication.*[1]	*Cluster Reduction*[2]	*Fronting.*[3]	*Weak Syll Deletion*[4]	*Stopping*[5]	*Voiceing.*[6]	*Assimilation.*[7]	*Final Cons. Deletion*	*Total*
Group 1	Julia			✓							1
	Eris			✓	✓	✓	✓			✓	5
	Myra	✓									1
	Cheryl			✓			✓				2
	Mean										2
Group 2	Nemo			✓	✓	✓				✓	4
	Sara	✓		✓		✓	✓			✓	5
	Kiana	✓		✓	✓		✓				4
	Kim			✓	✓		✓			✓	4
	Paul	✓		✓			✓				3
	Mean										4
Group 3	Jack			✓			✓				2
	Hannah	✓		✓			✓				3
	Mean										2.5

There are also some non-developmental processes analysed on the DEAP, and some of these were represented in these samples. One is 'Backing' (only used by Eris in Group 1 and Nemo, Sara, Kiana and Kim in Group 2). The incidence of this unusual phonological process was about three times higher than would be seen in the hearing population. There were also a number of other processes which were more frequent in Group 2 children (Sara, Nemo, Kiana, Kim and Paul). Processes such as assimilation, fronting, deaffrication and other types of atypical processes which did not meet the criterion of five examples but were present with at least more than two examples. For example from Nemo's samples some words like: /hapəl/ for /apəl/, /mabɪʔ/ for /rabɪt/; Sara: /bɛlə/ for /fɛðə/, /babɪʔ/ for /rabɪt/, Kiana: /ʃəmɑroʊ/ for /təmɑtoʊ/, Kim: /bɛbəb/ for /zɛbrə/ or /did/ for /ʃip/ and finally from Paul: /gwɒg/ for /frɒg/ or /dwam/ for /pram/. These examples tend to involve more than one phonological process as well as non-developmental processes, and they rendered the child's utterance very hard to understand. As these were one-word responses to pictures, it was possible to gloss them. If these words were in connected speech then it would be very difficult to understand the children's speech. There were times when even the caregivers could not understand what the children said. For example, in a 15 minutes interaction with Nemo there were 4 times when the examiner asked the caregiver what he had said, but the caregiver could not help.

The matched controls had a different picture. Sue, Erina, Myron, Keyna and Hanne did not have any active phonological processes, which was true of none of the children with hearing loss. The other matched controls such as Josie, Cherish and Pete had Gliding as their only active phonological process, Jasper had Gliding and Fronting, Kenny had Weak Syllable Deletion (only two examples in all of his sample) and Nick had Stopping, Backing (he replaced /f/ with /s/, e.g. /ʤərɑf/ was produced as /ʤərɑs/) and Other phonological processes. These results were all explicable in terms of their ages. The matched controls scored zero for other types of phonological processes (such as assimilation and deaffrication), whereas the children with hearing loss had at least one example of most of them.

5.3.3 Intelligibility

Intelligibility is a consequence of all the issues that may be present in speech, including the phonemic repertoire, the phonological processes and degree to which the child matches the adult targets. This latter point can be assessed using a measure of the percentage of consonants produced that were the adult target (PCC), which is supplemented by percent vowels correct (PVC) (which are not normally an issue in the typically hearing group), and then an overall measure present phonemes correct (PPC) combining the two. This is calculated in the DEAP using a portion of the child’s one-word utterance responses to pictures. Results for children with hearing loss can be seen in Table 43. All children scored within the normal range for ‘PVC’. Group 1 children were within the normal range for their age in PPC. But Group 2 scored significantly lower. Four of the five children had scores below -2 SD of the mean, with only Nemo scoring within the normal range. The Group 3 children were both below -1 SD of the mean for PCC and PPC. The matched controls scored 89% for PCC, 100% for PVV and 93% for PPC, which was very close to the group 1 scores.

Table 43: Intelligibility as Measured by Percentage of Phonemes Correct

Group	*Participants*	*Percent Consonants Correct (PCC)*	*Percent Vowels Correct (PVC)*	*Percent Phonemes Correct (PPC)*
Group 1	Julia	88	100	92
	Eris	73	99	83
	Myra	93	100	95
	Cheryl	88	97	92
	Mean	86	99	91
Group 2	Nemo	75	94	83
	Sara	53	100	73
	Kiana	72	96	81
	Kim	52	96	69
	Paul	66	99	79
	Mean	64	97	77
Group 3	Jack	78	96	85
	Hannah	81	100	88
	Mean	79	98	86

Putting all these results together (phonemic inventories, phonological processes, and speech measurements), Group 1 had more intelligible speech than the other two groups. Group 2 was below the normal range in most measures, with Group 3 variable or in between. Children with hearing loss in Group 1 got means close to the matched controls' mean. To reach a more solid conclusion about the children's intelligibility, the inconsistency measure should also be included.

5.3.4 Inconsistency

Children with typical development are very consistent in their production of one word on different occasions. Inconsistency in the production is an indicator of atypical speech development. Children with phonological delay and consistent phonological disorders have higher inconsistency rates than typical children. In this part of the DEAP, the criterion for being classed as 'inconsistent' in speech is 40% and above, in other words the higher the inconsistency measure, the greater the speech unintelligibility. Children with a high rate of inconsistency have multiple forms for the same word and can have some changes in the word's structures (such as changes in the number of syllables and their shape). Inconsistency rates for the participants can be seen in Table 44.

Groups 1 and 3 means were below the 40% criterion but Group 2 was still high in their inconsistency rate. Group 2 had a mean above 40%, an index of more phonological problems in their speech (which is consistent with their phonemic inventories and phonological processes). However Sarah and Kiana were below 40%, indicating their speech could not be classified as inconsistent. The matched controls had a mean of about 11%, an inconsistency rate was the normal range. Only Group 1 got a mean close to the matched controls and the other two groups were more inconsistent in their productions. However Group 3 mean and individuals were still below the 40% criterion and could not be classified as having inconsistent speech.

Table 44: The Inconsistency Rates

Group	*Participants*	*The Inconsistency Rate*
Group 1	Julia	18
	Eris	25
	Myra	8
	Cheryl	16
	Mean	17
Group 2	Nemo	43
	Sara	38
	Kiana	32
	Kim	68
	Paul	44
	Mean	45
Group 3	Jack	32
	Hannah	28
	Mean	30

5.4 Speech Perception

Group 1 children scored close to ceiling for all of the Early Speech Perception subtests (on average they had more than 22 correct responses out of 24), and their scores for NUCHIPS were in a range between 70 to 90% which was in the expected range for children with hearing loss (see Table 45).

Table 45: Speech Perception Scores in Different Tests

Group	*Participants*		*ESPT Subtests Results*			*NU-CHIPS*
			Pattern Perception	*Spondee Identification*	*Monosyllable Identification*	
Group 1	Julia		20	21	19	78
	Eris		23	21	23	70
	Myra		23	24	22	76
	Cheryl		24	23	24	88
		Mean	22.5	22.25	22	78
Group 2	Nemo		24	18	16	72
	Sara		22	16	9	70
	Kiana		24	19	17	90
	Kim		21	15	20	72
	Paul		22	15	15	74
		Mean	22.6	16.6	15.4	75.6
Group 3	Jack		24	24	21	94
	Hannah		24	20	24	88
		Mean	24	22	22.5	91

Group 2 children performed really well in speech perception tests if the discrimination was for general speech features. But when it came to discriminating based on more specific speech features their scores dropped. For example, in ESPT, the Pattern Perception subtest requires that children recognise words based on the number of their syllables but in the Monosyllable Identification subtest, they should recognise a specific word based on a vowel or a consonant. Thus, for the Pattern Perception subtest they got scores close to the ceiling (22 out of 24), but in the other two subtests (the Spondee Identification Subtest and Monosyllable Identification subtest) they had approximately 15-16 correct responses out of 24. In NUCHIPS, they scored below the range of children with typical hearing and were close to the mean of children with severe hearing loss.

According the criteria for each of these two tests (see Chapter 3, section 3.3.4), Sara was not eligible for the NUCHIPS. Sara's score was about 40% in the Monosyllable Identification subtest which was less than the required 75%. In addition to Sara, Paul was another exception. He got 15 out of 24, and while he was in category 4 (Consistent Word Identification), his score of less than 75% prevented him from going on to more complicated tests. Because Sara and Paul did not know many words in that subtest, the NUCHIPS was administered. In the NUCHIPS, these two participants did not indicate significant differences from the cohort.

Group 3 children scored better than the other two groups in speech perception tests. In Early Speech Perception subtests, they achieved full score in the Pattern Perception subtest and about 22 correct responses out of 24 for the Spondee Identification Subtest and the Monosyllable Identification subtest. In NUCHIPS, Jack got scores at the same level as children with normal hearing but Hannah's scores reflected the severity of her hearing loss. So with this high level of speech perception performance, it was not a surprising finding that Group 3 children had higher scores in hearing behaviour assessments (see Chapter 4, section 4.2) than the other two groups.

5.5 The Evidence for the Groupings

The results of the current study can now be summarised as in Table 46. The test scores for language and speech (from this chapter and the results of the auditory behaviour assessments from chapter 4 have been included. This summary indicates that the groups show different patterns of scores.

Table 46: Standard Score Criteria for Group Allocation (N = 11)

Assessment Tools	*Children with Higher Performance (n = 4)*	*Children with Lower Performance (n = 5)*	*Children with Variable Performance (n = 2)*
Reynell Comprehension Standard Score	85-115	< 85	Within the normal range for comprehension or expression but not both (85-115)
Reynell Expressive Standard Score	85-115	< 85	
Monosyllable Identification Subtest (ESP)	> 95%	< 80%	> 95%
NUCHIPS	70-90	70-90	85-95%
PCC from DEAP	Within ± 1 SD of Mean	Below -2 SD of Mean	Between -1- -2 SD of Mean
PEACH	75-80%	< 70%	>80%
ABEL	65-85%	< 65%	>80%

As well as these standard scores, the evidence in the language and speech sample analyses generally also supported these groupings. However, the speech and language analyses also showed some differences, particularly in Eris and Kiana's measures. The questions that arise are firstly, what factors might explain why these children were placed in these groups? And secondly, can we explain why two children had results that seem to be inconsistent with their grouping?

The numbers in these groups are small, and the groupings cannot therefore be seen as definitive. However, they do indicate the potential for considering how different intervention pathways might derive from the different group patterns. The full picture, however, also requires the consideration of other issues which have been covered in chapter 4 as well as those factors presented by Kumar et al. (2008).

Three of the 4 children in Group 1, Julia, Eris and Myra, were diagnosed and fitted with the proper hearing aids before one year of age, wore them consistently and received speech language therapy and specialist teacher of the deaf input in preschool (Cheryl was the exception, being diagnosed late, not getting specialised input early and not consistently wearing her hearing aids. However she also had the least degree of hearing loss of the participants, being mild in the lower frequencies and moderate at high frequencies). The first three children from Group 1were all from middle socio-economic groups (decile 4) whereas Cheryl was from decile 2. No pattern regarding ethnicity or type or cause of hearing loss can be seen, except that none of them were classified as severe or profound loss. They had no other significant disabilities and were reported to have general development within the normal range for their age. Cheryl had a big family (eight people at home), but the rest were from small families of 3-4 members. Julia, Eris and Myra's caregivers (both Mother and Father) had tertiary level education, and Cheryl's caregivers had high school qualifications. Parents' education level as some studies have shown could have positive influences on children's speech and language development. No factors stood out in regard to Eris that could explain why she had differences in her language and speech characteristics from the rest of the group.

All of the Group 2 children had hearing loss since birth as did Group 1, but none of them were diagnosed or received hearing aids under the age of 2, so they experienced a longer period without good auditory input and did not receive specialist help as early as those in Group 1. In addition, Group 2 children had a history of problems with their hearing aids ranging from losing them or damaging them to difficulties persuading the family to put them on their children. This group was more likely to be from a low socio-economic grouping, to be Māori or Pasifika, and with caregivers who had High School education or less (with the exception of Sara's caregivers). The family situations varied a great deal, and family stress seemed to be a factor for several of them. Four of the five children scored as developmentally delayed on the CDI, and the 5th was marginal. Kim had a non-accidental head injury which was an exceptional condition.

There was a range of related issues which were more likely to figure in Group 2 children than those in Group1. Kiana stood out from the children in Group 2 in that she received more specialist input and had caregivers who pursued options for her. However, she had behaviour problems which her caregivers felt did not let them have an effective relationship with her. She had the most severe hearing loss, and had recently received a unilateral cochlear implant, and was using her aids more consistently than the rest of the group. These factors may be related to her better performance in the language and speech samples analyses.

It is perhaps therefore no surprise to find that Group 3 children had a mixture of these factors. They were both Pakeha and both had moderate to severe hearing loss since birth but were not diagnosed and fitted with hearing aids until between 1 and 2 years old. They were not reported to have any developmental delay or disability. They both had specialist input fairly early, and had no problems with the aids or with wearing them consistently. They came from middle socio-economic deciles, small families, and parents who had High School or tertiary certificate level qualifications. This was a small group, and no firm conclusions can be drawn. However it may be that the later diagnosis of their hearing loss and the severity of the hearing loss are the most likely reasons why these children were not in Group 1.

The groupings for the children with hearing loss in terms of their progress in communication skills seemed to be fairly robust, within the limitations of the small numbers that we have. It is at least suggestive in relation to how a number of factors may combine in a complex relationship to result in particular patterns of development.

5.6 The Longitudinal Data

The previous results were cross-sectional, in that they looked at children in two age groups, at one point in time. The longitudinal data came from the older group of children (Myra, Cheryl, Kim, Kiana, Paul Jack and Hannah), who were between 4 and 5 years of age in their first assessment, being followed up and re-assessed a year later after they had been in school for at least a few months. In the initial assessments, Myra and Cheryl were found to be in Group 1, Kim, Kiana and Paul in Group 2, and Jack and Hannah in Group 3.

5.6.1 Language Comprehension

b) The New Reynell Comprehension scale and Caregiver Report Language Quotient

In the first year assessments, the Comprehension scale score of the New Reynell provided the basis for the 3 groupings of children, which were then supported by the Language Comprehension Quotient of the CDI (a caregiver report inventory converted score). In this second year, the groupings in these scores changed. The Group 3 children (Jack & Hannah) and Kiana (the Group 2 child who had performed significantly better in the language sample analyses than the rest of Group all now scored within the criteria for Group 1. Kim and Paul remained within the score criteria for Group 2 (Table 47).

Table 47: Language Comprehension Scores in the 2nd year

Group	*Participants*	*New Reynell Language Comprehension standard score (SS in 1st Yr))*	*CDI Language Comprehension Quotient*
Group 1: Children with Higher Performance	Myra	114	102
	Cheryl	94	100
	Jack	98	94
	Hannah	115	96
	Kiana	87	100
	Mean	102	98
Group 2: Children with Lower Performance	Kim	69	57
	Paul	77	64
	Mean	73	61

Any increase in a standard score from one year to the next indicates that a child may have made more than a year's progress in a chronological year. Although small shifts must be seen as within an error range and not significant, it is notable that all the Group 1 children made gains, and if 0.5 of a standard deviation might be considered a possible real increase, then all of the Group 1 children except Cheryl, and Paul from Group 2, may have made such progress. The change in SS for Hannah was especially dramatic, from 80 to 115. Kim's score was the most unchanged. The caregivers' reports for most of them remained the same, but Kiana got a better score from her caregiver and Paul got lower score from his caregiver, more in line with the norm-referenced test score.

5.6.2 Expressive Language

a) Standard Scores

The second year's assessment showed that the children had again made a year's progress in their expressive language scores (Table 48). Hannah had a slight drop in her Expressive Language standard score. This was probably because of a shift of focus in her intervention from expression to comprehension and also, based on her mother's report, might be because she was struggling at school. Cheryl had a remarkable positive change in her language expressive standard score which could be because of school or longer experience with preschool. The Group 2 children remained in the delayed range, and their expressive language standard scores were similar to their language comprehension scores.

Table 48: Expressive Language Scores

Group	*Participants*	*New Reynell Expressive Language standard score*	*CDI Expressive Language Quotient*	*MLU*	*Brown's stages*
Group 1	Myra	114	101	4.04	Stage V
	Cheryl	119	101	2.15	Stage II
	Jack	107	98	3.11	Stage IV
	Hannah	86	101	2.68	Stage III
	Kiana	90	98	3.12	Stage III
	Mean	103	100	3.02	Stag IV
Group 2	Kim	76	70	2.03	Stage II
	Paul	73	85	2.47	Stage II
	Mean	75	78	2.25	Stage II

The children's MLUs also improved after a year. Cheryl's MLU was only at stage II, but her language sample was constrained by the activity they chose to play, which was a maths game where the caregiver named a number and the child found it, a largely nonverbal or minimally verbal task for her. This factor significantly affected the language sample measures that were taken for Cheryl.

a) Expressive Morpho-Syntax Skills

Sections A-C

Jack, Kiana and Cheryl had a noticeable drop in the percentage of unanalysable utterances in their language samples while Hannah and Myra showed a marginal increase which could have happened because of the ‘Repetition’ (a kind of unanalysable utterances) (see Table 49). Myra and Hannah had a decrease in the percentage of ‘Incomplete’ utterances but an increase in Repetition. Those three participants with a decline in the percentage of unanalysable utterances showed the effect in different categories. Cheryl had a decrease in her Repetition and Incomplete utterances, Kiana in the percentage of Symbolic noise (perhaps the percentage of symbolic noise could show an effect of the chosen activity on the general profile), and Jack showed a decrease in the percentage of Unintelligible, Incomplete and Repetition utterances.

Group 2 had a lower percentage of unanalysable utterances. For Paul, Repetition and Incomplete utterances were the main source of the unanalysable utterances and for Kim, Unintelligible and Incomplete utterances had the higher percentages. In the analysable utterances, the percentage of Minor responses decreased noticeably and the percentage of Full Major and Elliptical Majors increased. These two changes together were a sign that there could be more complex structures for the upper stages of LARSP.

Table 49: Proportions of Analysable and Unanalysable Utterances

Group	*Participants*	*Unanalysable*	*Analysable*			
			Elliptical Major	*Reduced Major*	*Minor*	*Major*
Group 1	Myra	14	45	1	27	26
	Cheryl	11	61	1	26	12
	Jack	6	22	4	41	33
	Hannah	15	34	0	41	26
	Kiana	6	45	1	32	21
	Mean	10	41	1.4	33	24
Group 2	Kim	6	45	4	35	16
	Paul	16	35	9	34	22
	Mean	11	40	6.5	34	19

As seen in Table 49, all participants had more spontaneous utterances than responses. This could be because of fewer stimuli from their caregivers during the sample, or an increase in the children’s conversational assertiveness. Another important change especially for Group 1 and Kim in Group 2 was a noticeable drop in the percentage of Reduced Major utterances. This finding showed that the maturity of children’s utterances increased.

In the second year, children received more questions than other types of stimuli (see Table 50). For Jack and Kiana (from Group 1), the number of questions was high, and for Hannah and Cheryl the total number of other stimuli were high.

Paul had more spontaneous utterances in the second year assessment. The reason for this may be fewer stimuli from his caregiver (at least 50 fewer) or because he was more assertive this time than in the previous assessment. Kim's caregiver did not have any change in her number of stimuli.

Table 50: Types of Interactant Stimuli and Types of Child Utterances

Group	*Participants*	*Child Proportion Responses /Initiations*	*Child Proportion Resp/ Init the year before*	*Number of Interactant Questions*	*Number of Interactant Other Stimuli*	*Total Stimuli*
Group 1	Myra	28/72	32/68	32(51%)	31(49%)	63
	Cheryl	29/71	40/60	49(48%)	53(52%)	102
	Jack	35/65	26/74	95(75%)	31(25%)	126
	Hannah	42/58	42/58	42(49%)	43(51%)	85
	Kiana	45/55	30/70	78(63%)	46(37%)	124
	Mean	36/64	34/66	59(57%)	41(43%)	100
Group 2	Kim	36/64	43/57	44(56%)	34(44%)	78
	Paul	41/59	49/51	72(62)	45(38%)	117
	Mean	38/62	46/54	58(59%)	40(41%)	98

Morpho-Syntactical Patterns

Myra had fewer than 40% of her utterances in stage I, but Hannah, Cheryl, Kiana and Jack had over 50% of their analysable utterances in stage I. This is likely to be because their caregivers addressed a lot of questions to them which resulted in high numbers of minor and elliptical major utterances in response (see Table 51).

Group 2 children received fewer stimuli this time, so the number of their utterances in stage I was less as well (between 10-30 utterances, or 7% less than last year). About 57% of their utterances were analysed in stage I (see Table 51). For Paul, these utterances were mainly Responses and Statements and for Kim, they were Response and Other. Another important point in this part was an increase in the number of questions especially for Kim. It might indicate an increase in his willingness to be more assertive or to make requests for clarification or for information.

Table 51: The Number/Percentage of Utterances in Stage I

Group	*Participants*	*Minor*				*Major*						*Total in Stage I*
		Response	*Vocative*	*Other*[**]	*Total of Minor*	*Command*	*Question*	*Statement*			*Total of Major*	
								Verb	*Noun*	*Other*		
Group 1	Myra	10(6%[*])	1(1%)	31(20%)	42(27%)	1(1%)	5(3%)	0	9(10%)	4(3%)	19(12%)	61(39%)
	Cheryl	13(12%)	1(1%)	15(14%)	29(26%)	1(1%)	1(1%)	2(2%)	12(4%)	15(14%)	31(28%)	60(55%)
	Jack	64(27%)	9(4%)	22(9%)	95(41%)	3(1%)	2(1%)	1(0.5%)	2(1%)	8(3%)	16(7%)	111(48%)
	Hannah	22(19%)	1(1%)	21(19%)	44(39%)	3(3%)	1(1%)	8(7%)	2(23%)	6(5%)	20(18%)	64(57%)
	Kiana	27(14%)	0	36(18%)	63(32%)	0	3(2%)	1(0.5%)	24(10%)	10(5%)	37(19%)	100(51%)
	Mean	27(16%)	2(1%)	25(16%)	55(33%)	2(1%)	2(1%)	2(2%)	10(6%)	9(6%)	25(17%)	79(50%)
Group 2	Paul	22(14%)	2(1%)	30(20%)	54(35%)	2(1%)	20(13%)	1(1%)	10(0.4%)	1(1%)	34(22%)	88(58%)
	Kim	30(19%)	13(8%)	11(7%)	54(34%)	2(1%)	3(2%)	5(3%)	23(0.6%)	3(2%)	36(22%)	90(56%)
	Mean	26(17%)	8(5%)	21(13%)	54(34%)	2(1%)	12(7%)	3(2%)	17(10%)	2(1%)	35(22%)	89(57%)

[*] % of Analysable utterances

[**] There are large numbers in this column for some children. This is because counting and interjections such as 'Aah', 'oh', or 'yay' were included.

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Although in both groups around 50% of their utterances remained in stage I, 50% of the utterances could be analysed in other stages (see Table 52 and Table 53). More clauses and phrases can be seen in stage III and above, more extensions for stage III than stage II and a lot of connectors were present in the second year's results (see Table 54 and Table 55) (for more details for each group see Appendix P and Appendix Q). Taken together, these findings suggest progress in the complexity of the children's syntactic abilities. They also had traces in stages VI and VII that could indicate their awareness of more complicated language structures such as passive forms, initiators and comment clauses.

Table 52: The Number and % of Clauses & Connectors Used at Each of LARSP Stages II-V

Group	*Participant*	*Stage II*	*Stage III*	*Stage IV*	*Stage V*	*Total*	*Connectors*
Group 1	Myra	11(7%)[1]	21(13%)	16(10%)	18(11%)	66(42%)	35
	Cheryl	7(6%)	7(6%)	9(8%)	0	23(21%)	19
	Jack	11(5%)	53(23%)	23(10%)	13(6%)	100(43%)	18
	Hannah	5(4%)	13(12%)	14(12%)	5(4%)	37(33%)	15
	Kiana	21(11%)	24(12%)	18(9%)	10(5%)	73(37%)	40
	Mean[1]	11 (7%)	24(13%)	16(10%)	9(5%)	60(35%)	25.5
Group 2	Kim	14(9%)	13(9%)	9(6%)	2(1%)	38(25%)	4
	Paul	16(10%)	29(18%)	15(9%)	3(2%)	63(39%)	12
	Mean	15(10%)	21(13%)	12(8%)	3(2%)	51(32%)	8

[1]. Rounded to nearest 0.5

Table 53: The Number and % of Phrases and Expansions Used at Each of LARSP Stages II-V

Group	*Participant*	*Stage II*	*Stage III*	*Stage IV*	*Stage V*	*Total phrases*	*Expan-sions II-III*	*Expan-sions III-IV*
Group 1	Myra	58(25%)	146(62%)	30(13%)	1(0.4%)	235	7	18
	Cheryl	24(28%)	41(47%)	22(25%)	0	87	4	8
	Jack	69(26%)	170(65%)	23(9%)	1(0.4%)	263	6	54
	Hannah	25(20%)	87(68%)	16(13%)	0	128	3	13
	Kiana	62(27%)	129(56%)	41(18%)	0	232	11	33
	Mean[1]	48(25%)	115(59%)	26(15%)	0.4(0.1%)	189	6	25
Group 2	Kim	40(36%)	66(59%)	6(5%)	0	112	9	9
	Paul	35(23%)	108(72%)	8(5%)	0	151	2	25
	Mean	38(30%)	87(65%)	7(5%)	0	132	6	17

[1]. Rounded to nearest 0.5

Table 54: Clause Structures Achieved at Each Stage

Group	*Participant*	*Stage II*	*Stage III*	*Stage IV*	*Stage V*
Group 1	Myra			‘QVS’, ‘SVOA’, ‘VS(X+)	‘Coord. 1’,
	Cheryl	‘AX’	‘SVO’	‘QVS’	
	Jack	‘SV’,	‘SVC’, ‘SVO’,	‘+S’, ’SVOA’, ‘AAXY’	‘Coord. 1’,
	Hannah	‘SV’	’SVO’	‘QVS’, ‘VS(X+)’, ‘SVOA’	
	Kiana	‘VX’,	‘SVO’, ‘SVA’	‘+S’, ‘QVS’, ‘SVOA’	‘Coord. 1’
	Mean[1]	‘QX’,	‘SVO’, ‘SVC’	‘QVS’	
Group 2	Kim	‘QX’,	‘QXY’, ‘SVC’,	‘QVS’, ‘SVOA’	
	Paul			‘QVS’, ‘SVOA’, ‘VS(X+)	‘Coord. 1’,
	Mean	‘AX’	‘SVO’	‘QVS’	

Table 55: Phrase Structures Achieved at Each Stage

Group	Partici-pant	Stage II	Stage III	Stage IV	Stage V
Group 1	Myra	‘DN’, ‘AdjN’, ‘PrN’	‘PrDN’, ’DAdjN’, ‘Pronp’, ‘Prono’, ‘Cop’, ‘Auxm’, ‘Auxo’	‘NPPrNP’, ‘cX’, ‘XcX’, ‘NegV’	
	Cheryl	‘DN’	‘Pronp’, ‘Prono’, ‘Auxm’, ‘Auxo’	‘cX’, ‘XcX’	
	Jack	‘DN’, ‘IntX’, ‘Vpart’	‘DAdjN’, ‘Pronp’, ‘Prono’, ‘Cop’, ‘Auxm’, ‘Auxo’	‘NegV’, ‘NPPrNP’	
	Hannah	‘DN’	‘PrDN’, ‘Pronp’, ‘Prono’, ‘Cop’, ‘Auxm’, ‘Auxo’	‘cX’, ‘XcX’, ‘NegV’	
	Kiana	‘DN’	‘DadjN’, ‘PrDN’, ‘Pronp’, ‘Prono’, ‘Cop’, ‘Auxm’, ‘Auxo’	‘cX’, ‘XcX’, ‘NegV’	
Group 2	Kim	‘DN’	‘DAdjN’, ‘Pronp’, ‘Prono’, ‘Cop’, ‘Auxm’, ‘Auxo’	‘XcX’	
	Paul	‘DN’,	‘PrDN’, ‘Pronp’, ‘Prono’, ‘Cop’, ‘Auxm’, ‘Auxo’	‘NegV’	

Children’s word level morphemes can be seen in Table 56. One year later, language analysis showed that, especially for Paul, the total number of morphemes increased. The noun morphological endings were still low in number but the verb morphological endings were stronger.

Table 56: The Number of Different Morphological Endings One Year Later

Group	*Participants*	*‘ing’*	*‘pl’*	*‘ed’*	*‘3s’*	*‘gen’*	*‘n’t’*	*‘cop’*	*‘aux’*	*‘est’*	*‘er’*	*‘ly’*	*Total*
1	Myra	2	7	6	21	1	11	7	10	0	0	1	73
	Cheryl	2	2	0	6	0	2	0	1	0	0	0	13
	Jack	4	21	4	22	1	7	22	7	0	3	0	96
	Hannah	3	2	7	4	0	8	2	2	0	0	0	28
	Kiana	8	22	5	10	2	7	2	16	0	0	0	74
	Mean	4	11	4	13	1	7	7	7	0	0.6	0.2	57
2	Kim	1	1	3	7	0	2	2	1	0	0	0	18
	Paul	4	3	8	27	0	5	13	4	0	1	0	65
	Mean	3	2	6	17	0.5	4	8	3	0	0.5	0	41.5

Stage VI: Error Analysis:

While Kim’s percentage of utterances with errors was at the same level (about 9%), Paul showed an increase from 12% to 18% (see Table 57). This increase in the percentage of errors happened in the Clause and Phrase structures, which may be related to the fact that he was trying to produce more complex structures.

Table 57: The Number and % of Errors of Each Type

Group	*Participant*	*Clause*	*Phrase*	*Word*	*Total no. utterances with errors*
Group 1	Myra	2(1%)	13(8%)	1(0.6%)	16(10%)
	Cheryl	1(1%)	9(8%)	1(1%)	10(9%)
	Jack	25(11%)	17(7%)	7(3%)	37(16%)
	Hannah	0	3(3%)	2(2%)	5(4%)
	Kiana	4(2%)	6(3%)	2(1%)	9(5%)
	Mean	6(3%)	10(6%)	3(1.5%)	15(9%)
Group 2	Kim	7(5%)	9(6%)	2(1%)	15(10%)
	Paul	19(12%)	19(12%)	1(0.6%)	29(18%)
	Mean	13(8%)	14(9%)	1.5(1%)	22(14%)

Table 57 shows that Group 1 children had an overall decrease in the percentage of their errors in different levels. This change is obvious for Kiana who joined Group 1 a year later. This group also had fewer utterances with multiple errors types. Group 2 children had about a 5% decrease in their phrase level errors compared to the previous year but for clauses and words they still had the same rates of errors. Their utterances still had different error types or more than one error for each level at the same time (i.e. two or three errors from Phrase or Clause level or two or three errors only from Word level. Examples can be seen in Table 58).

Table 58: Examples of Morpho-Syntactical Errors

Speaker	*Utterance*	*Gloss*	*Error Type*
Myra	"haven't got a butterfly"	I haven't got a butterfly	Cl*: Subject omitted
Cheryl	"and Diego doing this"	And Diego is doing this	Phr**: AuxO omitted
Jack	"you know where is his legs?"	You know where his legs are?	Cl: Question inversion; Cl: Subject-verb agreement
Hannah	"we haven't have that one and that one"	We haven't had …	Wd***: Past participle (en) marker
Kiana	"here is drink"	Here is your drink	Phr: Determiner deleted
Kim	"these are Kirsty one"	These are Kirsty's ones	Wd: Plural and apostrophes deleted.
Paul	"but don't have look at other page"	But I don't have to look at other pages	Cl: Subject deleted. Phr: Infinitive marker deleted. Wd: Plural omitted

* Clause; ** Phrase; *** Word

Table 58 confirms the interpretation of Table 57. The number of errors in each utterance decreased, especially for Group 1. For both groups errors were restricted to mainly functional words. Some of these errors (such as errors at the word level) could possibly be related to the children's level of audibility or to their speech perception abilities.

5.6.3 Interactional Communication Patterns

In regard to better speech and language skills, it was worth looking at the conversational skills of the children to see if there had been any change in their socio-conversational skills over the period of the year. In the matter of being able to express their ideas, opinions and requests during conversation, all of the children showed symmetric and balanced rates with their communication partners (see Table 59). A rate of 40-50% would be an acceptable range for assertiveness for the second year since children were older and at the age of five. Cheryl had the lowest rate which was mainly the result of the chosen activity which did not need a lot of expressive language. Both Group 2 children, especially Paul, showed an increase in their assertiveness rates which confirmed the inference made from the number of spontaneous utterances in LARSP. Kim was highly assertive; however, this was again different from his caregiver's report.

Table 59: Conversational Participation Measures from Socio-Conversational Analysis

Group	*Participant*	*Speech Acts*			*Topic*		
		Assertivenes s %1 (normal c30- 45%)	*Responsive -ness % (verbal) (normal c90%)*	*Responsivenes s (nonv.+ v.) (normal c90%)*	*Initiate*	*Maintain*	*Extend*
Group 1	Myra	59[1]	64	92	6(3%)	89(49%)	87(48%)
	Cheryl	31	25	81	7(6%)	89(72%)	27(22%)
	Jack	50	55	73	20(8%)	113(47%)	110(45%)
	Hannah	48	57	84	14(8%)	97(57%)	58(34%)
	Kiana	44	61	84	18(9%)	98(47%)	92(44%)
	Mean	46.4	52.4	83	13(7%)	97(55%)	75(39%)
Group 2	Kim	55	50	79	28(17%)	78(49%)	55(34%)
	Paul	35	56	83	19(10%)	107(54%)	71(36%)
	Mean	45	53	81	24(14%)	93(51%)	63(35%)

[1] Rounded to nearest 0.5%

Except in the case of Myra, the responsiveness rates of the second year assessments decreased slightly to below the normal level. Over 50% of Group 1's responses were verbal and about 30% of their responses were nonverbal. It appears they still used both tools during conversations. Some gestures and body movements such as nodding and shaking head, shrugging shoulders, laughing when they agreed, and staring at their partners face when they did not know the answer, were the most common nonverbal responses from the children. They all showed a decrease in the number of Topic Initiations and instead they showed almost equal increases in the number of Topic Maintaining and Extending moves. Cheryl had a different pattern which was again an effect of the activity. Fewer Initiation and more Topic Extension and Maintenance moves are good signs in terms of maturation for keeping up with a topic across time, and being less distractible.

The Group 2 children still had a great number of Initiations during 15 minutes conversation. However, the number of Topic Extensions increased noticeably which could be a sign of more assertiveness. They also had plenty of Topic Maintaining moves which showed their cooperation for keeping a topic continuously with their partners.

In Fey's chart (1986) (see Figure 3), all children except Cheryl and Paul were in the upper quadrants. Only Myra was an active conversationalist; Jack, Kiana, Kim and Hannah were verbal non-communicators; and Cheryl and Paul were inactive communicators (see Figure 11).

ASSERTIVENESS		RESPONSIVENESS: EXPECTED	RESPONSIVENESS: LOW
	EXPECTED	Active Conversationalist + ASSERTIVENSS +RESPONSIVENESS ***Myra***	Verbal Non-Communicator +ASSERTIVENSS -RESPONSIVENESS ***Jack, Kiana, Hannah and Kim***
	LOW	Passive Conversationalist -ASSERTIVENSS +RESPONSIVENSS	Inactive Communicator -ASSERTIVENSS -RESPONSIVENSS ***Cheryl and Paul***
		EXPECTED	LOW

RESPONSIVENESS

Figure 11: Different Levels of Socio-Conversational Skills One Year Later

5.6.4 Speech Perception

The children in Group 1 reached the maximum score in the closed set speech perception tools except for Kiana who was still struggling to discriminate the one syllable words (at the time of assessment she had more than a year’s experience of cochlear implant and a hearing aid). Kiana continued to present a less straightforward picture than her group peers. Kim showed the expected pattern of a decrease in scores, descending from the simplest task to the most complex one (down to a level of c. 85% on 4 tests). But Paul had a completely unexpected drop in score for the simple test and then increased his score in the more difficult ones. This appeared to be due to his lack of knowing some words. He lost scores not because he did not hear them, but because he did not have the words in his lexicon. Even his lowest score however was over 80% showing acceptable speech perception skills.

5.6.5 Speech Production

The children's speech production features changed noticeably after a year. The number of missing consonants in their phonemic inventories decreased. Group 1 did not have those sounds that emerge later in childhood (the 'th' and 'r' sounds) in their Syllable Initial Position inventories (Table 60), however they mainly showed the developmentally appropriate uses of alternatives, replacing/θ/ with /f/, /r/ with /w/, and /ʒ/ with /ʤ/ or /ʃ/. They tended to devoice the /z/ in the syllable final position (see Table 60). These were very similar to the productions of the matched controls one year before. Also replacement of /θ/ with /f/ could be considered as a dialectical variation, as it is not uncommon in NZ English. Jack had the most dramatic change as he had almost all of phonemes in the syllable initial position and only /z/ and /θ/ were absent from the syllable final position, which is not outside the normal range for his age.

The number of missing phonemes from the phonemic inventories also decreased for Group 2; however some sounds (/v/, /s/, /z/, /k/, /t/, /f/ and the affricates) were still delayed in comparison with typical hearing children.

Table 60: Phonemes Absent from Phonemic Inventories

Group	*Participants*	*SI Phonemes not in repertoire*	*SF Phonemes not in repertoire*
Group 1	Myra	/θ/, /r/	/d/, /θ/, /ʒ/, /ʤ/
	Jack	--	/θ/, /z/
	Kiana	/θ/, /r/	/θ/, /s/, /ʤ/, /ʒ/
	Cheryl	/θ/	/θ/, /z/, /ʒ/
	Hannah	/θ/, /r/	/f/, /v/, /z/, /ʒ/
Group 2	Kim	/v/, /s/, /z/, /ʃ/, /r/	/t/, /f/, /θ/, /s/, /z/, /ʃ/, /ʒ/, /ʤ/, /ʧ/
	Paul	/v/, /θ/, /ð/, /s/, /z/, /r/	/k/, /θ/, /s/, /z/, /ʒ/

It is logical to expect that when the number of missing sounds from phonemic inventories decrease, the number of active phonological processes will also have declined, as the two are interrelated. In the second year assessment children in Group 1 showed fewer active phonological processes and some of them like Jack and Myra did not have any (see Table 61).

Table 61: Active Phonological Processes One Year After

Group	*Participants*	*Gliding*	*Cluster Reduction*	*Frontin g*	*Weak Syll Delet.*	*Stop-ping of Fric.s*	*Final Cons Delet.*	*Total*
Group 1	Myra							0
	Jack							0
	Kiana	✓	✓			✓		3
	Cheryl		✓					1
	Hannah		✓					1
Group 2	Kim		✓			✓	✓	3
	Paul	✓	✓					2

It was not only the number of phonological processes that decreased; the frequency of each active phonological process also decreased. For example Kiana in the first year assessment had about nine examples of stopping but in her second year assessment, she had five examples fro0m the same number of opportunities. In Group 2, the number of active phonological processes and their frequency also decreased (see Table 61). The other important change was that atypical phonological processes disappeared from their speech. However they still had some phonological processes belonging to the younger age range, such as Final Consonant Deletion, Cluster Reduction and Stopping which were expected to disappear by age 5.

In the second year, the inconsistency rate for Group 1 decreased to less than 10% and that of Group 2 to 22%, which can be considered as being in the typical range. This was another sign of their progress in speech production skills towards intelligible speech.

In the speech intelligibility measures, the means for Group 1 children increased to: PCC: 88%, PVC: 99%, and PPC: 92%, but according to the percentile rankings only Myra and Cheryl were within 1SD of the mean for age, with Jack, Kiana and Hannah below -1 SD of the mean. However in spite of this, their speech was more intelligible than a year before.

Group 2 were able to produce more phonemes correctly and their speech intelligibility measures increased to PCC: 78%, PVC: 97% and PPC: 86%. But their percentile rankings indicate that their speech measures were below -2 SD of the mean. They had certainly improved, but had not caught up to the normal range.

5.6.6 Influential Factors

Besides one year's development what else could have an effect on the children's speech and language development? The first point that the examiner noticed was attention span of the children. Some of them showed more attention during the assessments. The number of assessment sessions decreased to two sessions for each child. Each session was for less than an hour and had less break time. They were more cooperative than one year before. All of the children had their hearing aids on when the examiner met them.

There were some changes in the educational and rehabilitation services that the Group 1 children received. Myra participated in a programme designed for school at the Hearing House. At the time of the second assessments, Myra had just started school, so she did not have much school experience. All of her services for speech and language therapy and AoDC were stopped when she came under the supervision of a resource teacher. Hannah had been at school for ten months while the rest of the children had been at school for about 3-5 months. Hannah and Jack had started to learn sign language at their schools. The Group 2 children had also started school, but otherwise there were few changes in their lives. At the time of the second assessment Paul had been at a school for about seven months where he had a resource teacher and a speech and language therapist.

5.7 Conclusion

This chapter started by positing the existence of three groups within this small cohort of children with hearing loss; those who had relatively age appropriate performance, including in their speech and language skills; those who had significantly below age appropriate performance in speech and language skills, and a small group which seemed to be variable. The results for each assessment tool largely confirmed these groupings. However, some irregularities within each group were seen, for example Kiana and Eris sometimes stood out from their groups. There were many confounding factors that could have affected the children's performances. Kiana showed ongoing speech perception problems that put her in Group 2 in the first year and at the lower edge of the normal range in the second year. (She received a second cochlear implant in July 2014). Eris's problems were obvious when it came to spontaneous language analysis. She had more unintelligible and incomplete utterances, more elliptical utterances, less full major, and fewer phonemes than her cohort. (She received her first cochlear implant in September 2014). All of these together were a sign of problems with expressive speech and language skills.

The most influential factors that come to mind in regard to these different patterns are early diagnosis and intervention. Group 1 children, except Cheryl, were identified and received intervention before their first birthday. However, these two factors did not work well for Eris as she stood out from her group in many ways. To get better results after diagnosis and the fitting of hearing aids, other factors should perhaps be included.

It is important to evaluate children's communication skills with a comprehensive look into the functional (pragmatics) and the formal (syntax, morphology and phonology) aspects of language skills together. Using just MLU or a specific standardised test would not show the reality of these children's potential and performance, neither for research purposes nor for treatment goals. Eris and Kiana in this study were an example of how the standardised test could be misleading, and which might place children at a level to which they do not belong.

Analysis using the LARSP was also a good source of information about the children's language skills, especially when the whole profile was implemented. This is because it is a rich analysis which enables different aspects of a child's syntactical language performance to be considered. Some children, like Kiana, showed a profile similar to those of children in the higher performance group. However, her error analysis showed more immature language structures than the Group 1 children.

It is good to ask children to talk but it is not the only way that typical hearing children communicate. A balance between verbal and nonverbal acts is normal in interactions, and it is possible that insisting on just verbal communication may have negative consequences for children. For example, Hannah had good expressive language skills, and when we asked her caregiver to describe her personality, her older sister (who was also hearing impaired) added 'noisy'.

Children with and without hearing loss were more satisfied with the time that their caregivers played with them, compared to the time they spent for standardised assessment sessions. It would indicate that remediation and treatment goals that respected communication values and family involvement. Possibly also it indicates the value of speech and language assessments based on spontaneous speech and language samples.

It was interesting to see changes that happen over time in children's speech and language skills. Within the short timeframe of this study, some children had been on a normal track for speech and language development and after a year they were still there. Some children caught up with the higher performing group after a year. The lower performing group remained lower performing, but did not as a group fall further behind, in fact most trends were upwards. All these children were receiving support and intervention from the Advisers on Deaf Children, and some had a number of programmes and services involved with them, and this data would tend to indicate that these interventions were largely successful However, two of the three children in the lower performing group who were reassessed after a year, small in number as they were, did not reach the normal range in spite of interventions and time. These children perhaps need more and continuous support to get closer to the level of typical hearing children. However one child from this group, Kiana, did achieve the normal range at the second year assessment. She had been having a rich intervention programme and bimodal stimulation and perhaps for her this was the key.

There was a delay in the speech and language skills of some of the children with hearing loss. While some of these skills, like phonological processes, could be identified by a formal test, some of them like morphological endings, clause and phrase structures and overall syntactic patterns would not be detected so easily by the formal test. Informal evaluations, like the analysis of spontaneous language samples, retelling stories and free play would make it possible to access the tiny differences in language skills for children with hearing loss and to create a plan to treat them.

Chapter 6: Children with Hearing Loss Compared to Their Typically Hearing Peers

6. Introduction

The information presented in chapters 4 and 5 provided an overview of the children's speech and language characteristics, and factors possibly influencing their speech and language outcomes. By making a comparison with a group of typically hearing children this chapter will report how much hearing loss affects the children's speech and language. Chapter 5 showed that children with hearing loss had different speech and language outcomes. This chapter describes their situation as a group and compares the results of the children with hearing loss to the control group.

6.1 Language Comprehension

This section begins by examining language comprehension, a critical aspect of communication development. Language comprehension was assessed using the *New Reynell Developmental Language Scales* and the Child Development Inventory. Differences between children with hearing loss and their matched controls are reported.

6.1.1 The New Reynell Comprehension Scale

Table 62 shows the comprehension standard scores for the different age groups of children with hearing impairment and their matched controls. As the scores are standard scores, the mean for age from the normative sample on the test is 100, and the SD is 15. The normality of data was assessed using the Kolmogorov-Smirnov test, which showed all groups had a normal distribution of scores. The scores for the two groups were compared using an independent samples t-test. When comparing the children with hearing loss and their matched controls at 3-4 years of age, the Levene's Test for Equality of Variances was significant for the Language Comprehension scores, and so the statistical results with an underlying assumption of unequal variance were used.

Table 62: New Reynell Language Comprehension Standard Scores

Participants	*Mean (SD) for children with hearing Loss (N= 11)*	*Mean (SD) for matched controls (N = 11)*	*Sig. (2-tailed)*
3-4 Years Old (n = 4)	84.75 (13.52)	101.50 (5.20)	.084
4-5 Years Old (n = 7)	82.29 (11.54)	112.14 (11.96)	< .001*

* Significant at .05

The results showed that as a group, the mean for 3-4 year old and 4-5 year old children with hearing loss was 1 SD below the normative mean, whereas the matched control's means were at or above the test normative mean. The difference in mean between the two groups was not significant for the younger children ($p > .05$), possibly because the sample size was small. However, the difference did reach significance for the older children (4-5 year olds). The mean score of 4-5 year olds with hearing loss was only three points below the test mean -1 SD, and hence was just below the normal rangebut the performance of the control group of 4-5 year olds was very good. Their mean score was 12 points above the test normative mean. This took place even though they were matched on gender, age, ethnicity and socioeconomic status to the children with hearing loss.

6.1.2 Caregiver's Reports of Language Comprehension from the CDI

Caregivers' reports on their children's language comprehension from the CDI were also compared for the children with hearing loss and controls (see Table 63). The normality of data was assessed by a Kolmogorov-Smirnov test, which showed that the younger children's data did not show a normal distribution, but data for the older children did. Thus, the younger children were compared using a Mann-Whitney U test and the older children were compared with a Two Independent Samples t-Test. In comparing the children with hearing loss at 4-5 years with their matched controls, the Levene's test was significant for CDI Language Comprehension Quotient scores, and so statistics with an underlying assumption of unequal variance were used.

Table 63: CDI Language Comprehension Quotient (Caregiver Report) Scores

Participants	*Mean (SD) for children with hearing Loss (N = 11)*	*Mean (SD) for matched controls (N = 11)*	*Sig. (2-tailed)*
3-4 Years Old (n = 4)	61.62 (10.73)	89.45(12.18)	.021*
4-5 Years Old (n = 7)	83.46 (20.01)	102.40 (2.32)	.046*

* Significant at .05

The results showed that as a group, the mean of the 3-4 year old children with hearing loss was more than 2 SD below the normative mean, whereas the matched controls' mean score was close to the test mean (less than 1 SD below). This difference was significant for the younger group (p = .021). The 4-5 year old children with hearing loss as a group scored more than 1 SD below the normative mean while their matched controls' mean score was slightly above the test mean. This difference was also significant (p = .046). These group differences indicate that there was general agreement between the results of the formal language comprehension assessment tool (New Reynell) and what parents reported for their children's language comprehension skills on the CDI. In each case there was greater group difference for the younger children.

6.2 Expressive Language

First, children's standard scores on the New Reynell standardised tool for assessing expressive language will be reported. Second, significant differences between children with hearing loss and their matched controls for the measures of morpho-syntactical features based on the LARSP analysis will be presented.

6.2.1 The New Reynell Expression Scale

Table 64 shows the results for the expression scale of the *New Reynell Language Scales*. These standard scores had a similar pattern to the comprehension standard scores. The means of both groups of pre-school children with hearing loss were more than 1 SD below the test mean, whereas the control groups' means were close to or above the test mean. The difference between these group means was significant for the older children with hearing loss versus the older controls (p = .008). Consistent with their language comprehension standard scores, the older matched controls' mean score was more than10 points above the test mean, contributing to the significant difference between these two groups. Because there are no published New Zealand norms for the New Reynell it is not clear whether this above-average performance of the older control group is typical of other New Zealand 4-5 year olds with normal hearing. Perhaps due to the small size of the sample and the high variability in scores, the difference for the younger children was not significant (*p* > .05).

Table 64: New Reynell Language Expressive Standard Scores

Participants	*Mean (SD) for children with hearing Loss (N= 11)*	*Mean (SD) for matched controls (N = 11)*	*Sig. (2-tailed)*
3-4 Years Old (n = 4)	83.25 (15.59)	101.75 (9.98)	.093
4-5 Years Old (n = 7)	84.57 (14.08)	110.14 (16.16)	.008*

* Significant at .05

6.2.2 Caregivers' Reports of Language Expression from the CDI

The CDI caregivers' reports on their children's expressive language were also compared between groups. The normality of data was assessed using a Kolmogorov-Smirnov test, which showed that the younger children did not have a normal distribution whereas the older ones did. Thus, the younger children were compared using a Mann-Whitney U test and the older children were compared with a Two Independent Samples t-Test. The Levene's test was significant for CDI Expressive Language Quotient scores for the comparison between the 4-5 year old children with hearing loss and their matched controls, and so statistics with an underlying assumption of unequal variance were used. The results are displayed in Table 65.

Table 65: CDI Expressive Language Quotient (Caregiver Report) Scores

Participants	*Mean (SD) for children with hearing Loss (N= 11)*	*Mean (SD) for matched controls (N = 11)*	*Sig. (2-tailed)*
3-4 Years Old (n = 4)	65.99 (16.87)	99.19(7.15)	.021*
4-5 Years Old (n = 7)	80.72 (25.42)	100.00 (1.82)	.092

* Significant at .05

The results showed that as a group, the 3-4 year old and 4-5 year old children with hearing loss had means more than 1 SD below the test mean, whereas the matched control groups' means were at or above the test mean (see Table 65). The between-group difference was significant for younger children (*p* = .021) but not for older children (*p* > .05), perhaps because of the large SD for the older children with hearing loss (SD = 25.42).

These findings indicate a delay in both the comprehension and the expression of language for the preschool children with hearing loss, as a group, compared to their typically hearing peers. This was not equally true for all individuals however, as we saw in chapter 5. The New Reynell standardised language assessment showed significantly poorer receptive and expressive language scores only for the 4-5 year olds with hearing loss compared to matched controls. The CDI showed group difference for both younger and older children.

6.2.3 LARSP

Younger and older children with hearing loss did not have significant differences from their matched controls for many parts of the LARSP analyses (p > .05) even though the differences between children's means for different variables were large. This could be because of the large SD, limited of language samples and the restricted number of participants. In this section the significant group differences evident from the LARSP analysis will be discussed.

a) Unanalysable and Analysable Utterances

Children's unanalysable utterances (based on the definitions presented in Chapter 5) were counted and converted to percentages and compared to hearing status. The normality of data was again checked by the Kolmogorov-Smirnov and Levene's tests for distribution of variances, and all data had a normal distribution. This allowed the parametric, Two Independent Samples t-Test to be applied to investigate group differences.

The percentages of unanalysable utterances of children with hearing loss were higher than their matched controls. The difference between the younger children was significant (p = .031), but this difference was not significant for the older children (p > .05) (Table 66).

Table 66: Comparison of Unanalysable Utterances

Participants	*Mean (SD) for children with hearing Loss (N = 11)*	*Mean (SD) for matched controls (N = 11)*	*Sig. (2-tailed)*
3-4 Years Old (n = 4)	18.68(6.85)	7.21(4.48)	.031*
4-5 Years Old (n = 7)	15.02(5.65)	10.46(7.86)	.236

* Significant at .05

For the younger children, the significant differences in subcategories of unanalysable utterances between those with hearing loss and their matched controls, occurred for unintelligible utterances (p = .014) and abnormal responses (p = .047). For the older children the significant group differences occurred for the percentage of unintelligible utterances (p = .003) and deviant utterances (p = .005).

All the analysable utterances were categorized as Major (Elliptical Major 1, 2, 3+, Reduced and Full) or Minor units (see Table 67). When taking a close look at the proportion of each of these types of utterances, it was seen that both younger and older children with hearing loss used Minor and Reduced Major more than their matched controls. Matched controls in both age groups used more Elliptical and Full Major utterances than children with hearing loss. The only significant difference, however, was the percentage of Reduced Major used by older children with hearing loss compared to their matched controls (Table 67).

Table 67: Different Categorise of Analysable Utterances

Participants	*Analysable Utterances*	*Mean (SD) for children with hearing Loss (N = 11)*	*Mean (SD) for matched controls (N = 11)*	*Sig. (2-tailed)*
3-4 Years Old (n = 4)	Full Major	12.65 (6.05)	22.92 (12.18)	.182
	Minor	48.04 (19.33)	30.70 (6.93)	.142
	Elliptical Major	32.34 (15.46)	40.04 (12.74)	.470
	Reduced Major	6.97 (1.98)	6.33 (4.96)	.819
4-5 Years Old (n = 7)	Full Major	23.24 (10.93)	31.04 (10.21)	.193
	Minor	42.98 (16.61)	35.31 (9.42)	.309
	Elliptical Major	28.37 (20.29)	31.93 (12.60)	.700
	Reduced Major	5.41 (2.43)	1.72 (1.41)	.005*

* Significant at .05

It can be concluded based on these LARSP findings that children with hearing loss had more immature language than their matched controls and this became more obvious when they were 4 years old. A positive point for the children with hearing loss was the existence of all types of analysable utterances in their language samples and that they only needed to be prompted to use more Full or Elliptical Majors. They also had a higher percentage of unanalysable utterances which made their language vague and difficult to be understood a factor which needs to be considered in regard to therapeutic programmes.

b) Clause Structures

In this section, children's LARSP profiles have been compared in separate age groups (young and old children) with their matched controls. However, the only significant difference was between the percentage of clause structures in stage IV for older children with hearing loss and that of older matched controls (older children with hearing loss, 12.57(8.46), older matched controls, 18.43(6.50), *p* = .027).

c) Error Analysis

The younger children with hearing loss did not significantly differ from their matched controls in terms of the percentage of errors in Clause, Phrase and Word structures or the mean number of utterances with errors (p > .05).

The older children, however, had significant differences from their matched controls in all structures and the total utterances with errors (see Table 68). The data did not have a normal distribution in the Kolmogorov-Smirnov test, so the groups were compared with the non- parametric Mann-Whitney U test.

Table 68: Comparison of the Percentage of Errors in Different Levels

Participants	*% of Clause Errors*	*% of Phrase Errors*	*% of Word Errors*	*% of Total Utterances with Errors*
Children with Hearing Loss Aged 4-5	7.05(2.98)	11.17(8.62)	2.23(1.98)	13.98(8.35)
Matched Controls	2.46(1.79)	2.09(1.90)	0.61(1.05)	4.39(2.74)
Sig. 2 tailed.	.006*	.004	.033	.006

* Significant at .05

6.2.4 Interactional Communication Patterns

All of the language samples taken from the children and their caregivers were analysed using the Fey (1986) socio-conversational analysis system. Then two continua (assertiveness and responsiveness) were calculated. There were no significant differences between children with hearing loss and their matched controls (p > .05). However it was worthwhile to examine all of the children in Fey's figure in order to gain a holistic view of the children with hearing loss and their matched controls (see Figure 12).

All but one of the children with and without hearing loss were assertive in their interactions. The only child from the matched control group who was not assertive was Erina. She was the only child who was interacting with her father, and the activity and the style of their conversation were mostly question-answer based. Nick also differed; he was dominant in the conversation and received a score of over 50% percent so he was a child with high assertiveness.

Most of the participants were not very responsive to their communication partners. This might have been a result of the natural conversation styles of young children, or perhaps because of the choice of activity. When they got involved in some engaging activities, the children typically preferred to do that rather than answering their communication partners. Children of both age groups with hearing loss used verbal responses more than their matched controls. Kim was a special case in that during his first year, his caregiver reported that he was an isolated child and was not involved with other people. However in both assertiveness and responsiveness he scored on the higher end of the continuum. This might be an example of how caregivers can underestimate their children’s abilities.

Four children with hearing loss and the same number of matched controls were at the expected levels for assertiveness and responsiveness. Almost equal numbers of children with and without hearing loss are categorised as having an expected level of assertiveness but a low level of responsiveness.

ASSERTIVENESS

EXPECTED	Active Conversationalist + ASSERTIVENSS +RESPONSIVENESS ***Sara, Eris, Kim, Hannah Keyna, Kenny, Pete and Hanne***	Verbal Non-Communicator +ASSERTIVENSS -RESPONSIVENESS ***Julia, Nemo, Myra, Jack, Kianna, Paul & Cheryl*** ***Josie, Nick, Sue, Myron, Jasper & Cherish***
LOW	Passive Conversationalist -ASSERTIVENSS +RESPONSIVENSS ***Erina***	Inactive Communicator -ASSERTIVENSS -RESPONSIVENSS
	EXPECTED	LOW

RESPONSIVENESS

Figure 12: Classification of Children Based on Their Levels of Social-Conversational Participation

d) Discourse Level

In the final part of the analysis of spontaneous language, the researcher examined the discourse level of children in interaction with their caregivers. Three levels were examined: Initiate Topic, Maintain Topic, and Extend Topic. Children with hearing loss initiated more topics and had more topic maintenance than their matched controls. Older children did not show any differences from their matched controls for any of the discourse levels ($p > .05$). The younger children with hearing loss had at least three times fewer topic extensions and higher percentage of topic initiation than their matched controls. Parametric statistical tests showed that these differences were significant (see Table 69).

Table 69: Comparison of % of Different Discourse Levels

Discourse Level	*Children with HI 3-4*	*Matched Controls 3-4*	*Sig. (2-tailed)*
Initiate Topic	19.86(2.36)	9.62(5.05)	.010*
Maintain Topic	67.17 (6.36)	50.42(20.32)	.167
Extend Topic	12.97(4.82)	39.95(16.15)	.019

* Significant at .05

6.3 Auditory Behaviours

The main original articles on ABEL (Purdy et al., 2002; Souza et al., 2011) did not have any normative data for typically hearing children. So it was not possible to see a possible gap between children with hearing loss and typically hearing children based on published norms. The children's scores were compared to their matched controls and there were no significant difference between children with hearing loss and their matched controls ($p > .05$).

For PEACH, there is a normative data set, but for a wide range of ages (Ching & Hill, 2007). The younger children with hearing loss did not have any significant differences from their matched control on any subscale ($p > .05$). The older children, however, showed significant differences from their matched controls in Noise ($p = .005$) and Overall scores ($p = .010$) (see Table 70).

Table 70: Comparison of PEACH Results for Children Aged 4-5

PEACH	*Mean (SD) for children with Hearing Loss*	*Mean (SD) for Matched controls*	*Sig. (2-tailed)*
Quiet	77.97(17.30)	90.48(7.87)	.109
Noise	66.07(8.15)	87.86(10.35)	.005*
Overall	72.56(11.82)	89.28(7.15)	.010

* Significant at .05

6.4 Speech Perception

6.4.1 Pre-test Findings of the Early Speech Perception Test

Each of the three subtests in the ESPT has a pre-test designed to check if the children knew the words they would later hear. The pre-test revealed that for these NZ children there was a set of words which were culturally unknown or less well known. Of the total of 30 words, 18 were problematic in some way (Table 71). The consequence is that the ESPT may not be culturally suitable for NZ children. This may compromise the validity of the results. Based on the manual instructions and as a basis for continuing the assessment, the researcher told the children the target word for each one not correctly named at the time of the pre-test.

Table 71: The Word Knowledge of Children on Picture Cards of Early Speech Perception Test (N = 29)

Number	*Target word*	*Close Words*	*No Response*	*Related Words*	*Right Answer*
1	"cookie",	"biscuit(s)"(n = 11)	(n = 4)	'eat/ing' (n = 3)	(n = 11)
2	"hamburger"	"(cheese) burger" (n = 10)	(n = 10)	'eating'(n = 4)	(n = 5)
3	"birthday cake"	"cake" (n = 15)		"(happy) birthday" (n = 3)	(n = 11)
4	"hot dog"	"sausage (roll)"(n = 6)	(n = 10)	'eating'(n = 3)	(n = 10)
5	"ice cream cone"	"ice cream" (n = 10)	(n = 2)		(n = 17)
6	"bathtub"	"bath" (n = 24)	(n = 3)		(n = 2)
7	"sandwich"	"bread" (n = 4)	(n = 1)	'toast and jam'(n = 1)	(n = 23)
8	"French fries"	"chippies or (hot)chips" (n = 23)	(n = 5)	(McDonald) (n = 1)	(n = 0)
9	"cowboy"	"boy" (n = 3)	(n = 13)	'other names'(n = 3)	(n = 10)
10	"football"	"ball" (n = 17)	(n = 1)	"soccer or rugby ball" (n = 8)	(n = 3)
11	"lunch box"	"bag" (n = 15)	(n = 8)	'other names'(n = 2)	(n = 4)
12	"air plane"	"plane" (n = 6)			(n = 23)
13	"rain coat"	"jacket" (n = 7)	(n = 2)	"coat, suit, or(T) shirt" (n = 5)	(n = 15)
14	"cupcake"	"cake" (n = 7)	(n = 2)	"muffin or pineapple" (n = 5)	(n = 15)
15	"belt"		(n = 9)	'other names'(n = 3)	(n = 17)
16	"boot"	"shoe" (n = 14)		"gumboot" (n = 2)	(n = 13)
17	"bat"	"paint brush" (n = 3)	(n = 14)	'other names'(n = 8)	(n = 4)
18	"bee"	"buzzy bee or bumble bee" or "wasp" (n = 6)	(n = 4)	'other names'(n = 2)	(n = 17)

6.4.2 ESPT Results

Comparing the children with hearing loss with their matched controls showed that although the mean scores for the controls tended to be higher these differences, with the exception of that in the 3-4 year old children on the Spondee Identification subtest ($p = .039$), were not significant ($p > .05$). With a larger sample size, more significant results may have been achieved. This was also the case for the Monosyllable Identification subtest which showed a large difference in scores between groups, but perhaps because of the high variability, this was not significant (p > .05).

6.4.3 NU-CHIPS

Typically developing children have few speech perception difficulties at these ages on the NU-CHIPS task. At both ages, the hearing loss groups' scores were significantly below the control group scores (see Table 72).

Table 72: Comparison of NUCHIPS Results

Participants	*Mean (SD) for children with hearing Loss*	*Mean (SD) for matched controls*	*Sig. (2-tailed)*
3-4 Years Old	72.50 (3.79)	95.00 (3.46)	< .001*
4-5 Years Old	83.14 (8.86)	95.43 (3.78)	.010

* Significant at .05

This test appeared to have better sensitivity than the ESPT in examining speech discrimination skills in children, perhaps because of its special characteristics. While the ESPT was designed for children with profound hearing loss, the NU-CHIPS was designed to be used to test the speech discrimination abilities of children and other patients with language abilities as young as three years with a range of hearing levels. The NU-CHIPS includes the most frequently occurring phonemes of English. In order to decrease the probability of mistakes because of unfamiliar words, the words in the original test were chosen based on the receptive vocabularies of 3-year-old children. Word recognition is also not only based on vowel discrimination, but on discrimination of both vowels (witch, fish, sink, milk) and consonants (school, shoe, spoon, food).

6.5 Speech Production

The only parts of the DEAP that could be compared between groups using statistical tests were intelligibility on the basis of PCC, PVC, PPC, and Inconsistency.

6.5.1 Speech Intelligibility Measures

An indication of speech intelligibility can be derived indirectly by measuring the percentage of consonants and vowels that are correct. Table 73 shows that (as would be expected), vowels are more likely to be correct than consonants.

Table 73: Comparison of Speech Measurements

Speech Measurements	*3-4 Years Old*					*4-5 Years Old*				
	with Hearing Loss		*Matched Controls*		*Sig. 2-tailed*	*with Hearing Loss*		*Matched Control*		*Sig. 2 tailed*
	Mean (SD)	*Percentile Rank*	*Mean (SD)*	*Percentile Rank*		*Mean (SD)*	*Percentile Rank*	*Mean (SD)*	*Percentile Rank*	
PCC	72.68 (14.59)	16	85.75 (7.20)	50	.159	76.02 (14.10)	9	91.72 (4.28)	50	.025 *
PVC	98.28 (2.63)	37	99.67 (0.65)	50	.344	97.80 (1.77)	16	99.82 (0.49)	50	.023
PPC	82.93 (8.04)	16	90.78 (4.69)	75	.143	84.26 (9.14)	9	94.65 (2.70)	50	.023

* Significant at .05

Both groups of children with hearing loss had a lower percentage correct scores when compared to their matched control group. For the 3-4 years old children, these differences were not statistically significant ($p > .05$). This may be a consequence of the small number of participants, and the high variability as seen in the SDs. The younger children with hearing loss scored for PCC at the 16^{th} percentile and their matched controls scored at the 50^{th} percentile, indicating that this is a suitable speech production test for typically developing New Zealand children.

For the older children, there were statistically significant differences between children with hearing loss and the matched controls in all areas measured with the DEAP that allow statistical comparison ($p < .05$) (see Table 73).

6.5.2 Inconsistency Measures

Children with hearing loss in both age groups had significant differences from their matched controls in Inconsistency rates (see Table 74). The normality of data was checked using the Kolmogorove-Smirnov test, and then the parametric, Two Independent Samples t-Test, was applied.

Table 74: Comparison of Inconsistency Rates

Measure	*3-4 Years Old*			*4-5 Years Old*		
	Children with Hearing Loss	*Matched Controls*	*Sig. 2 Tailed.*	*Children with Hearing Loss*	*Matched Controls*	*Sig. 2 Tailed.*
Inconsistency Rate	30.84(11.37)	10.04(9.49)	.031*	32.57(19.52)	9.19(2.56)	.011

* Significant at .05

6.6 Correlation between Different Measures

A comprehensive description of speech and language characteristics usually includes a review of the relationships between the various parts, sometimes with the aim of finding causal relationships and sometimes to find just a simple association between different abilities. In this study, these relationships were investigated to see the links between auditory behaviours, speech perception skills, speech production skills and language skills based on children's scores in different assessment tools.

6.6.1 Auditory Behaviour and Speech Perception Skills

Closed set speech perception tests are useful since they mostly assess a child's hearing abilities, and speech and language disorders will not interfere with their results. However, they cannot show the child's speech perception performance in everyday life. There are two ways to solve this issue: using an open set speech perception test, or combining them with some subjective assessment tools. In this study, PEACH and ABEL were used as two subjective tools to assess the children's everyday listening skills using their hearing aids or other technology, the children's auditory behaviours in different environments, and their auditory-verbal skills. Only significant results are reported here. No adjustment to the significance level is made here for multiple comparisons and hence statistical findings, particularly given the small sample size, should be interpreted with caution.

The investigation into the relationship between children's scores on different subscales of the ESPT, and the PEACH and ABEL showed that the children's Pattern Perception scores were significantly correlated with PEACH overall scores ($r = .503$, $p = .017$).

Children's Spondee Identification scores showed a significant positive relationship with PEACH Overall scores (r = .601, p = .003), ABEL total scores (r = .542, p = .009) and Auditory Awareness scores (r = .627, p = .002).

Children's Monosyllable Identification scores had a significant positive relationship with PEACH Overall scores (r = .596, p = .003), ABEL Overall scores (r = .679, p = .001) and Auditory Awareness scores (r = .679, p = .001).

There was also a significant correlation between the children's NUCHIPS scores and PEACH overall scores (r = .628, p = .002) (Figure 13).

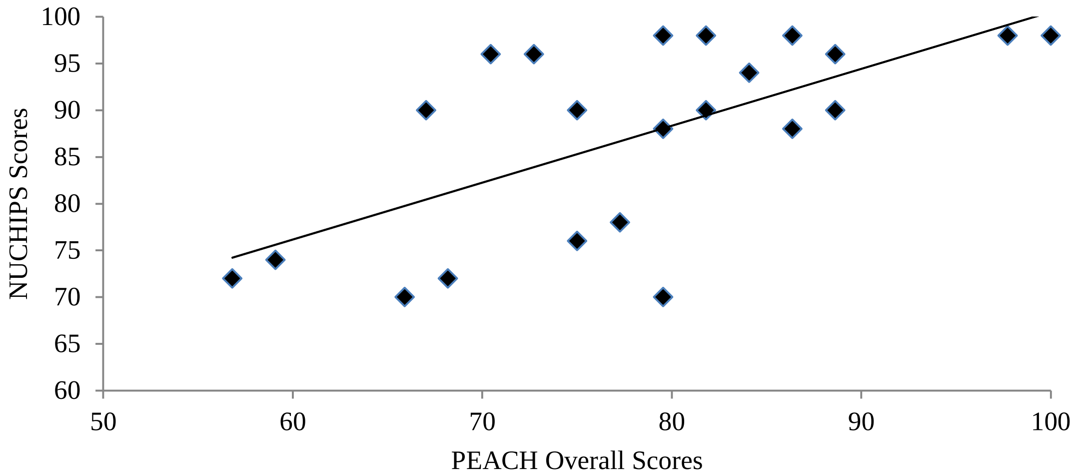

Figure 13: Association between NUCHIPS and PEACH Overall Scores

Children's NUCHIPS scores showed a significant correlation only with the Auditory Awareness subscale score from ABEL (r = .501, p = .017).

As expected, in examining the relationship between the two speech perception tests, the NUCHIPS scores were correlated with the children's scores for Spondee Identification (r = .736, p< .001) (Figure 14) and Monosyllable Identification subtests (r = .632, p = .002) (Figure 15), but NUCHIPS scores were not correlated with the scores for the Pattern Perception subtest (r = .317, p >.05).

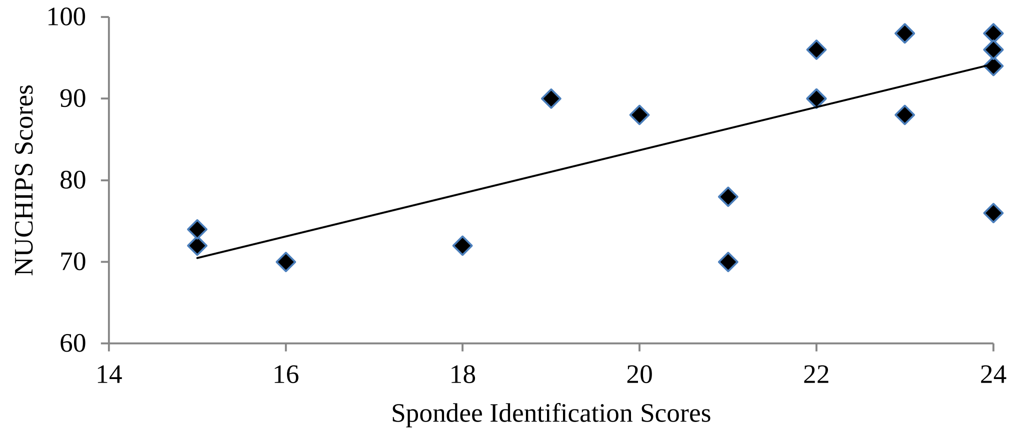

Figure 14: Association between Spondee Identification Scores and NUCHIPS Scores

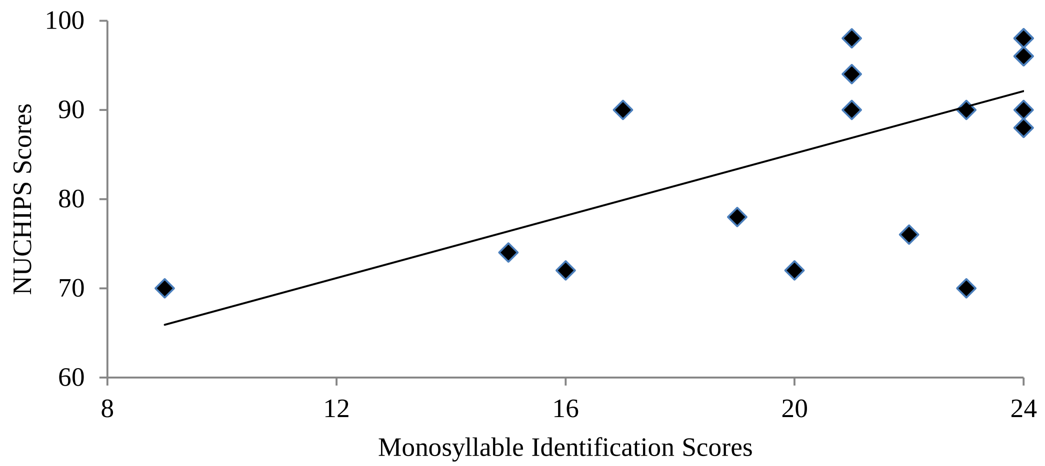

Figure 15: Association between Monosyllable Identification Scores and NUCHIPS Scores

6.6.2 Speech Perception Skills and Speech Production Skills

Children's Spondee Identification scores also correlated with their DEAP speech intelligibility scores (PCC ($r = .764$, $p < .001$) and PPC ($r = .771$, $p < .001$).

Consistent with this, Monosyllable Identification scores were correlated with speech intelligibility scores (PCC ($r = .621$, $p = .002$) and PPC ($r = .605$, $p = .003$).

NUCHIPS scores correlated with speech intelligibility scores (PCC ($r = .625$, $p = .002$) (Figure 16) and PPC (r = .634, p = .002) (Figure 17).

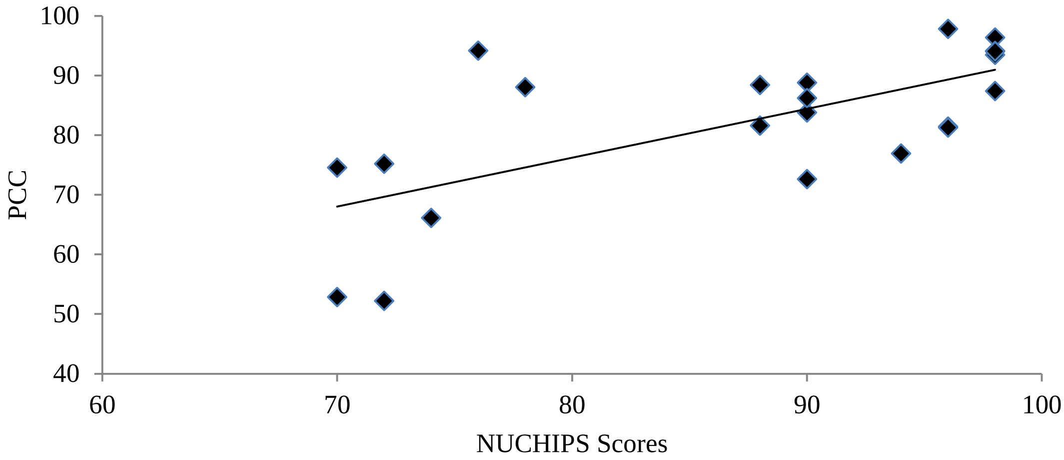

Figure 16: Association between NUCHIPS Scores and PCC Scores

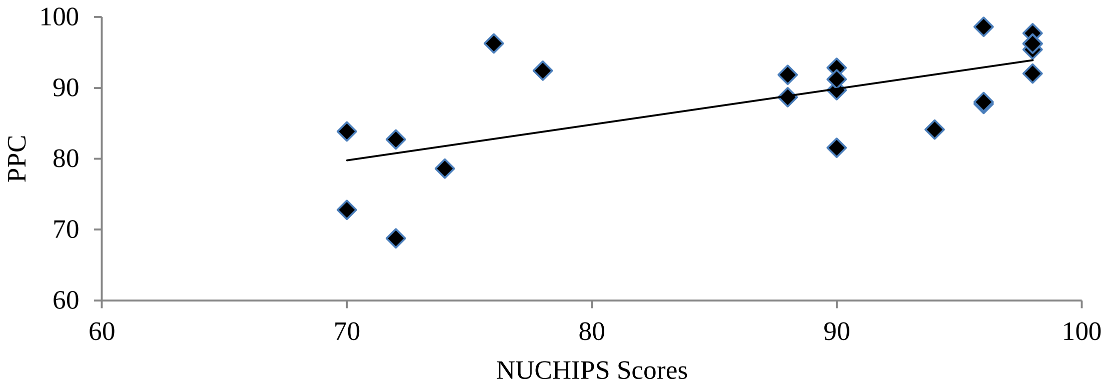

Figure 17: Association between NUCHIPS Scores and PPC Scores

6.6.3 Speech Perception Skills and Language Skills

Spondee Identification scores were correlated with the Language Comprehension scores (r = .671, p = .001), and Expressive Language scores (r = .655, p = .001).

Monosyllable Identification cores were correlated with the Language Comprehension scores (r =

.635, p = .001) and Expressive Language scores (r = .584, p = .004).

The NUCHIPS scores also were correlated with the Language Comprehension scores (r = .750, p < .001) (Figure 18) and the Expressive Language scores (r = .651, p = .001) (Figure 19). The correlation between the NUCHIPS and the Language Comprehension score was stronger than the Expressive Language scores.

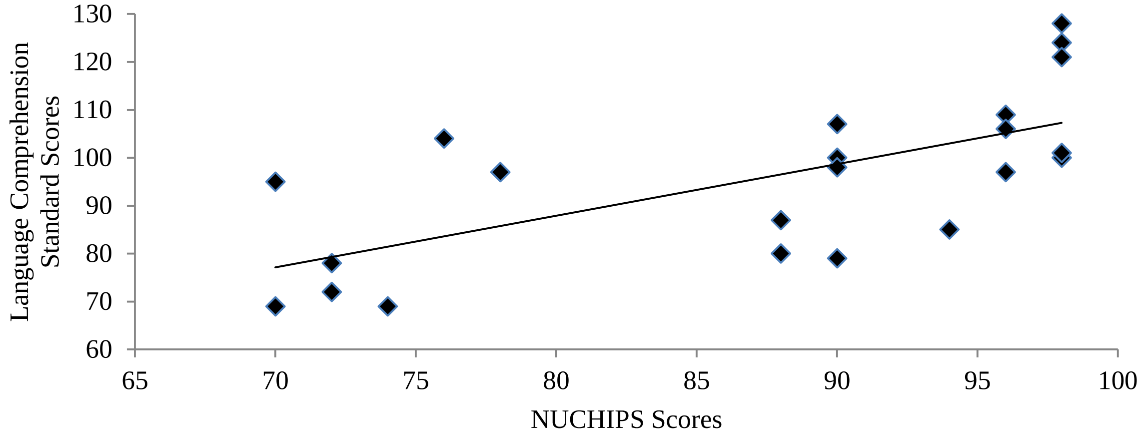

Figure 18: Association between NUCHIPS Scores and Language Comprehension Standard Scores

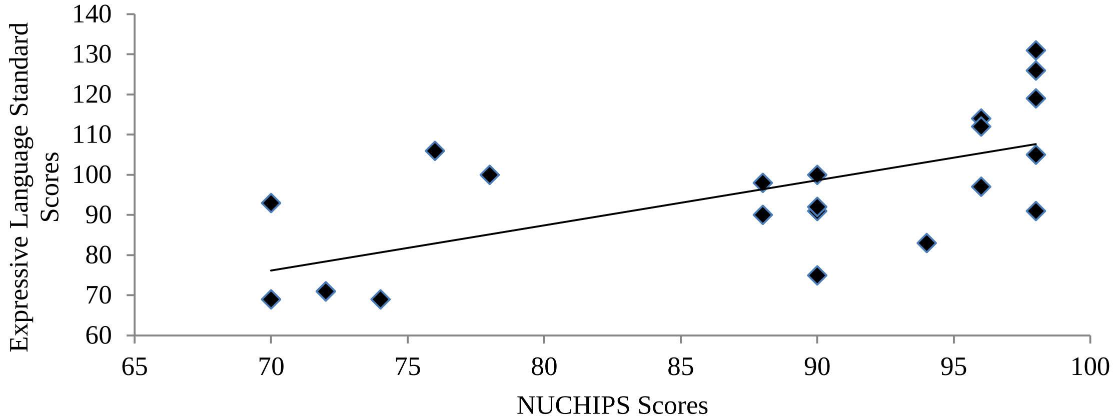

Figure 19: Association between NUCHIPS Scores and Expressive Language Standard Scores

6.7 Significant Longitudinal Changes

In the previous chapter, the longitudinal changes for each group were described. Here these changes have been checked for all older children with hearing loss as one group. There were changes in all areas, but only the significant group differences are reported (see Table 75).

Table 75: Significant Longitudinal Changes

Participants	*Mean (SD) for First Year*	*Mean (SD) for Second Year*	*Sig. (2-tailed)*
Language Comprehension	82.29 (11.54)	93.43 (17.40)	.044*
Expressive Language	84.57 (14.08)	95.00 (18.40)	.033*
Spondee Identification Subtest	20.00 (3.92)	23.14 (1.21)	.029*
NU-CHIPS	83.14 (8.86)	92.57(5.97)	.051
PCC	76.02 (14.10)	85.83 (6.21)	.025*
PPC	84.26 (9.14)	90.68 (4.18)	.026*
Inconsistency Rate	32.57(19.52)	12.57(9.07)	.014*

* Significant at .05

The older children with hearing loss when re-tested a year later on the New Reynell Language Comprehension Scale gained a mean score much closer to the test's mean, but with increased variability, as seen in the SD. There was a wide range of scores from 69 to 115. All of the children except Kim had made more than a year's progress in language comprehension in a chronological year. As a group, these changes was significant (p = .044).

For the New Reynell Expressive Language Scale, after a year and some time at school, the older group again had made more than a year's progress in a chronological year. The range of the scores was from 73 to 119. All children except Hannah made more than a year's progression in their expressive language scores. As a group, these changes was significant (p = .033).

In speech production, the children with hearing loss were scoring higher for all DEAP three scores one year later, and the changes in PCC (85.83(6.21), p = .025) and PPC (90.68(4.18), p = .026)) were statistically significant. In spite of this improvement, however, as a group they scored at the 5th percentile (below 1 SD of the mean) for PCC. The PPC was on percentile 50, in the normal range for their age, reflecting the combined results for PCC and PVC, with better results for vowels.

This increase in scores indicates that the children's speech was more intelligible than it had been the previous year. Their inconsistency rate also significantly decreased which further evidence of improved speech. Significant speech problems remain at 4-5 years however based on the PCC results.

These changes were not exclusively in the results of standardised tests; the spontaneous language analysis also showed changes although most of these did not reach a significant level. The only significant difference was for the reduction of unintelligible utterances (p = .036). This finding was in agreement with the speech measurement results.

6.8 Conclusion

In this chapter there was a comparison between children with and without hearing loss on some quantitative values derived from standardised tests and spontaneous language samples. It was found that children with hearing loss did not show significant differences from their hearing peers for most of the spontaneous language measures except the percentage of errors in different syntax structures and complex clause structures. However, they (especially the older group) had significant differences in almost all of the standardised tools from their matched controls. These differences were associated with the children's hearing loss, as they were not evident in the matched controls. These effects would be more evident after four years when the children have passed the main sensitive period for speech and language development.

Children's scores on different assessment tools are just an indicator of the level of their function on a specific test and in a specific area. Even if a child achieved scores in an age appropriate range, this does not guarantee that he or she will have spoken language and communication skills similar to a peer with normal hearing. A good example of this was Eris. There are often some subtle differences in some part of language which cannot be assessed by these standardised tools, and hence informal assessments should also be considered. As an example, the difference between children with hearing loss and their matched controls in the percentage of clauses in stage IV, or the number of plural marker as a morphological ending, could be examples of these subtle differences that could be targeted during assessment and intervention.

Speech perception, speech production, and language skills scores were correlated with each other. These findings show that these skills may play a role in improving or worsening related outcomes.

However, it should be kept in mind that there will be other factors contributing to better or worse speech and language outcomes in the child, e.g., speech perception deficits might not be the only reason of children’s lower scores in speech production tools.

Standardised speech and language assessment tools are useful to diagnose the delay and the progression that children make over time, and spontaneous language analysis is useful to find the depth of the speech and language problems, to find the most practical therapeutic targets, and to find those aspects of language (e.g. pragmatics) that cannot easily be assessed by standardised tools.

Chapter 7: Discussion and Directions for the Future

7. Introduction

The focus of this study was an in-depth examination of the communication skills and some of the background contexts for a group of young NZ children with hearing loss. Some skills were compared to a group of matched control children, to consider the reality of any concerns which were appearing in the skills of the children with hearing loss. The study also had a longitudinal element in that it re-examined the skills of some of the children a year later.

This chapter will first provide an overview of the findings of the study with an emphasis on what may be new when compared to other studies. Second, it will raise issues based on the descriptive and comparative findings to give a fresh interpretation of the speech and language learning world of families in NZ who have children with hearing loss.

7.1 The Overall Outlook

The first clear finding from this study is the variability among children with hearing loss. As a whole group, they performed significantly more poorly than their typical hearing matched controls in the results of most of the standardised tools. But there was always a large standard deviation in the scores of the group, and closer examination indicated that as pre-schoolers they broadly fell into three performance groups. Two of these groups had scores which were problematic to some degree, but one group was clearly within the normal range for communication skills for their age. The overall scores of the children with hearing loss tended to obscure the differences between these groupings.

The second finding provided some indications about trajectory. After a year which included some time at school, the higher-performing children continued to do well. The group which was well below the normal range continued to face challenges, however those who presented a mixed performance as pre-schoolers appeared to have improved. School seemed to provide motivation for use of both hearing aids and positive hearing behaviours.

The third finding relates to the holistic picture, and the value it added to the data. The degree and type of hearing loss in these children did not relate in any simple way to their communication skills, and the lack of predictive quality in these features meant a comprehensive speech and language assessment was necessary in order to judge the skills and the problems in communication that the children had. However, interpreting the speech and language data was enhanced by considering a range of related issues. Use of hearing aids, age of diagnosis, more and enriched intervention, and caregiver's educational level all seemed to be related to better outcomes for the children. Examination of a range of factors may enable better clinical decisions and planning than examining one or two measures alone.

Another finding was related to the nature of the measures used. It is less usual in research studies to get measures of these children's communication skills in interactive contexts. There may be good reasons for this. The nature of the sample is critical and it is time-consuming to gather and analyse the data. But this study also showed that there were some clinically significant findings about the nature of the children's communication, and equally significant, and more rarely examined, the study revealed clinically significant issues about the nature of the caregivers' communication when interacting with their children.

The proviso here is that these groups were very small in number; all these findings can be suggestive only, and will need to be followed up with larger numbers. However this study has allowed a rich and in-depth examination that could be followed up by targeted studies focusing on individual issues. The next part of this chapter will focus on the value for future intervention of some of the findings of this study, in comparison with the findings of other research.

7.2 Variability and Subgroups

This study is not the first to find significant variability of speech and language outcomes in a population of children with hearing loss. Others who have commented on variability in communication skills include (Blamey et al., 2001; Curtiss, Prutting, & Lowell, 1979; Davis et al., 1986; Jackson & Schatschneider, 2014; Koehlinger et al., 2013; Ling-Yu et al., 2013; Sarant et al., 2001; Svirsky, Robbins, et al., 2000).

Most of these studies tried to find out what was responsible for the variability. Some studies, as discussed in chapter 2, tried to diminish the significance of variability by using large samples. However, most of them still had some percentage of variability that could not be explained by the investigated factors (e.g. Sarant et al. (2009), Fitzpatrick et al. (2011)). However, the identification of three specific groups in this study might allow some intervention and service delivery decisions to be made early. For example, group 1 children might just need to be monitored every six months for any negative changes, and given family support. Group 2 children have a comparable level of speech perception skills, but they show speech production and language problems. An intensive speech and language intervention before entering school and retaining these services for the first year of school looks advisable for this group. Group 3 children need longer term and more intensive input, and show on-going difficulties. They also tend to have other problems (based on their parents' reports on the CDI) and need a team approach. This may enable more efficient and cost-effective service provision, and ensure that the most important needs are met.

7.3 The Complex Picture of Communication Skills

In the present study, the speech and language characteristics of a sample of younger children with hearing loss were investigated. Providing a unique speech and language picture for all children with hearing loss seems impossible. About 35 per cent of the children demonstrated age- appropriate speech and language skills (the higher performing group or Group 1), 45 per cent of the children with hearing loss had a significant delay in the development of their speech and language skills (the lower performing group or Group 2) and 20 per cent of the children were at the edge of or marginally below the normal range (variable performance or Group 3). This finding is fairly consistent with data reported by Sarant et al. (2009), however in that study the percentage of children with significant language delay was higher. This difference could be because they had a wider age range (1 to 6 years old), included mild to profound hearing loss and they divided their results into only two groups, with and without delay. It may be that some of those categorised in this study as variable would have been considered 'with delay' in Sarant et al.'s study.

The results of the present study were partially consistent with the findings reported by Fitzpatrick et al. (2011). Their results indicated they had two groups of children, those within the normal range and those below. The Comprehension scores of the PLS-4 showed that 85 per cent of their participants were within the normal range, while on the Expressive Language scores 70 per cent were within normal range. These are higher percentages than those found in the present study, but Fitzpatrick et al. excluded children with any additional disability, or those with significant bilingual backgrounds. This present study did not exclude any children on these grounds so may have had a wider sampling of children with hearing loss. However, the range was still probably not as wide as the population as a whole, due to a smaller number of participants with multiple issues and bilingualism being accessed, for a variety of reasons.

In speech, children in the higher performing group had a mean similar to Eriks-Brophy et al.'s

(2013) participants and HA users in Fitzpatrick et al. studies (2011). The other two groups in the present study scored similar or even less than these researchers' participants with Cochlear Implants. Again the percentage of participants who got scores at or above the normal range in these studies was higher than that of the present study. Based only on the speech production skills of children's scores in the GFTA-2, Eriks-Brophy et al. divided their participants into two groups, higher and lower performing. They found the difference between the two groups was related to the type of hearing technology used (CI users had lower scores as in the case of Fitzpatrick et al.'s study) and hearing age (children with longer history of device usage had better scores). In the present study only one child had CI and she had little experience with it at the time of the study, so the type of device will not explain the differences in performance that the participants in the present study showed. However age of diagnosis was a possible factor and this will be discussed further later.

In the present study, the older children with hearing loss showed significant differences from their matched controls in both speech and language measures. These results are broadly consistent with those found by Fitzpatrick et al. (2011) and Eriks-Brophy et al. (2013). These studies also found significant differences between children with hearing loss and typically hearing children, but their reported means were different. In the present study, children with hearing loss as groups were below -1 SD of the mean for their age, while in Fitzpatrick et al.'s and Eriks-Brophy et al.'s studies, children with hearing loss had a mean within the normal range. This might be because of the number of participants (they had larger samples), some demographic differences such as parents' education level (they had higher levels of education), the length of device usage (their participants had longer use) and the amount of therapy that their participants received (their participants were on the auditory verbal therapy programme).

The longitudinal element of this study indicated that a proportion of the children who were re-assessed after they had started school had made significant progress in speech and language measures after a year, and they scored within the normal range for their language skills although some individual differences were still evident. This is in contrast to the findings reported by Jackson and Schatschneider (2014) on the development of language skills of children with hearing loss over time. They found that their participants made significant upward progress in raw scores over time, but their standard scores did not improve significantly. The first reason for this difference might be age of participants. Children of different ages have different developmental rates. While language develops fast in the first three-four years of life, it starts to become slower after this period (this can be seen from the MLU for example). These researchers added the results for children of different ages (3 months to 6½ years old) and this might have neutralised the developmental rates. The second reason might be the way they chose their participants. Their participants were all from one university clinic which means they might not be representative of all children with hearing loss with different backgrounds. As discussed in chapter 4 socioeconomic status and parental education can have an impact on children's speech and language outcomes.

This significant improvement over a year for language skills was consistent with findings reported by Blamey et al. (2001). They found that children's language scores steadily improved over time (they used age equivalents rather than raw scores) but that the speech did not change significantly because their participants were quite intelligible to begin with. This present study found that the Group 1 children were in the normal range for most of the speech production skills in the first assessment, but that only Myra was able to keep within the normal range during the course of a year. Most of this study's participants increased their speech production skills, but the standard scores were still below the normal range. However, this present study's participants were younger than Blamey et al.'s participants. Their participants were in primary school, and by that time children will have acquired most of their speech production skills and their focus will be on other skills. Eriks-Brophy et al. (2013) in contrast to the present study found their participants made about a year's progress in their speech production skills after one year. However as mentioned previously Eriks-Brophy et al.'s (2013) participants had no additional disability, no recurrent otitis media and were monolingual in English with a long history of auditory verbal therapy.

The specific delay in speech was also evident in children's phoneme inventories. Fricatives and affricatives were problematic sounds and emerged later. This finding was consistent with finding from other studies (Blamey et al., 2001b; Ching et al., 2013a; Eriks-Brophy et al., 2013; Moeller et al., 2010; Serry & Blamey, 1999; Serry et al., 1997; Tobey et al., 1991; Wiggin et al., 2013).

Longitudinal results showed improvement in children's phonemic inventories. For children in the higher performing group, the missing sounds were age related (those phonemes which emerge later) so they were within the normal range. But children in the lower performing group still had problems with fricative sounds which placed them outside of the normal range for their age. This was consistent with findings for 5 year old children reported by Eriks-Brophy et al. (2013), in that their 5-year old participants still had problems with some fricative sounds. The growth of the number of phonemes over a year was consistent with results of studies which have been done on children with cochlear implants (Blamey et al., 2001a; Blamey et al., 2001b). Fricative sounds are discriminated mainly based on acoustic cues in the high frequencies (Ching et al., 2013a), and these children have problems receiving these sounds.

Generally, the children with hearing loss had examples of both developmental and non-developmental phonological processes in their speech. This was consistent with findings from previous studies (Eriks-Brophy et al., 2013; Flipsen Jr & Parker, 2008). However in the matter of active phonological processes, the groups were different. The higher performing group and the variable performance group had only one child who had an active non-developmental phonological process and only one child who used a phonological process that would normally have been suppressed earlier. All the children in the lower performing group had active non- developmental processes and active developmental processes appropriate at a younger age. This finding strengthens the hypothesis that some children with hearing loss have a delay in their phonological skills.

The specific problem with speech production skills for the current study's participants was also obvious regarding the most common phonological processes. Younger children with hearing loss had cluster reduction, weak syllable deletion, final consonant deletion and backing. This finding was fairly consistent with findings reported by Ambrose et al. (2014) and Ching et al. (2010). However, Ching et al. (2010) found that the phonological processes used by their participants were developmental, this contrasted to this study's finding, since younger children had 'backing' as an active phonological process which is a non-developmental phonological process.

The older children with hearing loss had stopping and cluster reduction as the most common phonological processes. This is consistent with the findings of Flipsen Jr and Parker (2008) and Ching et al. (2010). By the time they were in school a year later, only cluster reduction was a common phonological process in their speech and some of children did not have any active phonological process. It seems with age and with whatever intervention they had been receiving, their speech improved and they were considerably more like their typical hearing peers. But there were still some children who had some active phonological processes. This is consistent with Worsfold et al. (2010). In their study of children aged 7-8 years old with and without hearing loss, the children with hearing loss still had some active phonological processes while their matched controls showed none.

These speech and language problems were accompanied by problems in children's speech perception and auditory behaviour skills. Children with hearing loss had significant differences from their matched controls in the more complicated speech perception test (NU-CHIPS) but not for the simpler one. These results contrasted with the results of Looi and Radford (2011) indicating that there was no significant difference between children with hearing loss and children with typical hearing. The differences between this study and their study could be because of the age of the participants. Their participants were older (the age range of their participants was 6-13 years, mean 9 years, by that time children have almost reached the highest level of their speech perception skills.

Children with hearing loss even when using their hearing aids scored below children with normal hearing in auditory behaviour which is consistent with the findings of Ching and Hill (2007) and Ching et al. (2010). For children with hearing loss, Ching and Hill (2007) reported their results based on the severity of hearing loss. The range of overall scores was from 60 to 70 per cent for mild to severe hearing loss. In this study the participants score range was different from Ching and Hill (2007). They had a range of 56-86 per cent with a severity of hearing loss from mild to severe. However, the mean was close to that found by Ching and Hill (2007) and (Ching et al., 2013a).

Ching and Hill (2007) found that children with more severe types of hearing loss got lower scores in the PEACH, however in the present study, the highest scores belonged to Hannah and Jack with moderate-severe and moderate hearing loss. This could be a simple variation in data, and to make a definite conclusion a larger subject group is needed. If these two participants were excluded, then there would be a similar relationship between the children's scores and their severity of hearing loss to Ching and Hill (2007).

To sum up, most of the results of the current study such as delay in the speech and language outcomes are in line with the findings reported in many other studies. However, the current study showed that a higher percentage of NZ children with hearing loss had lower levels of performance in speech and language measures. This was more similar to findings reported from Australian studies and less like the Canadian studies. This can be a result of later diagnosis and the subsequently later fitting of hearing aids in this group in NZ. Not many of this study's participants had speech and language therapy intervention with a focus on auditory verbal therapy. Also most of the children with lower performance had a multi ethnic background, a feature often excluded in other studies. At least for three of these children there was a history of recurrent otitis media that might have had some influence on their outcomes. Again many studies excluded children with this problem or tried to investigate them in a separate group to get a clearer picture but at the same time they overestimated their participants' speech and language outcomes.

The current study showed a potential increase in language measures after a year which none of the previous studies discussed, here and in chapter 2, had reported. This can be a direct result of intensive support that these children received before and after they entered school. The participants in the present study did not make as much significant progress in their speech production skills in standard score terms, although the severity of their speech production problems decreased noticeably when compared to their performance a year before.

Among all the assessment tools, LARSP was the only one which gave more comprehensive data on children's language and interaction, below is a discussion on the specific results from this measure.

7.4 Specific Findings from LARSP

In addition to investigating the general picture of language and its development, this study had a closer look with LARSP into the morpho-syntactical skills of children with hearing loss. Syntax has been introduced as a more vulnerable area in hearing loss (Lederberg et al., 2013), but there were not many studies (as discussed in chapter 2) that investigated in depth this aspect of language in children with hearing loss. For this reason most of the findings in the present study could not be compared, so this information should be used with caution. One detailed study that looked into the syntax structures of children with hearing loss using the same profile is Bol and Kuiken (1990) but it was conducted on children in The Netherlands and their results could not be generalized to the English language.

The results for elliptical and reduced major utterances suggest both optimism and concern. Elliptical utterances happen when part of an utterance has been deleted because of the previous utterance, which is a normal condition and part of developing language skills. There were plenty of elliptical utterances in the children's language samples. But in reduced major, some of the major elements of utterances are deleted and this deletion cannot be explained by the previous utterances or the children's age. This type of utterance can be seen in typically developing younger children (2-3 years old) but when they are in language samples belonging to 3-4 years old (or older) children there is a need to reconsider the children's language skills carefully. The significant difference between older children with hearing loss and their matched controls confirmed the immaturity of syntax in the language of children with hearing loss. Even after a year the decrease in this type of analysable utterance was not significant and there were still some children who struggled with major elements in utterances. For example an utterance like "how old he?" from Paul's language sample when he was 5;09 years old shows problematic expressive syntax for his age.

Typically hearing children start using complex sentences when they are about 3 years old. So the common expectation for the relative frequency of utterances in different stages will be, highest to lowest, stages III, IV-V, and finally II. When children are at age 4, some traces of stages VI and VII can be expected. The matched controls, the Group 3 children and the Group 1 children showed this pattern, but the group 2 children used utterances belonging to stage II more than the complex utterances belonging to stages IV and V. This is in agreement with the children's performance in the New Reynell language scales in which they showed a delay in expressive clause structures compared to the other two groups and the matched controls. One year later however, this group showed the expected pattern for clause structures in the higher stages which means that the development of syntax in these children was still ongoing.

The grammatical gap between children with hearing loss and their matched controls showed most with long and complex clause structures. Older children with hearing loss were significantly different from their matched controls in the percentage of clause structures in stage IV, and the proportion of clause structures from stage V (complex clauses) was low. This finding was consistent with results reported by Worsfold et al. (2010). These researchers examined syntax in 89 children with hearing loss (mean age was 7;07) in a retelling story task. In their study, the median for the complex clause structures for children with hearing loss was one and for matched controls was two. In the present study, for those children who were re-sampled one year later, stages IV and V clause structures increased to over 10% of the analysable utterances which is a good sign of a child's progress.

Children with hearing loss had grammatical delay from another perspective which is the most common clause and phrase structures. Approximately 50 per cent of children with hearing loss used the clause structures 'SV', 'SVO', 'SVC', 'SVA', and 'SVOA'. The phrase structures that at least 50 per cent of children with hearing loss used were 'DN', 'Pronpo', 'Auxmo', and 'Cop'.

More than 50 per cent of the matched controls had the mentioned structures, but in addition they had 'VS(X)+', 'AdjN', 'Vpart', 'PrDN', 'DAdjN' and 'NegV' as their most common phrase and clause structures. The group 2 children had the most limited types of clause and phrase structures, which meant they were more delayed in their syntax skills.

Those children who were re-sampled one year later showed more complex expressive syntax not only in the percentage of utterances which were in the higher stages of LARSP but also in the most common clause and phrase structures in the lower stages. More than 50 per cent of children with hearing loss used 'SV', 'SVC', 'SVO', 'SVOA', 'QVS', and 'Coord. 1'. For phrase structures, they had 'DN', 'DAdjN', 'PrDN', 'Pronpo', 'Auxmo', 'Cop', 'cX', 'XcX', and 'NegV'. They had more expansions at stage III. All these findings together indicate at age 5 children display a more complex language.

The morphological endings were another component of language that showed some delay, although the differences between children with hearing loss and their matched controls were not significant. Children with hearing loss used fewer morphological endings and used mainly verb morphemes. This finding contrasted with findings reported by Worsfold et al. (2010). They used LARSP and found in a retelling story task that children with hearing loss used significantly fewer morphological endings than their matched controls. This could be because of the different procedures used to elicit language samples, the restricted number of participants in the current study and its high variability.

The older children with hearing loss had significantly more errors in the different structures (clause, phrase and word) than their matched controls. This finding was consistent with Koehlinger et al. (2013). They reported children with hearing loss used finite verb morphology with less accuracy compared to their normal hearing peers. They also found that children with and without hearing loss at age 6 had fewer morphological errors than children with and without hearing loss at age 3. The current study found similar findings for the matched controls, but not for the children with hearing loss. Both age groups of children with hearing loss had similar means of morphological errors which differs from the findings of Koehlinger et al.. This difference might be because of age, in that they compared 3 and 6 years old children but this present study compared 3 and 4 year olds. Their older participants had at least a year of school experience. However, the present study's finding about children with hearing loss aged 5-6 compared to those assessed at 3- 4 was consistent with their finding and also consistent with findings presented by Norbury et al. (2001) and (Ling-Yu et al., 2013). This finding means that the younger children used morphological endings less accurately than the older children and as they got older they got better which is to be expected. This finding shows the children were on a typical developmental track for morphosyntactical skills but with a little delay.

In the present study, the usual problem of children with hearing loss in regard to morphological endings was deletion which is consistent with Ling-Yu et al. (2013). They reported their participants had more omission errors. In fact, in the current study, the main problem was inconsistent use of morphological endings which means children used grammatical morphemes correctly in some utterances and then deleted them in other utterances. This problem even happened in similar utterances following each other. For example, Jack in a part of his conversation with his caregiver found 'two Lego dogs'. When he was trying to catch the caregivers' attention, he kept repeating, 'two dogs, two dogs …' but in his repetition the plural marker was deleted gradually. It might not be a new finding since it has been mentioned in the literature of the 70s and 80s (McGuckian & Henry, 2007), but it is a valuable outcome that shows some of these children despite progress in aspect related to diagnosis, intervention and technology still carry some of the morphological faults in their language and it is good to consider them when planning therapy.

To conclude, along with all the other problems that appear in the general picture of speech and language, detailed investigation showed that children with hearing loss have different degrees of delay and deficit in the more specific components of language, the morpho-syntactical features. Even though they were similar to typically hearing children in the most common structures and they even used similar percentages of different clause, phrase and morphological endings, they still had a higher percentage of errors in different structures. The positive finding was that they had delayed but not deviant morpho-syntactical development. Learning syntax and morphology will happen in a live interaction. But they are easily lost in the speech stream and are difficult to pick up by children with hearing loss since they have salient features (unstressed and without content) (Lederberg, 2006).

7.5 The Benefits of LARSP

In the current study, LARSP was an efficient tool to assess language in-depth, especially in aspects that were more vulnerable to being affected by hearing loss. With only 15 minutes of spontaneous language samples, the researcher was able to get a huge range of information compared to standardised tests which take longer and provide less practical information. Even though the transcription of the language samples was initially a time consuming job the speed of doing so improved with time.

LARSP is financially efficient compared to standardised tests. There is no need to buy anything except a voice recorder, pencil and paper, while for the standardised tests, therapists need to buy tests and their answer sheets, do recording (video usually) and do a double check.

There are other tests that can evaluate a particular aspect of syntax but these tests can rarely evaluate all structures (clause, phrase, word and even expansions) at the same time. Those kinds of assessment tools designed for example to assess a specific dimension (e.g. ‘ed’ as the past marker) will not say anything about other morphological endings or other utterance structures. However with LARSP all of this information will be available.

LARSP is not a pure morpho-syntactical profile. It can give information about interaction features, morpho-syntactical errors, general syntactical information and cohesion. This information can rarely be elicited from a standardised test. Even questionnaires or observational methods are time consuming and will be affected by many confounding factors.

Standardised tests usually need an interval about 6 months before they can be repeated (e.g. the New Reynell) in order to maintain validity. But language development happens in a continuous way and there may be reasons for needing evaluations more frequently than this. For example, for evaluation of children's progress during a short term therapy course (e.g. 10 sessions during 4 weeks), practitioners need assessment tools that do not need intervals. LARSP is one of those tools.

However, two disadvantages of LARSP are the analysis expertise needed by the assessor, and the need for the language sample to be as representative as possible of the child's expressive language capabilities. The analysis expertise requires training, however learning it is well within the skill set of speech language therapists. The results from LARSP are highly dependent on the features of the language samples. Some special issues about language samples were found in this study, which need to be considered during data interpretation and drawing conclusions.

7.6 Issues around Language Sampling

It became very clear in this study how much the type of activity and the genre of the language sample can affect the length of utterances and their complexity. Children both with and without hearing loss sometimes had samples that were dominated by one-word utterances, which was less about their language skills and more a function of what they were doing at the time. Group 1 children (higher performing) had a higher proportion of one-word major utterances than the other two groups, as did the typically hearing matched controls (see Excerpt C from Erina's language sample).

Erina's language sample was heavily influenced by the types of language stimulations that the caregiver used. The greatest number of her utterances were in stage I, 71 Stage I major utterances, 58 of them 'noun'. The caregiver chose two activities: reading a book and solving some puzzles, but the communication was basically about the caregiver extracting naming from the child. It is a "what's that?" kind of genre, where the child is required to demonstrate their knowledge and the caregiver delivers praise. This is what (Sinclair & Coulthard, 1975) called the I-R-E exchange that was so common in schools, where teachers asked known-information questions, children answered, and received an evaluation (of the 'good/correct' or 'no/wrong' type). Sometimes the 'E' move was implied, by the teacher repeating the answer, or moving on to the next task with the implication that the answer had been correct. This pattern is very evident in the excerpt you see below.

Similar activities were chosen by Sue’s caregiver, but Sue’s LARSP showed a different profile because her caregiver engaged in a different genre. She did not seek the names of things all the time, although she did do some of this, especially in the jigsaw task, but she also made comments (e.g. “We saw that at Kelly Tarlton’s, didn’t we?” and “oh!”) and left space for the child to make comments. This resulted in very different utterances from the child, e.g. “It can sting” and “he gotta fall in this side if he is standing on here”, along with “squid”, “toothpaste” and “seahorse”. These samples illustrate that the nature of the sample needs to be looked at carefully, as it has the potential to bias the results (see Excerpt D from Sue’s language sample).

Excerpt C: Interactants' Talk during Two Different Activities: Erina

Speaker	*Activity 1: Reading a Book* *Utterance*	*Activity 2: Solving a Puzzle* *Utterances*
Caregiver *	He's alright my dad! My dad isn't afraid of anything! Even the big bad ?	This one? (E. is nodding her head) Ok, Should we tip it out and start? (E. is nodding) What've we got here? What've we got? What've we got? What've we got? What've we got? We've got a? (E is waiting) What's that?
Erina	Wolf	Whale
Caregiver	… My dad can eat like a ?	It's a whale. A blue whale (He pointed to another piece)
Erina	Horse	Squid
Caregiver	Horse, and swim like a ?	That's a squid. You know what squid is. That's what I thought the octopus was. It's an octopus in there, isn't it? You are a squid in your swimming class, aren't you? (E is nodding) You're a squid in your swimming school. A …?
Erina	Fish	Dolphin
Caregiver	Well it's like you, you can swim like a fish, can't you? You're doing very well in swimming. He is as strong as a ?	A …?
Erina	Gorilla	Turtle
Caregiver	(made Gorilla sound) And as happy as a ?	Well done A … ?
Erina	Hippo	Shark
Caregiver	Hippo, Hippopotamus. He's alright my dad. My dad is as big as a ?	Wow, Scary teeth! Good girl. A …?
Erina	House	Em, sea horse
Caregiver	House and as soft as my ?	Sea horse, a …?
Erina	Teddy	Jelly fish
Caregiver	Teddy. He is as wise as an ?	Jelly fish (He pointed to another piece of puzzle)
Erina	Owl	Crab

Excerpt D: Interactants' Talk during Two Different Activities: Sue (Matched Control)

Speaker	*Activity 1: Reading a Book*	*Activity 2: Solving a Puzzle*
	Utterance	*Utterances*
Caregiver	… But the tub did not hold him at all, he went right on growing, 'poor Atoo' I said.	Whale Do you know what that is?
Sue	And everything is inside	Squid
Caregiver	Yes, it's all floating, isn't it? Oh, it is a toothbrush.	Good girl, squid We saw that at Kelly Tarlton's, didn't we?
Sue	Tooth paste	Ø
Caregiver	Yeah, then crashed the door, went down crashed, Atoo went down, I went down too, oh what a ride	Hum! Oh!
Sue	You get hurt	It can sting
Caregiver	Yeah, it might hurt bottom	Yeah it is sting hay
Sue	On this is	And this can chip
Caregiver	Yeah, down with the water into the cellar and down with Atoo too. I had to do something fast, I grabbed the phone. Hih?! Who's he gonna call?	Snap snap snap
Sue	The police man	And this can sting too
Caregiver	Yeah, what's he gonna say?	Yeah, a jelly fish stings too, isn't it? What about this one? Does this sting? (She is shaking her head) No? (She is shaking her head) Do you remember what that one is?
Sue	(shrugged her shoulders)	Ø
Caregiver	… He's down in the cellar. Do you know what the cellar is?	Remember when we went to the secret town, what Kelly called that a lots of
Sue	(turning head around as 'no')	Sea horse
Caregiver	It's special roof	Good girl
Sue	Downstairs	And this one can bite
Caregiver	…. call for help on the radio. Where they gonna take him you think?	Yeah because he is a
Sue	To the fire engine	And do you know what this one can do?
Caregiver	… But where can we take him? I asked. Up town? Down town? Where should they take him?	What?
Sue	In the pool	He could push children with this things
Caregiver	…. This big pool is just the thing	Pushes children?
Sue	He gotta fall in this side if he is standing on here	With these ones (she pointed to something)

The examples above illustrate the influence of the role the interactant chooses to take in the talk. However the activity chosen also influences the talk that can take place. The Excerpt E (from Sara's and Eris's language samples) shows both the influence of the activity and the role choices of the interactant. They involved similar activities (making cakes with their caregivers) but their language outputs were different since their caregivers used different language stimulations and also different genres.

Excerpt E: Excerpts from Sara's and Eris's Language Samples during a Similar Activity

Speaker	*Sara's Language Sample*	*Eris's Language Sample*
	Utterance	*Utterances*
Caregiver	Mummy just fold them over the edges	Next we need some flour?!
Child	Yeah	You want do it, Wait
Caregiver	Yeah. How many does it make?	Good girl.
Child	More	That one
Caregiver	Ok, so here. This is we need two spoons	And we need, we need a one and a half cups. We need a blue one and a green one.
Child	Uhum	Ok
Caregiver	24 level [tea] table spoons of butter, we need 24 , can you count 24?	Is that a blue and a green one?
Child	Twenty four here	That orange
Caregiver	Ok. So, do you wanna a tablespoon?	Yah, so what do we do?
Child	Yes	Orange and blue
Caregiver	Mummy have a tablespoon?	Orange and blue?!
Child	Yes	Yes
Caregiver	And we have to put the mixture over here by you	But mummy said a blue and a green.
Child	Yes	No
Caregiver	So let, when they say level	No?!
Child	Ok	No

This finding supports previous studies in suggesting that different genres can give different shapes to the language samples (Southwood & Russell, 2004; Wagner, Nettelbladt, Sahlén, & Nilholm; Westerveld et al., 2004; Wren, 1985). Wren (1985) studied the effect of different language elicitation tasks on the language samples of 30 children (15 with language problems and 15 matched controls in terms of age, sex, socioeconomic status and IQ) at age 6. They compared language samples retained from different language elicitation techniques such as spontaneous interaction (free play and conversation) to specific tasks to elicit specific structures like 'sentence building'. Their results showed that a lot of differences in children's language can be explained by the language elicitation tasks. In a more recent study in NZ, Westerveld et al. (2004) reported language differences resulting from different language elicitation techniques (narration versus conversation). They took language samples from 268 children (4;05-7;06). They found that the elicitation context had significant effects on expressive language measures. Narration was a useful task to get a more syntactically complex language samples. Southwood and Russell (2004) and Wagner et al. investigated a similar subject in other languages (Afrikaans and Swedish) and found similar results, different genre and elicitation tasks resulted in different language samples.

In the present study, caregivers were free to choose the activity they would engage in with their child for the purpose of language sampling. This provided a picture of caregivers' desires and interests, but at the same time different language outputs. However, the activities placed the children in particular roles, from a follower/passive role such as in baking a cake to an active/leader role such as solving their favourite puzzle. Different roles meant different language would be used by the child, and highlighted the fact that there is no such thing as 'the' language sample of a child, but only 'a' language sample, with a range of characteristics which influence the communication skills the child will be able to demonstrate. Free play with a more active role for the child may lead to a more representative language sample than a caregiver-led activity.

However it is not only the role of the child that needs to be taken into account. If the caregiver does not normally 'play with' the child in this context, then this may also not produce a representative language sample.

In this study, where free play was chosen by the caregiver, the children showed satisfaction at being invited to play and spend time with their caregivers especially when no one else was invited to do so. For example, all of the descriptions of Nemo by his caregiver were negative (see chapter 4) and he was not as cooperative as other children during the assessments. But during interaction with his caregiver, he asked to play a game again because he thought it was fun (see Excerpt F). This child hardly answered the questions in the speech and language assessments, but in this sample he used short, but well-structured and appropriate utterances to express his satisfaction and requests.

Excerpt F: Nemo and His Caregiver

Participants	*Utterance*
Caregiver	…That`s done.
Nemo	Make it again
Caregiver	What?
Nemo	Make it again
Caregiver	Make it again?
Nemo	(nods)
Nemo	That was fun
Caregiver	That was fun?
Nemo	Yeah
Nemo	Make it again
Caregiver	Yay?
Nemo	Make it again
Caregiver	Make it again, Ok. Sit back

The nature of the language sample particularly affected the socio-conversational measures taken. No other studies were found that used this measure so there are no direct comparisons, however other perspectives indicate how language is affected greatly by context, including genre and role (Halliday, 2007; Labov (1972); van Dijk, 2009), therefore it is to be expected that the impact would be greatest in socio-conversational skills. There is need for a balance between a 'natural' or representative sample of the child, and a natural or effective interaction, which therefore involves social and cultural norms and expectations of the caregiver / interactant, and these will not be the same for every caregiver/child dyad. The caregivers tended to show these children the boundaries of assertiveness and involvement, which is probably related to their young age (preschool) and the socialisation roles caregivers tend to have at this stage. The change that seems to occur as a result of increasing age may have as much to do with the changed social context, namely school, as it does to do with age itself.

In this case, the children's language profiles changed according to the amount of freedom they were given by their communication partner. In some interactions, caregivers allowed or encouraged the child to take the lead (e.g. with Julia, Nick, & Hanne), and these children's samples showed a higher percentage of assertiveness. These samples, as expected, also showed more variety in their language structures. Some caregivers asked a lot of questions, and created an 'interview' kind of genre. The child's answers as a consequence were often higher in one word and elliptical utterances (e.g. Erina and Cheryl). These children had limited opportunities to give their opinions or ideas. So their syntax on LARSP and their interaction skills on socio- conversational analysis looked different to those of their age peers, even though they had age- appropriate language skills on the test measures.

The language/interaction sample can also be affected by the children's relationship with their interactant. In this study, some children displayed completely different syntactic and interaction profiles when they were interacting with their father, the other grandmother or another person in their family. For example, after 30 minutes, Sara's mother left it to her father to finish the cake. Sarah showed a higher proportion of assertive conversational acts. She was talking more, giving instructions and requested more. She became the leader and she was giving orders to her father. So another factor that should be considered when taking a language sample is the child's communication partner because the behaviour of the communication partner can impact the type and amount of language that children will present.

The other factor that affected the language/interaction samples was the child's attention span, and how much they were interested in a particular activity. As an example, Paul's caregiver chose to read a story book in his second year assessment, and although Paul participated he was very distracted so that while his caregiver was trying to read the book, he was trying to drag his caregiver's attention to aspects of the pictures. He was trying to change the topic to something different that he was interested in and in those efforts he used more complex utterances than during the time that he was just a listener. This was perhaps an unexpected benefit, and highlights some of the recommendations in the literature to use things which are broken or which potentially frustrate the child's activity in order to prompt them to display their communication skills. For example, 'sabotage' techniques which include silly or unusual events to make children talk such as pouring coffee onto a plate rather than into a cup (Fey, 1986; Paul & Norbury, 2012).

However a task in which a child is not interested might have a contrary effect. In the first year assessments it was clear that when the children were not interested in a subject, they did not show as good a language performance as they did when they were engaged. Based on researcher observation, time of assessment, location and the children's enthusiasm about being part of a conversation should be considered in speech and language assessment as these various features will change the language sample.

To conclude, taking a representative language sample to show a comprehensive picture of a child's language is a fraught topic. It is not possible to show all of the language capabilities of children with only one language sample. Thus, depending on the researcher/therapist’s goal, a specific genre should be chosen such as structured conversation (interview) or un-structured (free play), and more than one sample across more than one genre may be desirable.

7.7 Interaction

Specific findings from LARSP were not limited to morpho-syntactical features. Based on LARSP, during interaction, children received different numbers of stimuli. Part of this is related to the caregivers’ efforts to get the child to practice new words, sounds or learn numbers which is a possible sign of a child’s speech problems or vocabulary problems. However, it seems children were also cooperative because of the higher percentage of ‘responses’ and ‘other’ reported in the ‘Minor’ part of stage I. This finding is a positive sign for children’s conversational abilities in spite of their speech and language problems.

The highest percentages of unanalysable utterances such as ‘incomplete’, ‘unintelligible’ and ‘repetition’ as in all of the three performance groups raises concerns about problems with speech sound, language components and even interaction. In fact, these concerns were reinforced when children’s scores were compared to their matched controls and they had significant differences from their matched controls in the ‘unintelligible’, ‘abnormal’ and ‘deviant’ categorisations. Such results show the necessity of speech assessments in both perception and production in addition to an in-depth grammatical investigation. A significant decrease in unintelligible utterances after a year is a reason to assume their speech had progressed, although the proportion of their utterances which were repetitions or incomplete was still high.

Children with hearing loss also had more problems understanding their communication partners’ utterances in immediate contexts than did their matched controls. This is evident in their ‘abnormal’ utterances. Approximately one per cent of their utterances were ‘abnormal’, while for their matched controls, this category was about 0.2%. These ‘abnormal’ utterances do not necessarily have morpho-syntactical errors, but they did not follow the previous utterances semantically. This finding supports the results reported by Most et al. (2010) from Israel. These researchers investigated the pragmatic profiles for 24 children with hearing loss aged 7 years old in interaction with an adult. They found there was only one parameter –contingency- that all children with hearing loss scored as ‘inappropriate’. ‘Contingency’ as used in that study was similar to ‘abnormal’ responses in this study, i.e. it was about whether the child’s utterance related to the previous one from their interactant. However, after a year, the percentage of abnormal responses decreased to 0.2%. Again they reached the level of the typically hearing children but not until then, which means they also had a delay in this component of interaction.

Some of the children with hearing loss put some effort into attempting to get joint attention from their communication partners. This was obvious for Group 3 children especially in the number of vocatives. This finding shows a gap between communication partners during interaction. Such problems should be considered for assessment and then, when the therapeutic plans are going to be implemented, by the families' involvement.

Children with hearing loss and their matched controls were evaluated in a very familiar place (usually at home) with a very familiar interactant (caregiver), which the literature advises is most likely to result in natural talk and interaction. Children with hearing loss regardless of their speech and language skills were as assertive and responsive as their matched controls. This finding supports the findings of Lederberg and Everhart (2000) suggesting that younger children with hearing loss (20 toddlers) interact actively with their mothers and they are eager to communicate. However, it is in contrast with findings reported by Most et al. (2010). They found all of their participants except one (N= 24) were scored as 'inappropriate' in the 'response' parameter which is related to the responsiveness of the communication partner as a listener. Perhaps this difference was because these researchers have been looking at only verbal responses from these children, while below it can be seen that the main part of children's responses regardless of their hearing status were nonverbal, without those nonverbal responses in the present study these children could be considered as nonresponsive to their communication partners.

Without including nonverbal acts (such as gestures, facial expressions, and body movements), all of the children with and without hearing loss appeared on the socio-conversational measure to be low in responsiveness. But, when nonverbal acts are included, this picture changes. Children with hearing loss responded to their communication partners more often verbally (66 per cent) than the children without hearing loss (55 per cent). The positive side of this is that these children with hearing loss had verbal competencies, and they used them. On the other hand, the matched controls used nonverbal skills alone in 45 per cent of their responses, compared to the children with hearing loss who did this in 34 per cent of their responses. This result is surprising, as it is logical to expect that children with hearing loss would need to rely more on nonverbal skills than typically hearing children, but in fact it appears that good hearing allows combinations of verbal and nonverbal communication to be used efficiently, and perhaps especially so with close social partners. It is possible that higher verbal responsiveness might result from environmental pressure on children with hearing loss to talk more, and could be a sign of an atypical communication environment.

The nonverbal acts that children with and without hearing loss used had different purposes which can be interpreted by Curtiss et al's (1979) 4 type categorisation. Children with hearing loss and their matched controls had many 'Type A' acts, which is a combination of word and gesture to express a meaning (e.g. combination of 'no' and shaking head). Some children occasionally used 'type B', which are verbal and nonverbal acts together but for two different purposes. For example, Kim, while shaking his head to show 'no' pointed with his finger to the voice recorder beside the caregiver and said "I know it".

Children also used nonverbal acts to give a gloss or to improve a verbal message which is 'type C'. 'Type C' usually illustrates an ambiguity, for example a pronoun when the reference is not clear. (see Excerpt G from Paul's sample below).

Excerpt G: A Combination of Nonverbal with Verbal Act (Type C)

Speaker	*Utterance*
Caregiver	"What would a crocodile do?"
Paul	[Eat them]* (pointed to some pictures in the book)
Caregiver	[Eat who]?"
Caregiver	Oh! Look! There are crocodiles. you are right.

* [ ] = overlapping talk

Children also sometimes used nonverbal acts when they could not remember a word, which is Curtiss et al's 'Type D'. Gestures such as pointing, tapping or any other movements that substitute for a missing semantic part of a verbal utterance (see Excerpt H from Cheryl's sample below). This could also sometimes be a sign of word finding problems or poverty of lexicon.

Excerpt H: A Nonverbal Standing in for a Verbal Element (Type D)

Speaker	*Utterance*
Cheryl*	And it had that thing when you hold onto it
Caregiver	Ehum, and then you [ride/walk]
Cheryl	And the thing that we (Child showed word with gestures which meant holding a horse bridle) here
Caregiver	Handles!
Cheryl	Yes

Children also sometimes replaced a complete verbal act with a nonverbal act, which was not one of Curtiss et al. (1979) categories. This category was added because children with and without hearing loss used this category frequently in the current study (‘Type E’) (see Excerpt I and Excerpt J below, from Josie’s and Cheryl’s samples).

Excerpt I: Nonverbal Acts; an Example from Matched Controls

Caregiver’s Utterance	*Josie’s Nonverbal Act- Utterance*
Did you see her at Disneyland?	(nods head)
And what happened to Cinderella?	(shakes head)
Do you remember what she lost?	What?
Was it her shoe?	(nods head)
Did she lose her shoe?	(nods head)
Did she find it again?	(nods head)

Excerpt J: Nonverbal Acts an Example from a Child with Hearing Loss

Caregiver’s Utterance	*Cheryl’s Nonverbal Act- Utterance*
She asked child finds number 14.	Haven`t find it
Ok, On the other side?!	(Child is looking at the other side.)
Oooooo![a sound like waiting for an answer]	(child just kept looking)
Anything?	(shaking head)
Ok, ready?	(Child is looking at her)

The high number of nonverbal acts was not related to general expressive language skills by standard score and the number of nonverbal responses in interactions ($r = -.20$, $p > .05$). Therefore a high rate of nonverbal responses it was not necessarily a feature of those children with lower language skills. This finding was partially consistent with the data reported by Curtiss et al. (1979). They found those children with more verbal skills used more verbal-nonverbal combinations, hence nonverbal communication should be seen as an integrated part of communication skills, rather than as an inferior substitute.

Children with hearing loss tended to have a mainly responsive role rather than an initiating one in these samples. For example, they had higher proportions of topic maintenance and topic initiation than topic extension functions. This finding is consistent with findings reported by Most et al. (2010). They found children with hearing loss had more topic introduction, topic change and topic maintenance compared to their typically hearing children. However, the extensions increased with age, in that the children followed up after a year had all increased their proportions of these topic functions, whether they were from the group who were already doing well, or those who were behind in communication skills (i.e. both Group 1 children and Group 2 children). Their 51-55 per cent topic maintenance was close to that of the 3-4 year old matched controls. The younger children with hearing loss had significant differences from the younger matched controls in proportions of topic initiation and topic extension in their samples. However, it was still the case that there was a lot of variability in these measures across the children, and generalisations cannot easily be made.

In conclusion, children with hearing loss participated in an interaction actively. This can be used as a strategy to implement educational and therapeutic programmes. But they had some features belonging to a younger age that need to be considered for intervention. That group with lower speech and language performance tended to be more responsive while the higher function groups tended to be promoters. This might show an association between children’s speech and language problems and their interactional skills, but future studies can investigate this subject for a definite conclusion.

7.8 Age of Diagnosis: The Only Plausible Explanation?

In this study, because of the limited number of participants and the design of the study it was not possible to find any causal relationship between those factors discussed in chapter 4 and children’s speech and language outcomes. However, some useful discussion can be made based on all of those descriptions.

When comparing the characteristics of the children in Group 2 and Group 3 with the children in Group 1, it became clear that the first two groups had a later age of diagnosis, later age of intervention and inconsistent use of hearing aids when compared to the Group 1 children. All were diagnosed after 18 months of age and had a history of inconsistent use of hearing aids. To catch up to their normal hearing peers, these children would need an enriched intervention programme to accelerate their speech and language development but most did not have this opportunity. Our results for children in the lower performing group and the variable group showed they received their hearing aids later than the higher performing group and they had limited phonemic inventories. This finding is consistent with Moeller et al. (2010). They found that their participants who were diagnosed later and consequently had received their hearing aids later were significantly delayed in phonological skills especially for consonants.

Children in the higher performing group had earlier diagnoses, were fitted with hearing aids earlier and had used their hearing aids consistently. Yoshinaga-Itano (2003a) and Worsfold et al. (2010) also found that children with earlier diagnoses of hearing loss had better performance in some of the skills related to expressive language, such as using more morphological endings with high frequency sounds, a greater number of sentences and better narrative skills. Kumar et al. (2008) in a systematic review found 15 studies that reported children with earlier diagnosis (mainly under 12 months) had better speech and language outcomes. However as discussed in chapter 2, there are some studies such as Sarant et al. (2009) and Fitzpatrick et al. (2011) that did not find any relationship between speech and language outcomes and age of diagnosis. Thus to make a definite conclusion about the relationship between age of diagnosis and speech and language outcomes in NZ children with hearing loss such studies should be repeated.

The great variability in language outcomes could also be the result of children's cognitive abilities. In the present study, cognition was evaluated on the basis of caregivers' reports on the CDI. Four out of five children in the lower performing group were below -1.5 SD of the mean for their age in general development scores. This finding is consistent with results of a number of other studies (Geers & Brenner, 2003; Mayne, Yoshinaga-Itano, & Sedey, 1998; Mayne, Yoshinaga-Itano, Sedey, et al., 1998; Sarant et al., 2009; Tobey et al., 2003). These studies showed children with lower cognitive skills had lower language skills. However there were a number of other issues with these children, and general development, extrapolated as a measure of cognition, is only one of the factors which may be involved. There is also the possibility that poor communication development hinders development in other areas, so direction of causation cannot be assumed.

This study showed that the degree of hearing loss is not the only predictor of language outcomes. Those with the more severe hearing loss did not necessarily have poorer communication scores. All of the performance groups included children with different degrees of hearing loss. Even milder types of hearing loss could be associated with some degree of morpho-syntactical difficulty, sometimes comparable to those of children with more severe types of hearing loss. This finding is consistent with some other studies (Curtiss et al., 1979; Davis et al., 1986; Blamey et al., 2001). However, there were two participants (Kiana and Eris) who stood out from their performance groups in some language skills. Eris with moderate hearing loss was in the higher performance group but she showed poorer language skills in the spontaneous language analysis. In contrast Kiana with severe-profound hearing loss showed better performance in spontaneous language skills while based on standardised assessments she was categorised as belonging to the lower performance group.

Chronological age can be regarded as an influential factor since the older children without hearing loss and some the older children with hearing loss usually had higher raw scores in speech and language measures than younger children. However these changes over time were intertwined with intensive rehabilitation from the Ministry of Education and the Hearing House for at least some of the children, which means it is difficult to arrive at a definite conclusion about the effect of chronological age.

Based on what has been discussed above, age of diagnosis cannot be the only plausible factor for differences in children’s speech and language outcomes. Other factors should be included in any decision making process such as parent’s education, socioeconomic status, children’s preschool and school experience and family involvement that contributed to children’s speech and language results even though they were not directly assessed.

7.9 Strengths of this Study

This study was unique in attempting to examine communication skills of children with hearing loss in depth. It used a combination of observation, formal assessments and interviews with caregivers and AoDCs. It also included broad inclusion criteria to attempt to gain a perspective on the full range of the population of young children with hearing loss in NZ.

The variability which was found in the current study led the researcher to conduct more investigation to find a pattern among the children. The classification of children with hearing loss in different speech and language outcomes was an important pattern that can give information not only on children's speech and language capabilities but also the children's needs that should be responded to by both families and government.

Earlier age of diagnosis along with all its benefits (earlier intervention, better acceptance by family, getting used to HA by children, and etc.) was recognised as the main influential factor in regard to speech and language outcomes. However other factors were also effective but not as important as age of diagnosis.

In-depth investigation of the morpho-syntactical component of language and of the interactional features of preschool children with hearing loss, rarely done by other studies, was another strong point of the current study.

Providing information on caregivers' hopes, stress, and needs was also a positive aspect of this study. Most of the related studies only involved children, but children's speech and language outcomes are an output of child, family and environment.

Significant language progress after a year was a promising finding from this study for children with hearing loss, their families and professionals.

7.10 Limitations

Although every effort was made to include every child with hearing loss who met the criteria in the area, only a limited number were actually involved. The small number limits the generalisability of the findings. The representativeness could also be questioned. There was only one child with cochlear implants, and this one had restricted experience with them. It did not prove possible to include any child with an early cochlear implant, any child with profound hearing loss on a waiting list for cochlear implants, any children with confirmed multiple disabilities, or any child with unilateral hearing loss.

7.11 Recommendations for Further Research

This study provides cautious support for the value of in-depth speech and language analysis specifically for preschool children with hearing loss. Speech and language consist of different dimensions and components which are interrelated and investigations show that any problem in one of these dimensions can have effects on the other dimensions and components (for a review of this point, see Conti-Ramsden and Durkin (2012)). Thus in evaluating children's speech and language all of these dimensions should be included when making a profile of their capabilities and weaknesses. Such information cannot be accessed only by standardised tools but should include some spontaneous language analysis such as LARSP.

Change over time was only one aspect of this study, but the differences going to school appeared to make to the children's skills were intriguing. The relationship between 'school readiness' and 'school stimulus' is not one which has appeared in the literature, and may be part of that complexity and balance which was raised earlier, and which needs further investigation. Perhaps additional studies are needed to evaluate features and development of speech and language during a period not of a year but of at least three years systematically from preschool through the first three years of school, and then into the higher levels where language becomes more complex. Such longitudinal studies are rare, but clearly of great value.

Obviously studies including larger numbers of participants are needed to support or refute the findings made in this study. Further investigation of factors and their interactions is called for, such as severity of hearing loss, age of identification, socioeconomic status, hearing support device, and maternal education.

Spontaneous language analysis has rarely been used in research, and the reasons – that it is time consuming and inconsistent – were both borne out in this study. The answer is probably not to make it less time consuming, but it may be to structure it slightly more, with any caregiver-led sample being balanced by a child-led one, or vice versa depending on the outcomes of the interactants' initial choices. More language samples, with different interactants such as siblings, teachers, peers or a stranger like a research assistant would also provide more representative language samples for analysis. The use of 'sabotage' techniques used consistently across participants also has promise.

Analyses of spontaneous samples are only as good as the systems used. Some adjustments of LARSP to NZ English, and of socio-conversational analysis to allow for the 3-element nature of much interaction (e.g. RQ-RS-Acknowledgement), rather than the binary nature of the present system, could be of value. The lack of local norms for the norm-referenced tools used is also an issue, and the presence of cultural variation (Maori and Pasifika children, who appear to have a higher rate of hearing loss than Pakeha and Asian children) highlights the need for the development of such locally normed instruments.

This study raised a number of issues that clearly could benefit from more evaluation, and these tended to centre round broadening and deepening understanding of context, for example, the extent of family contribution, the amount and types of treatment for communication skills, and the stress level and coping strategies of caregivers.

Now that this study has highlighted their potential value as issues further studies might consider examining in more depth factors such as the family involvement in the intervention, the amount of therapy, the situation of hearing aids, and the audibility that children have with their hearing aids. Perhaps controlling findings based on these factors might clarify other aspects of speech and language in children with hearing loss.

The field of intervention for hearing loss is changing very rapidly, not only in regard to technologies but also in regard to service delivery. Future studies may find different results because of these many changes which may impact on age of diagnosis and better hearing support devices, amongst other issues.

Appendices

Appendix A: Frequency and Percentage Occurrence of Phonological Patterns in Children with Hearing Loss with Cochlear Implants (N=6) Based on Analysis of Conversational Speech Aged 3;09 to 6;02 months (mean 5 years)(Flipsen, 2008)

Developmental Patternsa	*Occurrences*		*Percentage of Opportunities*	
	Mean (S.D.)	*Range*	*Mean (S.D.)*	*Range*
Regressive Assimilation	0.3 (0.5)	0-1	0.1 (0.2)	0.0–0.8
Progressive Assimilation	0.2 (0.6)	0-1	0.1 (0.3)	0.0–1.1
Cluster Reduction-Initial	6.1 (4.8)	0-19	36.3 (25.8)	0.0–88.2
Cluster Reduction-Final	6.8 (4.3)	0-18	32.1 (23.5)	0.0–85.7
Final Consonant Deletion	18.3 (11.7)	0-50	14.1 (9.8)	0.0–34.2
Liquid Simplification-Initial	1.7 (2.2)	0-10	17.8 (24.8)	0.0–100.0
Liquid Simplification-Final	2.0 (2.6)	0-9	12.7 (17.2)	0.0–60.0
Palatal Fronting-Initial	0.1 (0.2)	0-1	0.4 (1.7)	0.0–10.0
Palatal Fronting-Final	0.1 (0.2)	0-1	0.3 (2.0)	0.0–12.5
Stopping-Initial	20.4 (16.1)	0-56	36.8 (20.3)	0.0–75.0
Stopping-Final	0.5 (0.8)	0-4	1.8 (3.8)	0.0–21.1
Unstressed Syllable Deletion-Two Syllables	1.5 (1.7)	0-9	2.8 (3.0)	0.0–13.4
Unstressed Syllable Deletion-3+ Syllables	1.1 (1.4)	0-6	16.0 (17.7)	0.0–66.7
Velar Fronting-Initial	0.9 (2.7)	0-12	5.5 (18.4)	0.0–92.3
Velar Fronting-Final	0.1 (0.3)	0-1	0.5 (2.1)	0.0–11.1
Non-Developmental Patternsb				
Initial Consonant Deletion	3.5 (3.4)	0-14	2.0 (3.0)	0.0–18.5
Glottal Stop Substitution-Initial	0.0 (0.0)	0-0	0.0 (0.0)	0.0–0.0
Glottal Stop Substitution-Medial	0.6 (1.7)	0-8	1.6 (4.8)	0.0–26.7
Glottal Stop Substitution-Final	0.2 (0.5)	0-2	0.1 (0.4)	0.0–2.2
Backing-Initial	0.6 (0.9)	0-4	0.8 (1.3)	0.0–5.0
Backing-Final	0.3 (0.7)	0-3	0.6 (1.4)	0.0–7.1
Vowel Substitution	6.2 (4.9)	0-24	2.4 (2.0)	0.0–8.6
Vowel Neutralisation	1.6 (1.7)	0-6	1.6 (1.7)	0.0–6.0
Diphthong Simplification	1.2 (1.3)	0-4	1.2 (1.7)	0.0–8.9

a Values derived using NPA output from PEPPER software

b Values derived manually by the second author.

Appendix B: Parents' Questionnaire for First Year

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Thank you very much for helping with this study. Please answer these questions carefully and attach everything that you think help us to understand your child better

Your name?:

Your relationship to the child?:

The child's name & date of birth?:……………………………… Male ☐ Female ☐

How old are you? <20___; 20-25_____; 26-35____; 36-45_____; 46-50_____; 50-60____; > 60___; Or your actual age ___________________

In which suburb/area do you live in? (This is for coding only, and the suburb/area name will be removed later so you cannot be identified).

Could you tell me about your hearing status?

Can you hear normally?

Do you have some kind of hearing loss? In one ear ☐ or both ears ☐

How long have you had this problem?

What is the degree of your hearing loss?

Do you have any hearing aids? If so, what kind?

Do you have any other kind of health or disability problems?

What is the highest educational level of both the child's parents? (enter M for mother, F for father)

Less than 6 years at school (no high school)	☐;	2-4 years high school	☐
High school qualification (eg School Certificate)	☐	apprenticeship qualification	☐
Tertiary certificate or diploma (eg., Tech)	☐;	university degree	☐

Now let us talk about your child:

What ethnic or cultural group does your child belong to?: NZ Pakeha/European…. ☐, Māori ………………. ☐, Pasifika ……………. ☐; Other …………………………………….

Who is living at home with your child (mother, stepfather, older brother (6 yrs), Auntie, etc)?

Who first noticed that your child had a hearing loss? ......……………………………………………

How old was the child then?

Why does your child have this hearing loss?

Who tested for the hearing loss and told you the reason for it?

What did they do for your child?

What did you do when you were told about the hearing loss?

………………………………………………………………………………………………..……

Who prescribed hearing aid(s) (or cochlear implants) for your child? When?

How old was she/he when they were first fitted?

How successful were the hearing aids/implants at first?

Did your child wear them frequently? _____Or some times? ______Or rarely?___

Did you see changes in your child after they got their hearing aids?

Have there been changes in their aids since that time? What kind? ……………………………

What kind of hearing aids/implants is your child using now? (no. electrodes?)

…………………………………………………………………………………………….……….

Does your child use them frequently now? _____Or some times? ______Or rarely?___

(More than 50% of waking hours?___ Around 50%? ____Less than 50% of waking hours?____)

Do the aids/implants work well? What problems if any have there been with them?

Do you know the hearing threshold of your child when they use their aid(s)/implant(s)? If so, what is it?

Does your child talk (in a way you can understand)? ☐ Does your child lip read? ☐

Does your child use signs or gestures to communicate? ☐ Do they use true sign language? ☐

Do you know signs, or sign language? ☐

Does your child have any health or disability problems, other than the hearing loss?

Does your child go to preschool of any kind?

For how long have they been going to this preschool? How often do they go?

How well do they do at preschool? Can they communicate there?

What kind of primary school will your child go to?

mainstream state school ☐ special school or class ☐ private school ☐

How would you describe your child (their personality, their character etc?)

What is your child's attention span like?

Could you tell me what you can see happening in the future for your child? (your desires, hopes, wishes for your child)?

Are there any other things about your child that might help me in the assessments? For example, usual behaviour, interests, favourite foods, etc?

Appendix C: Parents' Questionnaire for Second Year

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Thank you very much for helping with this study. Please answer these questions carefully and attach everything that you think will help us to understand your child better

Follow-up Questionnaire – 12 months later

Your name?:

The child's name?:………………………………………………. Male ☐ Female ☐

Child's date of birth? ……………………………………………………………………

Your relationship to the child?:

Were you this child's caregiver a year ago? If not, what has changed in the child's life?

……….

During the last year, who has been living at home with this child (e,g,, mother, stepfather, older brother (6 yrs), Auntie)?

During the last year, What programmes has this child been doing (e.g., special education, speech language therapy)?

…………………………………………………………………………………………………..……

Have there been changes in the child's hearing, or their hearing aids (including cochlear implants) in the past year? If yes, what kind?

……………………………………………………………………………………………..………

How often does the child use their hearing aid(s) now?

More than 50% of waking hours?___ Around 50%? ____Less than 50% of waking hours?____

Do the aids/implants work well? What problems (if any) have there been with them over the past year?

Does the child talk (in a way you can understand)? ☐ Does the child lip read? ☐

Does your child use signs or gestures to communicate? ☐ Do they use true sign language? ☐

Do you know signs, or sign language? ☐

Does the child have any health or disability problems, other than the hearing loss?

What kind of primary school does the child go to?

mainstream state school ☐ special school or class ☐ private school ☐

How well are they doing at school? Can they communicate easily there?

Have the school indicated any problems? What strengths do they report in the child?

How would you describe the child now (their personality, their character etc?)

What is the child's attention span like?

Could you tell me what you can see happening in the future for the child? (your desires, hopes, wishes for the child)?

Are there any other things about the child that might help me in the assessments? For example, usual behaviour, interests, favourite foods, etc?

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NEW ZEALAND
Te Whare Wānanga o Tāmaki Makaurau

Thank you very much for helping with this study. Please answer these questions carefully and attach everything that you think help us to understand your child better

Your name?:

Your relationship to the child?:

The child's name & date of birth?:………………………………. Male ☐ Female ☐

How old are you? <20___; 20-25_____; 26-35____; 36-45_____; 46-50_____; 50-60____; > 60___; Or your actual age __________________

In which suburb/area do you live in? (This is for coding only, and the suburb/area name will be removed later so you cannot be identified).

Could you tell me about your hearing status?

Can you hear normally?

Do you have any kind of hearing loss? In one ear ☐ or both ears ☐

How long have you had this problem?

What is the degree of your hearing loss?

Do you have any hearing aids? If so, what kind? ....

Do you have any other kind of health problem or disability? ....

What is the highest educational level of the child's caregivers? (if relevant, enter M for mother, F for father or indicate other relationship here ……………………………………………………..)

Less than 6 years at school (no high school) ☐; 2-4 years high school ☐

High school qualification (eg School Certificate) ☐ apprenticeship qualification ☐

Tertiary certificate or diploma (eg., Tech) ☐; university degree ☐

Now let us talk about your child:

What ethnic or cultural group does your child belong to?: NZ Pakeha/European…. ☐,

Māori …………………. ☐,

Pasifika ………………. ☐;

Other …………………………………….

Who is living at home with your child (mother, stepfather, older brother (6 yrs), Auntie, etc)? ....

....

Does your child talk (in a way you can understand)? ………………………………………..

Does your child have any health or disability problems? ....

....

Does your child go to preschool of any kind? ....

....

How long have they been going to this preschool, and how often do they go?...................................

....

How well do they do at preschool? Can they communicate there? ....

....

What kind of primary school will your child go to?

mainstream state school ☐ special school or class ☐ private school ☐

How would you describe your child (their personality, their character etc?).......................................

....

What is your child's attention span like?...

18- Could you tell me what you can see happening in the future for your child? (your desires, hopes, wishes for your child)? ....

....

19- Are there any other things about your child that might help me in the assessments? For example, usual behaviour, interests, favourite foods, etc? ....

....

Appendix E: Advisors' Questionnaire for First Year

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Thank you very much for helping with this study. You have valuable information on the children on your caseload, and we very much appreciate your assistance.

Advisor's Name:……………………………………..……………….Date: ……………………

1- Child's Name: ....

2- Child's Gender: male☐, female☐; Child's Date of birth:..

3- Child's Ethnicity: NZ Pakeha/European☐, Māori ☐,
Pacifica ☐ Other ………………………………..

4- Languages spoken at home (by whom?) ……………………………………………………..

……………………………………………………………………………………………...

5- Any disabilities (including hearing) in other family members? ………………………………...

…………………………………………………………………………………………….

6- Cause of the child's hearing loss: environmental ☐, genetic ☐, unknown ☐

7- What is the type and severity of the child's hearing loss? …………………………….…………

……………………………………………………………………………………………..…

8- Recent aided hearing threshold and speech discrimination scores in free field condition: ....

……………………………………………………………………………………………..

9- Recent unaided hearing threshold (PTA) of the better ear (please enclose a copy of the latest audiogram):

10- Does the child have any additional disability? NO ☐ YES ☐ (If yes, please specify)

....

11- How old was the child when hearing loss was diagnosed? ....

12- What was the initial treatment (medical, educational, specialist eg SLT)?..................................

…………………………………………………………………………………………….

13- Does the child use hearing aids? NO ☐ YES ☐ How many? …… If one, which ear?............

If yes, what type?...

How old was the child when they were first fitted? ....

How successful were they? …………………………………………………

How much would you estimate the aid(s) is(are) used?

<50 % of waking hours ☐; approx.. 50% of waking hours ☐; >50 % of waking hours ☐

How well are the hearing aids maintained at home?..

14- Does the child have cochlear implant(s)? NO ☐ YES ☐

If yes how many, which ear, & type?...

At what age(s) were they implanted? …………………………………………………

Did the surgery go well? YES ☐ NO ☐ (If no, please specify)………………....

……………………………………………………………………………………

Are they full electrode arrays? YES ☐ NO ☐ Don't know ☐

How much would you estimate the CI is used? <50 % of waking hours ☐;

approx.. 50% of waking hours ☐; >50 % of waking hours ☐

What made this child a candidate for a cochlear implant(s)? ....

....

15- What intervention for speech and language did child have before any hearing aids (including cochlear implants)?...

…………………………………………………………………………………………

16- What intervention for speech and language has the child had since their aids or implants?..........

.... ………………………………………………………………………………………

.... ………………………………………………………………………………………

17- What kind of communication does the child use? Oral communication ☐;

sign language + oral communication ☐; sign language ☐ other ☐ ……………….

18- Does the child go to a preschool? YES ☐ NO ☐ Don't know ☐

If yes, what kind? ....

How often does the child go? ....

How long have they been going there? ....

How regular is their attendance?...

How beneficial do you estimate preschool attendance is for this child? ....

19- What type of schooling do you anticipate that this child will go to?...

Mainstream state school ☐ Special school or class ☐ Private school ☐

20- Are there any other relevant issues about this child's hearing, education or communication?

....

....

....

Appendix F: Advisors' Questionnaire for Second Year

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Thank you very much for helping with this study. You have valuable information on the children on your caseload, and we very much appreciate your assistance.

Advisor's Name: ....

Date: ....

Child's Name: ....

Child's Gender: male☐, female☐; ....

Child's Date of birth: ....

Child's Ethnicity: NZ Pakeha/European☐, Māori ☐, Pacifica ☐ Other …………………………

1- Have you had any special emphasis on one language during last 12 months? ……………………………………………………………………………………………………

…... ....

2- Has the child have any new kind of disability during last 12 months? Yes ☐ No ☐

yes, what kind of disability? ....

3- Has the child had any changes in his/her type and severity of hearing loss? ....

…………………………………………………………………………………………………

4- What was the recent aided hearing threshold and speech discrimination scores in free field condition: ....

....

5- Recent unaided hearing threshold (PTA) of the better ear(please enclose a copy of the latest audiogram): ....

6- Does child receive special intervention for his/her hearing loss or other disabilities (medical, educational, specialist eg SLT)? ....

7- Does the child have changes for using hearing aids? NO ☐ YES ☐

a. How much would you estimate the aid(s) is(are) used?

<50 % of waking hours☐; approx. 50% of waking hours☐; >50 % of waking hours ☐

b. How well are the hearing aids maintained at home? ....

8- Does the child receive new hearing aids or cochlear implant(s)? NO ☐ YES ☐

If yes how many, which ear, & type?...

At what age(s) were they implanted? ……………………………………………….

Did the surgery go well? YES ☐ NO ☐ (If no, please specify)…………………

……………………………………………………………………………………………

Are they full electrode arrays? YES ☐ NO ☐ Don't know ☐

How much would you estimate the CI is used?

<50 % of waking hours☐; approx. 50% of waking hours☐; >50 % of waking hours ☐

What made this child a candidate for a cochlear implant(s)? ....

9- Does the child have any changes in his/her speech and language therapy programs during last 12 months? Yes☐ No☐, if yes what kind of changes? (Ex. The number of session increased, the type of intervention changed, ...) ....

……………………………………………………………………………………………

10- What kind of communication does the child use during last 12 months? Oral communication☐; sign language + oral communication☐; sign language ☐; other ☐ ……………….

11- Does the child go to school? YES ☐ NO ☐ Don't know ☐

If yes, what kind? Mainstream state school ☐ Special school or class ☐ Private school ☐

How often does the child go? ....

How long have they been going there? ....

How regular is their attendance? ....

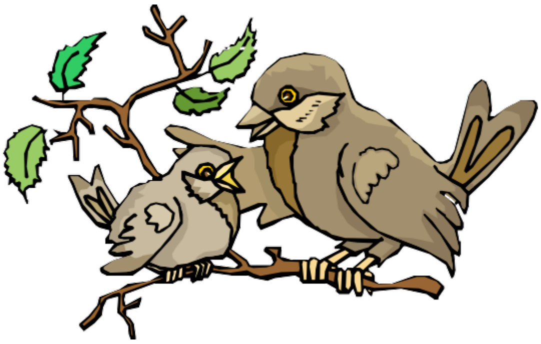
How beneficial do you estimate preschool attendance is for this child? ....

12- Are there any other relevant issues about this child's hearing, education or communication?

....

....

Appendix G: Parents' Evaluation of Aural/Oral Performance of Children (P.E.A.C.H.)



Parents' Evaluation of Aural/Oral Performance of Children (P.E.A.C.H.)

Developed by Teresa Ching & Mandy Hill

Child's Name:		Your Name:	
D.O.B:		Interviewer:	
Number & Interval:		Date:	

Parents' Evaluation of Aural/Oral Performance of Children (P.E.A.C.H.)
Developed by Teresa Ching & Mandy Hill

What is the PEACH?

The PEACH (Parents' Evaluation of Aural/oral performance of Children) is a questionnaire designed to record how your child is hearing and communicating with others when using his/her hearing aids and/or cochlear implant. We ask you to observe your child's listening behaviour in everyday life and give a rating in relation to a range of hearing and communication scenarios.

The PEACH is not a test. Remember even normal hearing people have some difficulty hearing in some situations. Children's listening skills improve as they grow and develop and as they get more listening practice.

Why use the PEACH?

The PEACH is used to evaluate the effectiveness of your child's hearing aids and/or cochlear implant. Your PEACH ratings will be used to build a picture of your child's functional performance in everyday life situations. The results can be used by your child's audiologists to tailor audiological intervention to address the specific difficulties experienced by your child. The PEACH scores collected at several intervals over time can also be used to monitor your child's progress with intervention.

How do I do it?

Think about your child's behaviour over the past week in relation to each question.
Give a rating, based on the estimated percentage of time that your child displays the described behaviour.

What happens next?

After you return a completed PEACH, a researcher may contact you to talk through your ratings. The researcher may ask you further questions to make sure they have a thorough understanding of the abilities and needs of your child.

Results from the PEACH will be used to monitor your child's progress. The information will also be passed onto your child's audiologist to guide intervention.

Pre-Rating Checklist

	Yes	No
Has the child been wearing his/her hearing aids and/or cochlear implant?		
Has the child been well/healthy?		
Have the child's hearing aids and/or cochlear implant been working properly?		

If the PEACH is used to assess performance when aided, it should only be completed when the answer to all of the above items is YES.

Please reflect on your child's listening behaviour over the past week and circle the appropriate number

	Question	Never 0%	Seldom 1 - 25%	Sometimes 26 - 50%	Often 51 -	Always 75-
1.	How often has your child worn his/her hearing aids and/or cochlear implant?	0	1	2	3	4
2.	How often has your child complained or been upset by loud sounds?	4	3	2	1	0
3.	When you call, does your child respond to his/her name in a quiet situation?	0	1	2	3	4
4.	When asked, does your child follow simple instructions or do a simple task in a quiet situation?	0	1	2	3	4
5.	When you call does your child respond to his/her name in a noisy situation when he/she can't see your face? (examples of responses include looks up, turns, answers verbally)	0	1	2	3	4
6.	When asked, does your child follow simple instructions or do a simple task in a noisy situation?	0	1	2	3	4
7.	When you are in a quiet place reading with your child, how often does he/she pay close attention to what you are saying? OR if your child is listening to stories/songs on the TV or CD when there is no other background noise how often can he/she follow what is being said?	0	1	2	3	4
8.	How often does your child initiate/ participate in conversation in a quiet situation?	0	1	2	3	4
9.	How often does your child initiate/ participate in conversation in a noisy situation?	0	1	2	3	4
10.	How often does your child understand what you say in the car/bus/train?	0	1	2	3	4
11.	How often does your child recognise peoples' voices without seeing who was talking?	0	1	2	3	4
12.	How often does your child successfully use a phone?	0	1	2	3	4
13.	How often does your child respond to sounds other than voices?	0	1	2	3	4

Please provide comments regarding any of the above items:

Scoring: To be completed by professional

QUIET	(Q's 3+4+7+8+11+12) A		(A/24) x 100	
NOISE	(Q's 5+6+9+10+13) B		(B/20) x 100	

Appendix H: The Auditory Behaviour in Everyday Life (ABEL) –Revised by (Purdy et al., 2002) Revised by Karen Anderson (2011)

Child’s name ------------------------- Completed by ---------------------------- Date: -----------------------

	Purpose: To provide a quick and simple questionnaire for parents to Complete without assistance to evaluate their perceptions of gains in everyday auditory behaviour of their child with hearing loss. Instructions: You know your child best! Please circle the number beside each item	Never	Hardly Ever	Occasionally	About half the	Frequently	Almost Always	Always
Auditory-Oral	1. Initiates spoken conversations with familiar people.	0	1	2	3	4	5	6
	2. Says a person’s name to gain their attention.	0	1	2	3	4	5	6
	3. Says “please” or “thank you” without being reminded.	0	1	2	3	4	5	6
	4. Responds verbally to greeting from familiar people.	0	1	2	3	4	5	6
	5. Asks for help in situations where it is needed.	0	1	2	3	4	5	6
	6. Shows interest in spoken conversations around him/her.	0	1	2	3	4	5	6
	7. Responds verbally to greeting from unfamiliar person(s).	0	1	2	3	4	5	6
	8. Says the names of siblings, family members, classmates.	0	1	2	3	4	5	6
	9. Asks about sounds heard around him/her (e.g., planes, trucks, animals).	0	1	2	3	4	5	6
	10. Plays cooperatively in a small group without adult supervision.	0	1	2	3	4	5	6
	11. Sings.	0	1	2	3	4	5	6
		Auditory-Oral Total / 11 =						
Auditory Awareness	1. Answers telephone appropriately.	0	1	2	3	4	5	6
	2. Responds to own name spoken in the same room.	0	1	2	3	4	5	6
	3. Responds to a door bell or knock.	0	1	2	3	4	5	6
	4. Will whisper a personal message.	0	1	2	3	4	5	6
	5. Asks about sounds heard around him/her (e.g., planes, trucks, animals).	0	1	2	3	4	5	6
	6. Knows when making loud sounds (e.g., slamming doors, stomping).	0	1	2	3	4	5	6
	7. Is aware when telephone is ringing.	0	1	2	3	4	5	6
	8. Sings.	0	1	2	3	4	5	6
	9. Knows when hearing aid(s) or cochlear implant(s) are not working.	0	1	2	3	4	5	6
	10. Experiments with newly discovered sounds.	0	1	2	3	4	5	6
		Auditory Awareness Total /10 =						
Conversational/ Social Skills	1. Initiates spoken conversations with unfamiliar people (not strangers).	0	1	2	3	4	5	6
	2. Takes turns in conversations.	0	1	2	3	4	5	6
	3. Talks using a normal voice level.	0	1	2	3	4	5	6
	4. Frequency of making inappropriate vocal noises.	0	1	2	3	4	5	6
	5. Becomes quieter in activity level or play when asked to do so.	0	1	2	3	4	5	6
		Conversational/Social Skills Total /5 =						
A typically developing child who learns primarily through listening can be expected to evidence all skills by age 6.								

Appendix I: Agreement Figures for Each Participant in Each Subtest of DEAP

Subtest	*Subject*	*Agreement Rate %*	*Mean*
Articulation	Subject 1 (Paul)	95.16	95.70
	Subject 2 (Cheryl)	95.16	
	Subject 3 (Pete)	96.77	
Inconsistency	Subject 1 (Josie)	68.00	76.00
	Subject 2 (Kiana)	76.00	
	Subject 3 (Hannah)	84.00	
Phonology	Subject 1 (Jack)	90.41	89.35
	Subject 2 (Kim)	83.11	
	Subject 3 (Jasper)	94.52	
Total Reliability			87.02

Appendix J: Agreement Figures for Each Participant in LARSP

Subtest	*Subject*	*Agreement Rate %*	*Mean*
Native Speaker of English	Subject 1 (Josie)	84.5	85.8
	Subject 2 (Myra)	87	
	Subject 3 (Jack)	86	
Bilingual Speaker of English	Subject 1 (Sara)	85	85.25
	Subject 2 (Kenny)	85.5	
	Total Mean		85.55

Appendix K: System of Coding Conversational Acts for Profiling Children's Levels of Social-Conversational Participation (Fey, 1986)

Utterance Level	
Assertive Conversational Acts	
Requestives: Ask Information or Actions	
Request for Information (RQIN)	All forms of questions to take new information from the conversational partner
Request for Action (RQAC)	Any forms that ask the accomplishment of some action by the partner
Request for Clarification (RQCL)	All questions that look for clarification of some previous utterances
Request for Attention (RQAT)	Utterances that are looking for the attention or acknowledgement from the partner
Assertive: Labels, report facts, state rules, explanation and so forth.	
Comments (ASCO)	Identification and descriptions of observable objects and events
Statements (ASST)	Reports of mental events, evaluations, statements of rules, explanations, and so forth.
Disagreement (ASDA)	Comments or statements that deny a proposition of some previous assertion
Performatives (PERF): claims, jokes, teasing, protests, and warnings that are accomplished just by being produced	
Responsiveness Conversational Acts: provide information requested or acknowledge assertives and performatives	
Responses to Requests for Information (RSIN)	Attempts to provide new information requested by the partner
Responses to Requests for Action (RSAC)	Verbal accompaniments to the performance of an action requested by the partner
Responses to Requests for Clarification (RSCL)	Attempts to repeat or otherwise clarify a previous utterance following the partner's request for clarification
Responses to Requests for Attention (RSAT)	Responses to attentional requests that serve to acknowledge the partner and to indicate that the partner may continue
Responses to Assertives and Performatives (RSAS)	Simple acknowledgements of or agreements with previous partner utterances that add no new information to the previous utterance
Imitation (IMI)	Utterances that repeat all or part of the prior utterance, including its intonation pattern, and that includes no new information
Other	Any utterances that do not fit clearly under the above categories
Discourse Level	
Initiate Topic	Utterances that either do not follow a previous utterance or that introduce new information that is not related to information from a previous utterance
Maintain Topic	Utterances that are related to some previous utterances and that fulfil the speaker's obligations but that add no new, nonsolicited information
Extend Topic	Utterances that are related to a previous utterance and that extend the established topic by adding new semantic details or by shading appropriately to some related topic
Extend Topic- Tangential	Utterances that are related tangentially to some aspect of a previous utterance but do not seem to extend the topic in an adequate manner

Appendix L: Brown’s Stages of Language Development, 1973 (as cited in Shipley and McAfee (2009)

Stage	*Age (Months)*	*MLU*	*Language Development*
I	12-26	1.0-2.0	First words, linear simple sentences.
II	27-30	2.0-2.5	Linear simple sentences with emergence of grammatical morphemes.
III	31-34	2.5-3.0	Noun phrases and auxiliary verbs. Emergence of different sentences modalities (e.g. questions, negatives, imperatives).
IV	35-40	3.0-3.75	Emergence of complex sentences. Embedding of sentence elements.
V	41-46	3.75-4.5	Compound sentences.

Appendix M: LARSP Profiles for Group 1

Name: Julia Age: 3; 04; 27 Sample Date: 14/March/2012 Type: Mom & Child interaction

A Unanalysed			Problematic		
1. unintelligible 6	2.symbolic noise	3. Deviant 7	1. Incomplete 15	2. Ambiguous	3. Stereotype

B Responses			Repe-titions	Normal Response: Major: Elliptical 1	2	3+	Reduced	Full	Minor	Abnormal: Structural	☐	Prob-Lems
Stimulus Type		Totals										
99	Questions	56	1	21	2		1	11	21	7	19	
21	Others	16	6	6					10			
C	Spontaneous	97	1	31	9	10	8	23	16			
D	Reactions											

Stage							
Stg I (0:9-1:6)	Minor: 47	Responses 27		Vocatives 2	Other 18	Problems	
	Major	Comm 'V'	Quest 'Q'	Statement 'V'	'N' 17	Other 11	Problems
75	Conn	Clause			Phrase		Word
Stg II (1;6-2;6)	16	VX 1	QX 1	SV 4, SO, SC 1, Neg X; AX 5, VO 4, VC, Other	DN 44, AdjN 2, NN, PrN 4	VV, V part 1, Int X 1, Other 3	-ing 9, Pl
	9	X+S:NP 5		X + V:VP 1; X + O:NP 1	X + C:NP 1	X + A:AP 1	-ed 6
Stg III (2;0 – 2;6)	27	VXY; let XY 1; do XY 1	QXY 1; VS(X) 1	SVC 10, SVO 7, SVA 4, negXY 1; VCA, VOA 1, VOiOd, other	D Adj N 1, Adj Adj N, Pr DN 2, PronP 42, Prono 25	Cop 15, Auxm 7, Aux0 6, other 3	-en 1, 3s 12, gen
	17	XY+S: PN		XY+V: VP 5; XY+ C:NP 7	XY+ O:NP 3	XY+ A: AP 2	n't
Stg IV (2;6 – 3;0)	18	+S; VXY+ 4	QVS 3, QXY+ 1, VS(X+) 3, tag	SVOA 7, SVCA, SVOiOd, SVOC; AAXY, other	NP pr NP, Pr D Adj N, cX 5, XcX 3	Neg V, Neg X, 2 aux, other	'cop 6, 'aux 3
Stg V (3;0 – 3;6)	and 7, c 9, s, other	Coord., other	Coord. 1, Other	Coord. 1 1+; Subord. A 1 1+; S C O; Comparative	Postmod. Clause 1 1+; Postmod. Phrase 1+		-est, -er 2, -ly

Stg VI (3;6--4;6)	(+)				(-)			
	NP	VP	Clause	Conn	Clause	Phrase		Word
	Initiator 1, Coord.	Complex	Passive 1, Complement, how, what	and, c, s	Element ☐ ☐, concord	NP: D pr PronP, D ☐ pr ☐, D ☐ pr ☐	VP: Aux M, O, Aux Cop ☐	N irreg, reg
	Other					Ambiguous		

Stg VII (4;6+)	Discourse	Syntactic Comprehension
	A Connectivity, it; Comment clause 3, there; Emphatic order, other	Style

Total No. Sentences: 212	Mean No. Sentences per turn:	Mean Sentence Length: 413/169: 2.444

Figure A 1. Julia's LARSP Profile

Name: Eris Age: 3;08;1 Sample Date: 17/July/2012 Type: Child & Mum interaction, cooking

A Unanalysed			Problematic	
1. unintelligible 7	2.symbolic noise	3. Deviant	1. Incomplete 4	2. Ambiguous

B Responses			Repe-titions	Normal Response: Major: Elliptical 1	2	3	Reduced	Full	Minor	Abnormal: Struct-ural	☐	Problems
Stimulus Type		Totals										
30	Questions	16		8	1			1	6		10	
45	Others	17	3	2	1			2	12		20	
C	Spontaneous	35		16		2	4	7	6			
D	Reactions											

Stg I (0:9-1:6) 40	Minor 24		Responses 12		Vocatives 3		Other 9	Problems
	Major 16	Comm 'V' 2	Quest 'Q'	Statement 'V'	'N' 3		Other 11	Problems
	Conn	Clause				Phrase		Word
Stg II (1;6-2;6)	4	VX 1	QX	SV SO SC 2 Neg X	AX VO 1 VC Other	DN 6 AdjN 5 NN PrN	VV V part 1 Int X Other	-ing Pl
	3	X+S:NP		X + V:VP 2	X + O:NP	X + C:NP 1	X + A:AP	-ed 1
Stg III (2;0 – 2;6)	11	VXY let XY do XY	QXY VS(X) 1	SVC 4 SVO 6 SVA negXY	VCA VOA VOiOd other	D Adj N Adj Adj N 1 Pr DN PronP 23 Prono 2	Cop 5 Auxm 5 Aux0 other 1	-en 1 3s gen
	6	XY+S: NP		XY+V: VP 3	XY+ C:NP 2	XY+ O:NP 1	XY+ A: AP	n't
Stg IV (2;6 – 3;0)	1	+S VXY+	QVS QXY+ VS(X+) tag	SVOA 1 SVCA SVOiOd SVOC	AAXY other	NP pr NP Pr D Adj N cX 1 XcX 1	Neg V Neg X 2 aux other	'cop 3 'aux
Stg V (3;0 – 3;6)	And 4 c s other	Coord . other	Coord. Other	Coord. 1 1+ Subord. A 1 1+ S C O Comparative 1		Postmod. Clause 1 1+ Postmod. Phrase 1+		-est -er 1 -ly

Stg VI (3;6- -4;6)	(+) NP	VP	Clause	Conn	(-) Clause	Phrase: NP	VP	Word
	Initiator Coord.	Complex	Passive Complement how what	and c s	Element ☐ ☐ concord	D pr PronP D ☐ pr ☐ D ☐ pr ☐	Aux M Aux O Cop ☐	N irreg reg
	Other						Ambiguous	

Stg VII (4;6+)	Discourse		Syntactic Comprehension
	A Connectivity Comment clause Emphatic order	it there other	Style

Total No. Sentences: 81	Mean No. Sentences per turn:	Mean Sentence Length: 128/68: 1.882

Figure A 2. Eris's LARSP Profile

Name: 2.1.1: Myra Age: 4;00;20 Sample Date: 26/3/2012Type: Mum & child interaction, solving puzzle and a game.

A Unanalysed		Problematic
1. unintelligible 1	2.symbolic noise 1	3. Deviant 1
1. Incomplete 15	2. Ambiguous	3. Stereotype

B Responses		Repe-titions	Normal Response: Major: Elliptical 1	2	3	Reduced	Full	Minor	Abnormal: Struct-ural	Abnormal: ☐	Problems
Stimulus Type	Totals										
31 Questions	25		4	1			4	16		4	
50 Others	25	3	2	1	2		5	15		8	
C Spontaneous	103		9	3	13	5	42	31			
D Reactions											

Stage						
Stg I (0:9-1:6)	Minor 62 Problems	Responses 21		Vocatives 2	Other 39	
	Major	Comm	Quest	Statement		
	7	'V' 1	'Q'	'V'	'N' 2	Other 4 Problems
69	Conn		Clause		Phrase	Word
Stg II (1;6-2;6)	7	VX 3	QX	SV 2, SO, SC, Neg X; AX 2, VO, VC, Other	DN 25, djN, NN, PrN 1; VV, V part 5, Int X, Other 2	-ing 2, Pl 4
	3	X+S:NP		X + V:VP 1; X + O:NP	X + C:NP 1; X + A:AP 1	-ed 21
Stg III (2;0 – 2;6)	53	VXY, let XY, do XY	QXY, VS(X)	SVC 18, SVO 30, SVA 5, negXY; VCA, VOA, VOiOd, other	D Adj N 2, Adj Adj N, Pr DN 5, PronP 65, Prono 19; Cop 25, Auxm 19, Aux0 3, other 4	-en 2, 3s 18, gen
	38	XY+S: NP 4		XY+V: VP 16; XY+ C:NP 8	XY+ O:NP 7; XY+ A: AP 3	n't 3
Stg IV (2;6 – 3;0)	9	+S, VXY +	QVS 1, QXY+ VS(X+) 1, tag	SVOA 6, SVCA 1, SVOiOd, SVOC; AAXY, other	NP pr NP 1, Pr D Adj N, cX 1, XcX; Neg V 4, Neg X, 2 aux, other 1	'cop 17, 'aux 9
Stg V (3;0 – 3;6)	And 7, c 10, s 9, other	Coord. Other 1	Coord. Other	Coord. 1 1 1+; Subord. A 1 1 1+; S; C 2; O 1; Comparative	Postmod. Clause 1 1+; Postmod. Phrase 1+	-est, -er, -ly 1

Stg VI (3;6- -4;6)	(+)				(-)		
	NP	VP	Clause	Conn	Clause	Phrase	Word
	Initiator 1, Coord.	Complex	Passive, Complement, how, what	and, c, s	Element, concord	NP: D, D, D, pr, pr, pr, PronP; VP: Aux M, Aux O, Cop	N irreg, reg
	Other					Ambiguous	

Stg VII (4;6+)	Discourse	Syntactic Comprehension
	A Connectivity; Comment clause 1; Emphatic order 1; it; there; other	Style
	Total No. Sentences: 174	Mean No. Sentences per turn: / Mean Sentence Length: 508/153: 3.320

Figure A 3. Myra's LARSP Profile

Name: Cheryl Age: 4;03;20 Sample Date: 27/July/2012 Type: Cild & Mum Interaction, Book reading

A Unanalysed			Problematic		
1. un intelligible 3	2.symbolic noise	3. Deviant	1. Incomplete 20	2. Ambiguous	3. stereotype

B Responses				Normal Response						Abnormal		
				Major								Problems
			Repe-titions	Elliptical			Reduced	Full	Minor	Struct-ural	☐	
Stimulus Type		Totals		1	2	3						
61	Questions	36		27	3				6	1		
61	Others	19	22	9	1	1		3	5			
C Spontaneous		83		47	5	4	8	16	3			
D Reactions												

Stage								
Stg I (0:9-1:6)	Minor 14 Problems	Responses 8		Vocatives 1		Other 5		
	Major 37	Comm 'V' 2	Quest 'Q'	Statement 'V' 1	'N' 32	Other 1	Problems 1	
51	Conn	Clause				Phrase		Word
Stg II (1;6-2;6)	11	VX 1	QX 2	SV 4 SO SC 2 Neg X	AX 1 VO 2 VC Other	DN 56 AdjN NN PrN 2	VV V part 2 Int X Other 4	-ing Pl
	10	X+S:NP 2		X + V:VP 4	X + O:NP 1	X + C:NP 1	X + A:AP 2	-ed 5
Stg III (2;0 – 2;6)	20	VXY 1 let XY do XY	QXY VS(X)	SVC 9 SVO 10 SVA negXY	VCA VOA VOiOd other	D Adj N 3 Adj Adj N Pr DN 7 PronP 41 3 Prono 15	Cop 10 Auxm 4 Aux0 other	-en 3s 9 Gen
	15	XY+S: NP		XY+V: VP 3	XY+ C:NP 7	XY+ O:NP 4	XY+ A: AP 1	n't 2
Stg IV (2;6 – 3;0)	3	+S VXY+	QVS QXY+ VS(X+) Tag	SVOA SVCA 1 SVOiOd SVOC	AAXY other 2	NP pr NP 4 Pr D Adj N 1 cX 2 XcX 3	Neg V 4 Neg X 2 aux other 1	'cop 6 'aux
Stg V (3;0 – 3;6)	And 9 c 1 s 3 other	Coord. other	Coord. Other	Coord. 1 1+ Subord. A 1 2 1+ S C 1 O 2 Comparative 2		Postmod. Clause 1 2 1+ Postmod. Phrase 1+ 1		-est -er -ly

Stg VI (3;6- -4;6)	(+)				(-)			
	NP	VP	Clause	Conn	Clause	Phrase		Word
	Initiator Coord. 3	Complex	Passive Complement how what	and c s	Element ☐ ☐ concord	NP D pr PronP D ☐ pr ☐ D ☐ pr ☐	VP Aux M Aux O Cop ☐	N irreg reg
	Other			Ambiguous				

Stg VII (4;6+)	Discourse	Syntactic Comprehension
	A Connectivity it Comment clause there Emphatic order other	Style
	Total No. Sentences: 184	Mean No. Sentences per turn:	Mean Sentence Length: 371/138: 2.688

Figure A 4. Cheryl's LARSP Profile

Appendix N: LARSP Profiles for Group 2

Name: Nemo Age: 3;08;19 Sample Date: 16/5/2012 Type: child and mum interaction- paly with truc

A Unanalysed 1. unintelligible 5 2.symbolic noise 4 3. Deviant							Problematic 1. Incomplete 2. Ambiguous 3. Stereotype					
B Responses		Repe-titions	Normal Response						Abnormal		Problems
			Major					Minor	Struct-ural	☐	
			Elliptical			Red uced	Full				
Stimulus Type	Totals		1	2	3+						
32 Questions	24	1	4		2	1	2	15		1	
136 Others	48	39	2			1		45	2	35	
C Spontaneous	72	1	11	3	2	11	8	37			
D Reactions											

Stage						
Stg I (0:9-1:6)	Minor 97 Responses 26 Vocatives 3 Other 68 Problems					
	Major	Comm	Quest	Statement		
	10	'V' 3	'Q' 1	'V' 1 'N' 1 Other 4 Problems		
107	Conn	Clause			Phrase	Word
Stg II (1;6-2;6)	18	VX 2	QX 5	SV 3 AX 1 SO VO SC 4 VC Neg X 3 Other	DN 2 VV AdjN 3 V part 1 NN Int X PrN Other	-ing 1 Pl
	3	X+S:NP 2		X + V:VP X + O:NP	X + C:NP 1 X + A:AP	-ed 1
Stg III (2;0 – 2;6)	10	VXY 4 let XY do XY	QXY VS(X)	SVC 2 VCA SVO 1 VOA SVA 1 VOiOd negXY 1 other 1	D Adj N Cop 5 Adj Adj N Pr DN Auxm 2 PronP 14 Aux0 Prono 10 other	-en 3 3s 3 gen
	2	XY+S: NP		XY+V: VP 1 XY+ C:NP 1	XY+ O:NP XY+ A: AP	n't
Stg IV (2;6 – 3;0)	4	+S VXY+	QVS 3 QXY+ VS(X+) tag	SVOA AAXY 1 SVCA other SVOiOd SVOC	NP pr NP Neg V Pr D Adj N Neg X 2 cX 2 aux XcX other	'cop 3 'aux
Stg V (3;0 – 3;6)	and c s other	Coord . other	Coord. Other	Coord. 1 1+ Subord. A 1 1+ S C O Comparative	Postmod. Clause 1 1+ Postmod. Phrase 1+	-est -er -ly

Stg VI	(+)				(-)			
(3;6--4;6)	NP	VP	Clause	Conn	Clause	Phrase		Word
	Initiator Coord.	Complex	Passive Complement how what	and c s	Element ☐ ☐ concord	NP D pr PronP D ☐ pr ☐ D ☐ pr ☐	VP Aux M Au O Co p	N irreg reg
	Other				Ambiguous			

Stg VII (4;6+)	Discourse	Syntactic Comprehension
	A Connectivity it Comment clause there Emphatic order other	Style
	Total No. Sentences: 196	Mean No. Sentences per turn:	Mean Sentence Length: 208/144: 1.444

Figure B 1. Nemo's LARSP Profile

Name: Sara Age: 3;08;13 Sample Date: 30/July/2012 Type: Mum & Child interaction- cooking

A Unanalysed 1. unintelligible 9 2.symbolic noise 3. Deviant 1	Problematic 1. Incomplete 2 2. Ambiguous

B Responses			Normal Response						Abnormal		Problems
			Major								
		Repe-	Elliptical			Red			Struct-		
Stimulus Type	Totals	titions	1	2	3	uced	Full	Minor	ural	□	
51 Questions	42		3			2		37	1	5	
92 Others	67	7	4				1	62		8	
C Spontaneous	88	1	28	7	1	14	17	21			
D Reactions											

Stg I (0;9-1;6) 146	Minor 120 Problems	Responses 52	Vocatives 7	Other 61
	Major 26	Comm 'V' 3	Quest 'Q' 2	Statement 'V' 1 'N' 6 Other 14 Problems

Stage	Conn	Comm	Quest	Clause		Phrase		Word
Stg II (1;6-2;6)	21	VX 2	QX 1	SV 8 SO SC 2 Neg X 3	AX 3 VO 2 VC Other	DN 13 AdjN NN PrN	VV V part 2 Int X 5 Other 1	-ing 5 Pl
	5	X+S:NP 1		X + V:VP 1	X + O:NP 1	X + C:NP 2	X + A:AP	-ed 1
Stg III (2;0 – 2;6)	16	VXY let XY do XY	QXY VS(X)	SVC 1 SVO 13 SVA 2 negXY	VCA VOA VOiOd other	D Adj N Adj Adj N Pr DN 1 PronP 28 Prono 8	Cop 2 Auxm 2 Aux0 other	-en 1 3s 1 Gen
	1	XY+S: NP		XY+V: VP 1	XY+ C:NP	XY+ O:NP	XY+ A: AP	n't 1
Stg IV (2;6 – 3;0)	4	+S 1 VXY+	QVS 1 QXY+ VS(X+) tag	SVOA 2 SVCA SVOiOd SVOC	AAXY other	NP pr NP Pr D Adj N cX XcX	Neg V 1 Neg X 2 aux other	'cop 'aux
Stg V (3;0 – 3;6)	and c s other	Coord. other	Coord. Other	Coord. 1 1+ Subord. A 1 1+ S C O Comparative		Postmod. Clause 1 1+ Postmod. Phrase 1+		-est -er -ly

Stg VI (3;6- -4;6)	(+)			(-)				
	NP	VP	Clause	Conn	Clause	Phrase		Word
						NP	VP	N
	Initiator Coord.	Complex	Passive Complement how what	and c s	Element □ □ concord	D pr PronP D □ pr □ D □ pr □	Aux M □	irreg reg
	Other			Ambiguous				

Stg VII (4;6+)	Discourse	Syntactic Comprehension
	A Connectivity it Comment clause there Emphatic order other	Style

Total No. Sentences: 218	Mean No. Sentences per turn:	Mean Sentence Length: 290/197: 1.472

Figure B 2: Sara's LARSP Profile

Name: Kiana Age: 4; 05; 29 Sample Date: 17/May/2012 Type: child & mum are playing with cars

A Unanalysed 1. unintelligible 3 2.symbolic noise 14 3. Deviant 1		Problematic 1. Incomplete 7 2. Ambiguous 3. Stereotype	

B Responses			Repetitions	Normal Response: Major: Elliptical 1	2	3	Red uced	Full	Minor	Abnormal: Structural	☐	Problems
Stimulus Type		Totals										
50	Questions	29		5	1		1	2	20	1	12	
54	Others	31	2	1		3		8	19		17	
C	Spontaneous	125	1	16	2	7	15	55	30			
D	Reactions											

Stage						
Stg I (0:9-1:6) 74	Minor 69 Responses 31 Vocatives 7 Other 31 Problems					
	Major 5	Comm ‘V’ 3	Quest ‘Q’ 1	Statement ‘V’ ‘N’ Other 1 Problems		
	Conn			Clause	Phrase	Word
Stg II (1;6-2;6)	13	VX 5	QX	SV 6 AX 2 SO VO SC VC Neg X Other	DN 48 VV 2 AdjN 5 V part 4 NN Int X 1 PrN 1 Other 2	-ing 4 Pl 3
	9	X+S:NP		X + V:VP 4 X + O:NP 4	X + C:NP X + A:AP 1	-ed
Stg III (2;0 – 2;6)	58	VXY 1 let XY 2 do XY	QXY 1 VS(X) 1	SVC 15 VCA SVO 20 VOA 1 SVA 17 VOiOd negXY other	D Adj N 1 Cop 21 Adj Adj N Pr DN 12 Auxm 28 PronP 84 Aux0 5 Prono 14 other 7	-en 3 3s 17 gen
	57	XY+S: NP 4		XY+V: VP 19 XY+ C:NP 10	XY+ O:NP 16 XY+ A: AP 8	n’t 5
Stg IV (2;6 – 3;0)	15	+S 8 VXY+ 1	QVS 3 QXY+ VS(X+) 1 tag	SVOA 2 AAXY SVCA other SVOiOd SVOC	NP pr NP Neg V 9 Pr D Adj N Neg X cX 1 2 aux XcX 1 other	‘cop 9 ‘aux 2
Stg V (3;0 – 3;6)	And 3 c 5 s 6 other	Coord. other	Coord. Other 1	Coord. 1 1 1+ Subord. A 1 5 1+ S C O Comparative	Postmod. 1 1+ Clause Postmod. 1+ Phrase	-est -er -ly

Stg VI (3;6- -4;6)	(+)				(-)			
	NP	VP	Clause	Conn	Clause	Phrase		Word
						NP	VP	N
	Initiator Coord.	Complex	Passive Complement how what	and c s	Element ☐ ☐ concord	D pr PronP D ☐ pr ☐ D ☐ pr ☐	Aux M Aux O Cop ☐	irreg reg
	Other					Ambiguous		

Stg VII (4;6+)	Discourse	Syntactic Comprehension
	A Connectivity it Comment clause there Emphatic order other	Style
	Total No. Sentences: 214	Mean No. Sentences per turn:	Mean Sentence Length: 551/185: 2.978

Figure B 3: Kiana’s LARSP Profile

Name: Kim Age: 4;00;24 Sample Date: 6/May/2012 Type: child & Mum Interaction, play with Lego

A Unanalysed			Problematic		
1. unintelligible 8 1	2.symbolic noise 3	3. Deviant	1. Incomplete 1 1	2. Ambiguous	3. Stereotype

B Responses		Repetitions	Normal Response: Major: Elliptical 1	2	3	Reduced	Full	Minor	Abnormal: Structural	☐	Problems
Stimulus Type	Totals										
32 Questions	29		4	1				24	1	4	
44 Others	40	4	8		1	1	3	27		3	
C Spontaneous	91	2	13	2	1	14	23	38			
D Reactions											

Stg I (0:9-1:6) 105	Minor 89 Problems	Responses 44	Vocatives	Other 45
	Major 16	Comm 'V'	Quest 'Q' 6	Statement 'V' 'N' 2 Other 8 Problems

	Conn			Clause		Phrase		Word
Stg II (1;6-2;6)	9	VX	QX	SV SO SC 1 Neg X 3	AX 4 VO 1 VC Other	DN 17 AdjN 2 NN PrN	VV V part Int X Other 7	-ing 1 Pl
	2	X+S:NP 1		X + V:VP	X + O:NP	X + C:NP	X + A:AP 1	-ed 7
Stg III (2;0 – 2;6)	23	VXY let XY do XY	QXY VS(X)	SVC 1 SVO 17 SVA 4 negXY	VCA VOA VOiOd other 1	D Adj N 4 Adj Adj N Pr DN 1 PronP 51 Prono 10	Cop 4 Auxm 1 Aux0 1 other	-en 3s 2 Gen
	12	XY+S: NP 1		XY+V: VP 2	XY+ C:NP	XY+ O: NP 6 3	XY+ A: AP	n't 1
Stg IV (2;6 – 3;0)	8	+S 2 VXY+	QVS QXY+ VS(X+) tag	SVOA 6 SVCA SVOiOd SVOC	AAXY other	NP pr NP Pr D Adj N cX XcX	Neg V Neg X 1 2 aux other	'cop 3 'aux
Stg V (3;0 – 3;6)	And 1 c s 1 other	Coord. other	Coord. Other	Coord. 1 1+ Subord. A 1 1+ S C O 1 Comparative		Postmod. Clause Postmod. Phrase	1 1+ 1+	-est -er -ly

Stg VI (3;6-4;6)	(+)				(-)			
	NP	VP	Clause	Conn	Clause	Phrase: NP	Phrase: VP	Word
	Initiator Coord.	Complex	Passive Complement how what	and c s	Element ☐ ☐ concord	D pr PronP D ☐ pr ☐ D ☐ pr ☐	Aux M Aux O Cop ☐	N irreg reg
	Other				Ambiguous			

Stg VII (4;6+)	Discourse	Syntactic Comprehension
	A Connectivity it Comment clause there Emphatic order other	Style
	Total No. Sentences: 181	Mean No. Sentences per turn:	Mean Sentence Length: 294/160: 1.837

Figure B 4: Kim's LARSP Profile

Name: Paul Age: 4;08;06 Sample Date: 27/May/2012 Type: Child & Mum Interaction, card game

A					
Unanalysed 1. unintelligible 8 4	2.symbolic noise	3. Deviant	Problematic 1. Incomplete 5	2. Ambiguous	3. Stereotype

B Responses Stimulus Type		Totals	Repetitions	Normal Response: Major: Elliptical 1	2	3	Reduced	Full	Minor	Abnormal: Structural	□	Problems
85	Questions	59		28				2	29	4	10	
83	Others	39	26	9			2	2	26	2	10	
C Spontaneous		102	3	36	6		10	14	36			
D Reactions												

Stg I (0:9-1:6) 129						
Minor 91	Responses 51	Vocatives 19	Other 21	Problems		
Major 38	Comm 'V'	Quest 'Q'	Statement 'V'	'N' 19	Other 19	Problems

	Conn	Clause				Phrase		Word
Stg II (1;6-2;6)	14	VX	QX	SV 1 SO SC 6 Neg X	AX 6 VO 1 VC Other	DN 42 AdjN 4 NN PrN	VV V part Int X 1 Other 3	-ing Pl
	13	X+S:NP 4		X + V:VP 1	X + O:NP	X + C:NP 5	X + A:AP 3	-ed 5
Stg III (2;0 – 2;6)	13	VXY let XY do XY	QXY 3 VS(X)	SVC 4 SVO 4 SVA 2 negXY	VCA VOA VOiOd other	D Adj N 2 Adj Adj N Pr DN 9 PronP 14 Prono 9	Cop 6 Auxm 2 Aux0 3 other 1	-en 3 3s 7 Gen
	11	XY+S: NP 1		XY+V: VP	XY+ C:NP 4	XY+ O:NP 4	XY+ A: AP 2	n't 1
Stg IV (2;6 – 3;0)	7	+S 3 VXY+	QVS (+) 4 QXY+ VS(X+) Tag	SVOA SVCA SVOiOd SVOC	AAXY other	NP pr NP Pr D Adj N cX 3 XcX	Neg V 2 Neg X 1 2 aux other 1	'cop 3 'aux 3
Stg V (3;0 – 3;6)	And 7 c 1 s other	Coord. other	Coord. Other	Coord. 1 1+ 1 Subord. A 1 1+ S C O 1 Comparative		Postmod. Clause 1 1+ Postmod. Phrase 1+		-est -er -ly

Stg VI (3;6- -4;6)	(+)				(-)			
	NP	VP	Clause	Conn	Clause	Phrase: NP	Phrase: VP	Word
	Initiator Coord.	Complex	Passive Complement how what	and c s	Element □ □ concord	D pr PronP D □ pr □ D □ pr □	Aux M Aux → O Cop □	N irreg reg
	Other					Ambiguous		

Stg VII (4;6+)		
	Discourse A Connectivity it Comment clause there Emphatic order other	Syntactic Comprehension Style

Total No. Sentences: 252	Mean No. Sentences per turn:	Mean Sentence Length: 358/200: 1.79

Figure B 5: Paul's LARSP Profile

Appendix O: LARSP Profiles for Group 3

Name: Jack Age: 4;06;08 Sample Date: 19/5/2012 Type: Child & Mum Interaction, playing with logo

A Unanalysed 1. unintelligible 6 2.symbolic noise 6 3. Deviant 4	Problematic 1. Incomplete 15 2. Ambiguous 3. Stereotype 1

B Responses			Repe-titions	Normal Response: Major: Elliptical 1	2	3	redu ced	Full	Minor	Abnormal: Struct-ural	☐	Problems
Stimulus Type		Totals										
75	Questions	46	1	9		1	3	3	30	2	24	
35	Others	20	1	2				2	16		13	
C	Spontaneous	185	2	14	10	9	9	60	83			
D	Reactions											

Stage						
Stg I (0:9-1:6)	Minor 129	Responses 41		Vocatives 76	Other 12	Problems
	Major 13	Comm 'V'	Quest 'Q'	Statement 'V' 1 'N' 1	Other 10	Problems 1
142	Conn	Clause			Phrase	Word
Stg II (1;6-2;6)	14	VX 1	QX	SV 10, SO, SC, Neg X; AX 1, VO 2, VC, Other	DN 32, AdjN 1, NN, PrN 7; VV, V part 7, Int X 1, Other 15	-ing 14 Pl 4
	6	X+S:NP		X + V:VP 4; X + O:NP 2	X + C:NP; X + A:AP	-ed 8
Stg III (2;0 – 2;6)	52	VXY let XY do XY	QXY VS(X)	SVC 7, SVO 30, SVA 13, negXY 2; VCA, VOA, VOiOd, other	D Adj N 1, Adj Adj N, Pr DN 10, PronP 88, Prono 14; Cop 13, Auxm 27, Aux0 12, other 4	-en 2 3s 11 gen
	65	XY+S: NP 7		XY+V: VP 22 4; XY+ C:NP	XY+ O:NP 23; XY+ A: AP 10	n't 9
Stg IV (2;6 – 3;0)	28	+S 5 VXY+ 1	QVS QXY+ 1 VS(X+) tag	SVOA 12, SVCA 2, SVOiOd, SVOC; AAXY, other 7	NP pr NP 4, Pr D Adj N 1, cX 1, XcX 1; Neg V 11, Neg X, 2 aux, other	'cop 9 'aux 6
Stg V (3;0 – 3;6)	And 8 c 3 s 6 other	Coord. 2 other	Coord. Other	Coord. 1 1+; Subord. A 1 1+; S C 2; O; Comparative	Postmod. Clause 1 1+; Postmod. Phrase 1+	-est -er 3 -ly

Stg VI (3;6-4;6)	(+)				(-)		
	NP	VP	Clause	Conn	Clause	Phrase	Word
	Initiator 3 Coord.	Complex	Passive Complement how what	and c s	Element ☐ ☐ concord	NP: D pr PronP; D ☐ pr ☐; D ☐ pr ☐ VP: Aux M ☐	N V irreg reg
	Other				Ambiguous		

Stg VII (4;6+)	Discourse A Connectivity it Comment clause 1 there Emphatic order other	Syntactic Comprehension Style

Total No. Sentences: 289	Mean No. Sentences per turn:	Mean Sentence Length: 676/251: 2.693

Figure C 1: Jack's LARSP Profile

Name: Hannah Age: 4; 10; 03 Sample Date: 12/8/2012 Type: Child & Mum Interaction, cooking

A Unanalysed			Problematic	
1. unintelligible 1 3	2.symbolic noise	3. Deviant	1. Incomplete 11	2. Ambiguous3. Stereotype

B Responses			Repetitions	Normal Response: Major: Elliptical 1	2	3+	Reduced	Full	Minor	Abnormal: Structural	□	Problems
Stimulus Type		Totals										
46	Questions	38		2				4	32		2	
51	Others	30	1		2			2	26		21	
C	Spontaneous	91		11	1	12	3	26	38			
D	Reactions											

Stage		Comm	Quest	Statement / Clause		Phrase		Word
Stg I	Minor 96 Problems	Responses 48		Vocatives 14		Other 34		
(0:9-1:6) 104	Major 8	Comm 'V'	Quest 'Q' 2	Statement 'V'	'N' 1	Other 5	Problems	
	Conn			Clause		Phrase		Word
Stg II (1;6-2;6)	7	VX	QX	SV 2 SO SC 1 Neg X	AX 2 VO 2 VC Other	DN 2 AdjN NN PrN	VV V part 3 Int X 3 Other 6	-ing 1 Pl
	4	X+S:NP 1		X + V:VP 2	X + O:NP	X + C:NP 1	X + A:AP	-ed 4
Stg III (2;0 – 2;6)	23	VXY let XY do XY	QXY VS(X) 1	SVC 8 SVO 12 SVA 1 negXY	VCA VOA VOiOd other 1	D Adj N 1 Adj Adj N Pr DN 1 PronP 59 Prono 19	Cop 9 Auxm 22 Aux0 4 other 2	-en 3s 4 Gen
	14	XY+S: NP		XY+V: VP 12 1	XY+ C:NP	XY+ O:NP	XY+ A: AP 1	n't 3
Stg IV (2;6 – 3;0)	18	+S VXY+	QVS QXY+ 2 VS(X+) 5 tag	SVOA 7 SVCA SVOiOd SVOC	AAXY 2 other 2	NP pr NP Pr D Adj N cX 1 XcX	Neg V 2 Neg X 2 aux other	'cop 4 'aux 6
Stg V (3;0 – 3;6)	And 2 C 15 s 2 other	Coord . other	Coord. Other 1	Coord. 1 1+ Subord. A 1 1 1+ S C O Comparative		Postmod. Clause 1 1 1+ Postmod. Phrase 1+		-est -er -ly 2

Stg VI (3;6- -4;6)	(+)				(-)			
	NP	VP	Clause	Conn	Clause	Phrase		Word
	Initiator Coord.	Complex	Passive Complement how what	and c s	Element □ □ concord	NP D pr PronP D □ pr □ D □ pr □	VP Aux M Aux O Cop □	N irreg reg
	Other					Ambiguous		

Stg VII (4;6+)	Discourse	Syntactic Comprehension
	A Connectivity it Comment clause 1 there Emphatic order other	Style
	Total No. Sentences: 175	Mean No. Sentences per turn:
	Mean Sentence Length: 353/159: 2.220	

Figure C 2: Hannah's LARSP Profile

Appendix P: LARSP Profiles Group 1, Follow up

Name: Myra Age: 5;00;25 Sample Date: 2/04/2013 Type: Playing with alphabet stickers, spelling

A Unanalysed			Problematic		
1. unintelligible	2.symbolic noise 1	3. Deviant 2	1. Incomplete 8	2. Ambiguous	3. Stereotype 1

B Responses			Repetitions	Normal Response: Major: Elliptical 1	2	3	Reduced	Full	Minor	Abnormal: Structural	☐	Problems
Stimulus Type		Totals										
32	Questions	22		7	4	1		2	8			
31	Others	22	6	5	4	3		3	7			
C	Spontaneous	113	7	33	6	10		36	28			
D	Reactions											

Stg I (0:9-1:6) 61	Minor 42 Problems	Responses 10		Vocatives 1		Other 31
	Major 19	Comm ‘V’ 1	Quest ‘Q’ 5	Statement ‘V’	‘N’ 9	Other 4 Problems

	Conn	Clause			Phrase		Word
Stg II (1;6-2;6)	11	VX 1	QX	SV 8 SO SC Neg X	AX VO 2 VC Other	DN 35 AdjN 8 NN PrN 6	VV 2 V part 1 Int X Other 6	-ing 2 Pl 7
	7	X+S:NP 1		X + V:VP 3 3	X + O:NP	X + C:NP	X + A:AP	-ed 6
Stg III (2;0 – 2;6)	21	VXY let XY do XY	QXY 1 VS(X) 1	SVC 6 SVO 11 SVA 1 negXY	VCA VOA VOiOd other	D Adj N 18 Adj Adj N Pr DN 5 PronP 55 Prono 6	Cop 23 Auxm 24 Aux0 13 other 2	-en 7 3s 21 Gen 1
	18	XY+S: NP 1		XY+V: VP 7	XY+ C:NP	XY+ O:NP 7	XY+ A: AP 3	n’t 11
Stg IV (2;6 – 3;0)	16	+S VXY+	QVS 3 QXY+ VS(X+) 7 Tag 1	SVOA 5 SVCA SVOiOd SVOC	AAXY other	NP pr NP 6 Pr D Adj N 1 cX 5 XcX 3	Neg V 12 Neg X 2 2 aux 1 other	‘cop 7 ‘aux 10
Stg V (3;0 – 3;6)	And 11 c 14 s 10 other	Coord . other	Coord. Other 1	Coord. 1 7 1+ Subord. A 1 4 1+ S C 1 O 5 Comparative		Postmod. Clause 1 1 1+ Postmod. Phrase 1+		-est -er -ly 1

Stg VI (3;6--4;6)	(+)				(-)			
	NP	VP	Clause	Conn	Clause	Phrase: NP	VP	Word: N
	Initiator 1 Coord.	Complex	Passive 3 Complement how what	and c s	Element ☐ ☐ concord	D pr PronP D ☐ pr ☐ D ☐ pr ☐	Aux M Aux O Cop ☐	irreg reg
	Other						Ambiguous	

Stg VII (4;6+)	Discourse	Syntactic Comprehension
	A Connectivity it Comment clause there Emphatic order 1 other 1	Style
	Total No. Sentences: 182	Mean No. Sentences per turn:	Mean Sentence Length: 635/157: 4.044

Figure D 1: Myra’s LARSP Profile, One Year After

Name: Jack Age: 5;05;23 Sample Date: 3/03/2013 Type: Playing with lego

A Unanalysed 1. unintelligible 2 2.symbolic noise 1 3. Deviant 1	Problematic 1. Incomplete 7 1	2. Ambiguous	3. Stereotype

B Responses			Repetitions	Normal Response						Abnormal		Problems
				Major					Minor			
				Elliptical			Reduced	Full		Structural	☐	
Stimulus Type		Totals		1	2	3						
95	Questions	58		4	2	5	1	7	38			
31	Others	23	2	1	1			4	17			
C	Spontaneous	152		30	6	3	11	62	40			
D	Reactions											

Stage						
Stg I (0:9-1:6) 111	Minor 95 Problems	Responses 64		Vocatives 9		Other 22
	Major 16	Comm 'V' 3	Quest 'Q' 2	Statement 'V' 1 'N' 2 Other 8 Problems		
	Conn	Clause			Phrase	Word
Stg II (1;6-2;6)	11	VX	QX 1	SV 6 AX 3 SO VO 1 SC VC Neg X Other	DN 41 VV AdjN 2 V part 3 NN 1 Int X 6 PrN Other 16	-ing 4 Pl 21
	6	X+S:NP		X + V:VP 2 X + O:NP 1	X + C:NP 1 X + A:AP 2	-ed 4
Stg III (2;0 – 2;6)	53	VXY let XY do XY	QXY VS(X)	SVC 19 VCA SVO 26 VOA 1 SVA 7 VOiOd negXY other	D Adj N 7 Cop 36 Adj Adj N Pr DN 2 Auxm 14 PronP 63 Aux0 12 Prono 32 other 4	-en 5 3s 22 Gen 1
	54	XY+S: NP 4		XY+V: VP 10 14 XY+ C:NP	XY+ O:NP 22 XY+ A: AP 4	n't 7
Stg IV (2;6 – 3;0)	23	+S 6 VXY+	QVS 2 QXY+ 1 VS(X+) tag	SVOA 9 AAXY 3 SVCA 1 other SVOiOd 1 SVOC	NP pr NP 3 Neg V 14 Pr D Adj N Neg X 2 cX 2 aux XcX other 4	'cop 22 'aux 7
Stg V (3;0 – 3;6)	And 2 c 3 s 13 other	Coord . other	Coord. Other 1	Coord. 1 3 1+ Subord. A 1 6 1+ 1 S C 1 O Comparative 1	Postmod. Clause 1 1 1+ Postmod. Phrase 1+	-est -er 3 -ly

Stg VI (3;6-4;6)	(+)				(-)			
	NP	VP	Clause	Conn	Clause	Phrase		Word
						NP	VP	N
	Initiator 6 Coord. 1	Complex	Passive 1 Complement how what	and c s	Element ☐ ☐ concord	D pr PronP D ☐ pr ☐ D ☐ pr ☐	Aux M Aux O Cop ☐	irreg reg
	Other						Ambiguous	

Stg VII (4;6+)	Discourse		Syntactic Comprehension
	A Connectivity it Comment clause there Emphatic order other		Style
	Total No. Sentences: 247	Mean No. Sentences per turn:	Mean Sentence Length: 725 /233: 3.111

Figure D 2: Jack's LARSP Profile, One Year After

Name: Kiana Age: 5;05;27 Sample Date: 14/05/2013 Type: Playing with doll house, and alphabet stickers

A Unanalysed			Problematic		
1. unintelligible 2 1	2.symbolic noise	3. Deviant	1. Incomplete 8	2. Ambiguous	3. Stereotype

B Responses				Normal Response						Abnormal		
				Major								Problems
			Repetitions	Elliptical			Reduced	Full	Minor	Structural	☐	
Stimulus Type		Totals		1	2	3						
78	Questions	60		17	5	2		7	29			
46	Others	29	2	9	1			1	18			
C	Spontaneous	107		35	12	10		34	16			
D	Reactions											

Stg I	Minor 63	Responses 27	Vocatives	Other 36	Problems
(0:9-1:6) 100	Major 37	Comm 'V'	Quest 'Q' 3	Statement 'V' 1 'N' 24	Other 10 Problems

	Conn	Clause				Phrase		Word
Stg II (1;6-2;6)	21	VX 7	QX	SV 6 SO SC Neg X 2	AX 1 VO 5 VC Other	DN 52 AdjN NN 2 PrN 2	VV 1 V part 2 Int X Other 3	-ing 8 Pl 22
	11	X+S:NP		X + V:VP 5	X + O:NP 5	X + C:NP	X + A:AP 1	-ed 5
Stg III (2;0 – 2;6)	24	VXY 2 let XY 1 do XY 1	QXY VS(X)	SVC 1 SVO 14 SVA 5 negXY	VCA VOA VOiOd other	D Adj N 4 Adj Adj N Pr DN 7 PronP 57 17 Prono 8	Cop 11 Auxm 23 Aux0 other 2	-en 2 3s 9 Gen 2
	33	XY+S: NP 4		XY+V: VP 15	XY+ C:NP	XY+ O:NP 10 4	XY+ A: AP	n't 7
Stg IV (2;6 – 3;0)	18	+S 4 VXY+	QVS 8 QXY+ VS(X+) 1 tag	SVOA 3 SVCA 1 SVOiOd 1 SVOC	AAXY other	NP pr NP 1 Pr D Adj N cX 14 XcX 13	Neg V 12 Neg X 2 aux 1 other	'cop 2 'aux 16
Stg V (3;0 – 3;6)	And 36 c 2 s 2 other	Coord. 1 other	Coord. Other	Coord. 1 5 1+ 2 Subord. A 2 2 1+ S C O Comparative		Postmod. 1 1+ Clause Postmod. 1+ Phrase		-est -er -ly

Stg VI (3;6- -4;6)	(+)				(-)			
	NP	VP	Clause	Conn	Clause	Phrase		Word
	Initiator 1 Coord. 1	Complex	Passive 1 Complement how what	and c s	Element ☐ ☐ concord	NP: D pr PronP D ☐ pr ☐ D ☐ pr ☐	VP: Aux M Aux O Cop ☐	N irreg reg
	Other						Ambiguous	

Stg VII (4;6+)	Discourse	Syntactic Comprehension
	A Connectivity it Comment clause there Emphatic order other	Style

	Total No. Sentences: 209	Mean No. Sentences per turn:	Mean Sentence Length: 611/196: 3.117

Figure D 3: Kiana's LARSP Profile, One Year After

Name: Cheryl Age: 5;03;11 Sample Date: 18/07/2013 Type: Playing game with numbers…

A Unanalysed			Problematic		
1. unintelligible 1	2.symbolic noise	3. Deviant	1. Incomplete 4	2. Ambiguous	3. Stereotype

B Responses		Repetitions	Normal Response: Major Elliptical 1	2	3	Reduced	Full	Minor	Abnormal: Structural	☐	Problems
Stimulus Type	Totals										
49 Questions	16		8				1	7	1		
53 Others	16	5	5	1			1	9			
C Spontaneous	78	3	45	7	2		11	13			
D Reactions											

Stage						
Stg I (0:9-1:6) 60	Minor 29 Problems	Responses 13		Vocatives 1	Other 15	
	Major 31	Comm 'V' 1	Quest 'Q' 1	Statement 'V' 2 'N' 12	Other 15	Problems

Stage	Conn	Clause			Phrase	Word
Stg II (1;6-2;6)	7	VX	QX	SV 1 SO SC Neg X AX 5 VO 1 VC Other	DN 23 AdjN NN PrN 1 VV V part Int X Other	-ing 2 Pl 2
	4	X+S:NP		X + V:VP 1 X + O:NP 1	X + C:NP 2 X + A:AP	-ed
Stg III (2;0 – 2;6)	7	VXY let XY do XY	QXY VS(X)	SVC 1 SVO 5 SVA negXY VCA VOA VOiOd other 1	D Adj N Adj Adj N 1 Pr DN 1 PronP 14 Prono 8 Cop 2 Auxm 8 Aux0 6 other 1	-en 3s 6 Gen
	8	XY+S: NP		XY+V: VP 5 XY+C:NP	XY+ O:NP 3 XY+ A: AP	n't 2
Stg IV (2;6 – 3;0)	9	+S VXY+	QVS 6 QXY+ VS(X+) 1 tag	SVOA 2 SVCA SVOiOd SVOC AAXY other	NP pr NP 1 Pr D Adj N cX 9 XcX 8 Neg V 2 Neg X 1 2 aux other 1	'cop 'aux 1
Stg V (3;0 – 3;6)	And 18 c 1 s other	Coord. other	Coord. Other	Coord. 1 1+ Subord. A 1 1+ S C O Comparative	Postmod. Clause 1 1+ Postmod. Phrase 1+	-est -er -ly

Stg VI (3;6- -4;6)	(+) NP	VP	Clause	Conn	(-) Clause	Phrase NP	Phrase VP	Word
	Initiator Coord.	Complex	Passive Complement how what	and c s	Element ☐ ☐ concord	D pr PronP D ☐ pr ☐ D ☐ pr ☐	Aux M Aux O Cop ☐	N irreg reg
	Other				Ambiguous			

Stg VII (4;6+)		
	Discourse A Connectivity it Comment clause there Emphatic order other	Syntactic Comprehension Style

Total No. Sentences: 124	Mean No. Sentences per turn:	Mean Sentence Length: 236/110: 2.145

Figure D 4: Cheryl's LARSP Profile, One Year After

Name: 2.2.7: Hannah Age: 5;09;28 Sample Date: 7/08/2013 Type: Reading books

A Unanalysed			Problematic		
1. unintelligible 1	2.symbolic noise	3. Deviant	1. Incomplete 5	2. Ambiguous	3. Stereotype

B Responses			Repetitions	Normal Response: Major: Elliptical 1	2	3	Reduced	Full	Minor	Abnormal: Structural	□	Problems
Stimulus Type		Totals										
42	Questions	26		5	3			1	17			
43	Others	22	14	2	1	1		5	13			
C	Spontaneous	65		23	1	2		23	16			
D	Reactions											

Stage						
Stg I (0;9-1;6) 64	Minor 44 Problems	Responses 22	Vocatives 1	Other 21		
	Major 20	Comm 'V' 3	Quest 'Q' 1	Statement 'V' 8	'N' 2	Other 6 Problems

Stage	Conn	Clause			Phrase		Word
Stg II (1;6-2;6)	5	VX	QX	SV 5, SO, SC, Neg X, AX, VO, VC, Other	DN 20, AdjN 1, NN, PrN	VV, V part, Int X, Other 4	-ing 3, Pl 2
	3	X+S:NP		X + V:VP 3, X + O:NP	X + C:NP	X + A:AP	-ed 7
Stg III (2;0 – 2;6)	13	VXY, let XY, do XY	QXY, VS(X) 1	SVC 1, SVO 11, SVA, negXY, VCA, VOA, VOiOd, other	D Adj N 2, Adj Adj N, Pr DN 3, PronP 42, 18 Prono 7	Cop 6, Auxm 9, Aux0, other	-en, 3s 4, Gen
	13	XY+S: NP		XY+V: VP 6, XY+ C:NP	XY+ O:NP 7	XY+ A: AP	n't 8
Stg IV (2;6 – 3;0)	14	+S, VXY+	QVS 5, QXY+, VS(X+) 5, tag	SVOA 3, SVCA, SVOiOd, SVOC, AAXY, other 1	NP pr NP, Pr D Adj N, cX 3, XcX 3	Neg V 8, Neg X, 2 aux 1, other 1	'cop 2, 'aux 2
Stg V (3;0 – 3;6)	And 6, c 6, s 3, other	Coord. other 5	Coord. Other 2	Coord. 1 1+ 2, Subord. A 1 1 1+, S C O, Comparative	Postmod. Clause 1 1+, Postmod. Phrase 1+		-est, -er, -ly

Stg VI (3;6- -4;6)	(+)				(-)			
	NP	VP	Clause	Conn	Clause	Phrase: NP	VP	Word
	Initiator 1, Coord.	Complex	Passive, Complement, how, what	and, c, s	Element □, □ concord	D pr PronP, D □ pr □, D □ pr □	Aux M, Aux O, Cop, □	N irreg, reg
	Other					Ambiguous		

Stg VII (4;6+)	Discourse	Syntactic Comprehension
	A Connectivity, it, Comment clause, there, Emphatic order, other	Style

	Total No. Sentences: 133	Mean No. Sentences per turn:	Mean Sentence Length: 303/113: 2.681

Figure D 5: Hannah's LARSP Profile, One Year After

Appendix Q: LARSP Profiles Group 2, Follow up

Name: Kim Age: 5;00;14 Sample Date: 27/04/2013 Type: Playing with Lego and drawing

A Unanalysed			Problematic		
1. unintelligible 6	2.symbolic noise	3. Deviant	1. Incomplete 2	2. Ambiguous 1	3. Stereotype

B Responses		Repetitions	Normal Response: Major: Elliptical 1	2	3	Reduced	Full	Minor	Abnormal: Structural	☐	Problems
Stimulus Type	Totals										
44 Questions	29		12				1	16	1		
34 Others	26		17	1			1	7			
C Spontaneous	98		34	10	1		22	31			
D Reactions											

Stage					
Stg I (0:9-1:6)	Minor 54 Problems	Responses 22	Vocatives 2	Other 30	
	Major 34	Comm 'V' 2	Quest 'Q' 20	Statement 'V' 1 'N' 10 Other 1	Problems
88					

Stage	Conn	Clause			Phrase	Word
Stg II (1;6-2;6)	14	VX	QX 5	SV 5 SO SC 1 Neg X 1 AX 1 VO 3 VC Other	DN 36 AdjN NN 1 PrN VV 1 V part Int X Other 2	-ing 1 Pl 1
	9	X+S:NP 4		X + V:VP 1 X + O:NP 3	X + C:NP 1 X + A:AP	-ed 3
Stg III (2;0 – 2;6)	13	VXY let XY do XY	QXY VS(X)	SVC 6 SVO 5 SVA 1 negXY VCA VOA 1 VOiOd other	D Adj N 3 Adj Adj N Pr DN 1 PronP 28 Prono 9 Cop 11 Auxm 8 Aux0 4 other 2	-en 1 3s 7 Gen
	9	XY+S: NP 1		XY+V: VP 3 XY+ C:NP 3	XY+ O:NP 2 XY+ A: AP	n't 2
Stg IV (2;6 – 3;0)	9	+S VXY+	QVS 6 QXY+ VS(X+) 2 tag	SVOA 1 SVCA SVOiOd SVOC AAXY other	NP pr NP Pr D Adj N cX XcX 3 Neg V 2 Neg X 1 2 aux other	'cop 2 'aux 1
Stg V (3;0 – 3;6)	And 4 c s other	Coord. other	Coord. Other	Coord. 1 1+ 1 Subord. A 1 1+ S C O 1 Comparative	Postmod. Clause 1 1+ Postmod. Phrase 1+	-est -er -ly

Stg VI (3;6- -4;6)	(+) NP	VP	Clause	(-) Conn	Clause	Phrase: NP	VP	Word
	Initiator 2 Coord.	Complex	Passive Complement how what	and c s	Element ☐ ☐ concord	D pr PronP D ☐ pr ☐ D ☐ pr ☐	Aux M Aux O Cop ☐	N irreg reg
	Other					Ambiguous		

Stg VII (4;6+)	Discourse	Syntactic Comprehension
	A Connectivity it Comment clause 1 there Emphatic order other	Style

Total No. Sentences: 163	Mean No. Sentences per turn:	Mean Sentence Length: 311/153: 2.032

Figure E 1: Kim's LARSP Profile, One Year After

Name: 2.2.5 : Paul Age: 5;09;02 Sample Date: 23/06/2013 Type: Reading books

A Unanalysed			Problematic		
1. unintelligible 1	2.symbolic noise	3. Deviant	1. Incomplete 11	2. Ambiguous	3. Stereotype

B Responses				Normal Response						Abnormal		Problems
				Major								
			Repe-	Elliptical			Red			Struct-		
Stimulus Type		Totals	titions	1	2	3	uced	Full	Minor	ural	☐	
72	Questions	44	1	16	2	4		3	19			
45	Others	22	16	6		1		4	11			
C	Spontaneous	95	2	22	8	12		29	24			
D	Reactions											

Stg I (0:9-1:6) 90

Minor Problems 54 Responses 30 Vocatives 13 Other 11

Major 36: Comm 'V' 2; Quest 'Q' 3; Statement 'V' 5, 'N' 23, Other 3, Problems

	Conn			Clause		Phrase		Word
Stg II (1;6-2;6)	16	VX 1	QX 5	SV 5 SO SC Neg X	AX 2 VO 3 VC Other	DN 22 AdjN 1 NN PrN 1	VV 2 V part 1 Int X 1 Other 7	-ing 4 Pl 3
	2	X+S:NP		X + V:VP 1	X + O:NP 1	X + C:NP	X + A:AP	-ed 8
Stg III (2;0 – 2;6)	29	VXY let XY do XY	QXY 5 VS(X)	SVC 13 SVO 7 SVA 3 negXY	VCA VOA 1 VOiOd other	D Adj N 1 Adj Adj N Pr DN 3 PronP 43 Prono 17	Cop 29 Auxm 8 Aux0 7 other	-en 3s 27 Gen
	25	XY+S: NP 2		XY+V: VP 8 8	XY+ C:NP	XY+ O:NP 5	XY+ A: AP 2	n't 5
Stg IV (2;6 – 3;0)	15	+S VXY+ 1	QVS 5 QXY+ 2 VS(X+) 1 tag	SVOA 5 SVCA 1 SVOiOd SVOC	AAXY other	NP pr NP Pr D Adj N cX XcX 1	Neg V 6 Neg X 2 aux other 1	'cop 13 'aux 4
Stg V (3;0 – 3;6)	And 7 c 1 s 4 other	Coord . other	Coord. Other	Coord. 1 1+ 2 Subord. A 1 1+ S C O Comparative 1		Postmod. Clause 1 1+ Postmod. Phrase 1+		-est -er 1 -ly

Stg VI (3;6- -4;6)

(+)				(-)			
NP	VP	Clause	Conn	Clause	Phrase		Word
Initiator Coord.	Complex	Passive 1 Complement how what	and c s	Element ☐ ☐ concord	NP D ☐ pr ☐ PronP D ☐ pr ☐ D ☐ pr ☐	VP Aux M Aux O Cop ☐	N V irreg reg
Other				Ambiguous			

Stg VII (4;6+)

Discourse	Syntactic Comprehension
A Connectivity it Comment clause there Emphatic order other	Style

Total No. Sentences: 192	Mean No. Sentences per turn:	Mean Sentence Length: 400/161: 2.484

Figure E 2: Hannah's LARSP Profile, One Year After

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