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Editorial

The development of oral language in children with bilateral hearing loss: From speech perception to morphosyntax

This *Lingua* Special Issue was initiated at the workshop *Beyond hearing: Current investigations in listening and language skills in cochlear implant users* held at May 25, 2011 at Leiden University (The Netherlands). This workshop closed off a 5-year research project that was conducted in the context of a ‘VIDI’ grant within the Innovational Research Incentives Scheme funded by the Dutch Organization of Scientific Research (NWO). The project was the starting point for international and multi-disciplinary cooperation on research concerning the interaction between language, cognition and hearing in the developing child. Between 2008 and 2013, it has been continued in following collaborative European research projects coordinated by the first and the second editor (FP7-SME-1-2008-222291 ‘‘DUAL PRO’’ and FP7-SME-1-2010-262266 ‘‘OPTI-FOX’’, FP7-2012-324401 ‘‘HEARING MINDS’’).[1]

The above mentioned research projects address the complex nature of oral language comprehension and production by emphasizing the interaction between two modules of perception (audition, language) and between the central cognitive system and each of them. Under such a view, research investigating speech comprehension requires a genuine inter-disciplinary approach combining insights from audiology, linguistics and (developmental) psychology. Against this background, the main aim of present *Lingua Special Issue* is to unravel to which extent hearing loss, cognitive performance of the individual and the linguistic characteristics of the auditory input contribute to receptive and productive oral language capacities in the developing child. Jointly, the contributions address several questions that concern the development of early speech perception skills and how these may affect the development of oral language grammar in different populations of children with hearing- and/or language-impairment.

In what follows, we will give a brief presentation of the main properties of the populations under investigation both from an audiological and developmental linguistic point of view. In Section 2, we will identify the auditory and linguistic benefits that are associated with a relatively new population of hearing impaired children for whom hearing has been partially restored thanks to cochlear implantation very early in life. Section 3 will discuss three important factors related to auditory perception that influence oral grammar development in atypical populations. Finally, Section 4 will give a brief overview of the different contributions to this volume.

1. Hearing impairment: the importance of early detection and early intervention

Human hearing is attuned to the sounds of language. Over a large range of audible sound, healthy individuals can discriminate minor differences in loudness and pitch that enable them to make vital meaning differences in words and sentences. The problem of profound congenital deafness affects 1.2–3.2 per 1000 newborns and has an important negative effect on the individual’s communicative abilities. For centuries, profound deafness implied an almost full decrease in the ability to understand speech sounds and therefore forced many patients to recur to non-auditory communication modes such as lip-reading or signing. It is well known that in deaf children who do not have sufficient gain from their hearing devices a severely reduced access to the speech signal makes them particularly prone to deficits in the development of their oral language (Svirsky et al., 2000; Norbury et al., 2001; Hansson et al., 2007). Importantly, the

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negative effect of congenital deafness on the developing child does not stop at the level of spoken language itself. Strong language skills are crucial to literacy development, which is in turn the foundation for further academic success (Chute and Nevins, 2006; Geers et al., 2003). By the age deaf children have to enter elementary school, they will not have built up the strong oral language skills necessary for mainstreaming, for reading and writing tasks, which facilitate the access to mathematical concepts (Spencer et al., 2003; Brannon, 2005). These attested negative effects of bilateral profound hearing loss on the developing child will be taken up again in Section 2 with respect to the short-, medium- and long-term benefits of enhanced access to auditory stimuli in young deaf infants thanks to early hearing rehabilitation.

Depending on the type and degree of deafness, appropriate early intervention programs include the use of conventional hearing aids (HAs) or cochlear implants (CIs) (Govaerts et al., 2002; De Ceulaer et al., 1999; Daemers et al., 2006; Dirckx et al., 1996). Since the eighties, the latter are used as prosthetic devices that replace the cochlear function via electrical stimulation of the auditory nerve and as such, partially restore hearing to profoundly deaf people. For many years CIs have been implanted mostly in adults with acquired hearing loss. This was mainly due to the fact that the few congenitally deaf adults who did receive a cochlear implant showed only minor improvements in speech and language perception and production abilities after implantation. For a long time, the efficiency of cochlear implantation was taken to be highly dependent upon the presence of fully developed auditory and language systems before the onset of deafness (see e.g. Okazawa et al., 1996; Naito et al., 1997).

Yet, by the end of the previous century a new population of cochlear implant recipients announced itself. Over the years, it has been shown at numerous occasions that children with hearing loss that have been identified in the first months of life and who are provided with timely and appropriate intervention have significantly better early speech perception and production skills, larger receptive and productive vocabularies and better oral grammar abilities than infants who do not benefit from such and early intervention (Yoshinago-Itano, 1998; Moeller, 2000; Govaerts et al., 2002; JCIH, 2007). In many Western countries, by the end of previous century the emergence of national hearing screening programs for newborns has opened the way to an early diagnosis of congenital deafness within the first few weeks after birth (Govaerts, 2002). Thanks to recent advances in hearing technology, infants of any age can benefit from a hearing aid (ASHA, 2009). For many children with severe to profound hearing impairment, however, even the use of a very powerful hearing aid does not provide sufficient access to speech. Fortunately, for many of them, cochlear implants have become a safe option and implantation is possible in infants as young as four to five months (Govaerts et al., 2002). Opponents of the use of CIs in congenitally deaf children have longtime questioned its potential benefits arguing that a reduced and impoverished auditory signal as transmitted by the implant would not enable these children to express themselves as freely as their hearing peers (Lane, 1992). Today, many pediatric cochlear implanted children have proven to be able to take in sufficient information from the speech signal as coded by the cochlear implant speech processor to achieve good speech perception and overall oral language skills. As such, this implantable hearing device seems to be able to fulfill a *conditio sine qua non* with respect to successful oral language development by providing deaf children with early access to auditory stimuli. Over the last decade, besides post-lingually deafened adults, pre-lingually deaf children have thus become another vast population of cochlear implant recipients.

2. Auditory and general linguistic benefits of pediatric cochlear implantation

This *Special Issue* is mainly concerned with the auditory and linguistic benefits that may arise from appropriate hearing rehabilitation in this relatively new population of pre-lingually deaf infants. In the literature, there have been many efforts to measure the effectiveness of pediatric cochlear implantation in different domains of child development. Summerfield and Marshall (1999) have developed a model in which the enhancement of auditory receptive skills is the starting point of a cascade of benefits that may follow from cochlear implantation. These include short-term benefits in the first three years of life, such as the increased use of aural/oral communication modes and enhanced levels of speech and language perception and production. In the next five years, the observed achievements are expected to lead to medium-term benefits beyond the auditory and language domains, including amongst other, a successful integration in primary education, enhanced reading, writing and mathematical skills, greater social versatility and robustness, and an overall increase in the quality of life of the child. Finally, long-term benefits are expected to include a successful transition to secondary education and overall enhanced educational qualifications, greater social independence and quality of life in adulthood.

Importantly, the entire cascade of benefits is taken to span at least twenty years. Thanks to the above sketched general approach to neonatal hearing screening, by the end of the previous century in many European countries an important number of deaf infants were able to receive cochlear implants. As a consequence, there is a cohort of ‘first generation’ pediatric cochlear implanted children with different native language backgrounds that has now reached adolescence. Some of these children have been followed closely during infancy and childhood, either in cross-sectional or longitudinal studies often evaluating the short-term benefits of pediatric cochlear implantation in terms of receptive and productive speech and language skills (see amongst many others, Kirk et al., 2002; Svirsky et al., 2004;

Tomblin et al., 2005; Dettman et al., 2007; Hay-McCutcheon et al., 2008; Nicholas and Geers, 2007; Geers et al., 2009). A few have also investigated potential mid-term benefits, for instance by focusing on the association between strong language skills and literacy development (see e.g. Spencer et al., 2003). Only few pediatric cochlear implantees have already reached adulthood; it thus seems too early to make strong claims about potential long-term benefits such as enhanced opportunities in employment or further education.

3. Factors influencing oral language development in young children with a hearing impairment

As presented in the previous section, there is an overwhelming body of literature reporting on the overall benefits of early cochlear implantation in deaf children. It should be observed, however, that the achieved performance level of each individual child does not necessarily compare to that of an average typically developing hearing peer. As a matter of fact, at present deaf children wearing cochlear implants constitute a heterogeneous group with very different audiological, cognitive and educational characteristics. Language outcomes may vary to a great extent: some children with cochlear implants seem to be on a developmental trajectory that parallels children with normal hearing while others perform far below average on a series of measures (see e.g. Pisoni et al., 2000 on 'Star' CI-performers on open-set word recognition, receptive and expressive language and speech intelligibility).

There has been great interest in identifying the factors that explain the observed variability in language outcomes of children with hearing impairment. In what follows, we will give a non-exhaustive presentation of a number of alleged contributing factors. These include, amongst many others (i) the hearing levels of the child both in an unaided and aided condition and the type of hearing device used by the child (classical hearing aids vs. cochlear implants), (ii) the age at which the child receives his/her cochlear implant; and (iii) post-cochlear hearing factors influencing auditory perception.

Importantly, around 40% of children with a hearing impairment have additional disabilities. They may present with visual impairment (potentially leading to deaf-blindness), learning and intellectual disabilities (e.g. Down's syndrome, autism spectrum disorders), attention deficit disorders (ADD/ADHD), cerebral palsy or emotional disturbance. For obvious reasons, children with multiple disabilities are a very challenging group with respect to hearing rehabilitation. Given the focus of this *Special Issue* it is beyond the scope of this introductory paper to discuss the potential effect of additional disabilities on oral language outcomes in children with hearing impairment..

3.1. Hearing levels and the type of hearing device

A vast number of studies investigating the short-term linguistic benefits of cochlear implantation have compared oral language outcomes of profoundly deaf children wearing classical hearing aids to those of children wearing cochlear implants. Provided that variability between the two groups with respect to unaided hearing levels is low, most studies show that the overall rates of oral language development are significantly better in children with CIs as compared to children wearing classical hearing aids (Boothroyd et al., 1991; Geers and Moog, 1994; Robbins et al., 1997; Spencer et al., 1998; Svirsky et al., 2000).

Comparing both populations of children with hearing impairment, Geers and Moog (1994) found that children with cochlear implants outperformed the group of children wearing classical hearing aids both with respect to receptive and expressive oral language skills. The language levels of the children wearing cochlear implants could be compared to those found in children with classical hearing aids whose unaided hearing levels were on average 20 dB better. In a similar vein, Tomblin et al. (1999) compared spontaneous language samples of children with cochlear implants and with classical hearing aids who did not differ from each other with respect to pure-tone average hearing loss (ca. 110 dB both in the left and the right ear, i.e. all hearing aid users were considered to be cochlear implant candidates) and found that on the Index of Productive Syntax (IPsyn) children with cochlear implants proved to perform significantly better than children wearing hearing aids. The fact that they did so for all subscales of the IPsyn, including noun phrases and verb phrases, the formation of questions and negations, and for sentence structure is a strong indication of a stable pattern of better performance which comprises different components of oral grammar.

Subsequent work has confirmed the advantage of cochlear implants over classical hearing aids with respect to oral language development in prelingually deaf children. Additional comparisons between both populations of hearing impaired children have shown that the cochlear implant is able to improve the deaf child's hearing up to the level of severely hearing impaired peers wearing classical hearing aids. Evaluating the speech perception, production and a number of general language measures of eighty-seven primary-school children with impaired hearing over a three-year period, Blamey et al. (2001) have found that the speech perception performance of children with cochlear implants who have a mean unaided pure tone average (PTA) hearing loss of 106 dB HL compares to that of children fitted with classical hearing aids having an unaided PTA hearing loss of 78 dB HL. Based on these findings the authors take the perceptual effect of a cochlear implant in the population under investigation to be equivalent to an average improvement in hearing thresholds of more than 20 dB.

Today, the criteria for cochlear implant candidacy in children generally include bilateral profound hearing loss in the better ear (>85 dB) and no appreciable benefit with hearing aids. This implies that children with moderate to severe hearing loss are generally not taken to be candidates for cochlear implantation. In the latter case, classical hearing aids are taken to be best suited. Against the background of the above mentioned findings with respect to oral language performance outcomes in both populations of hearing impaired children it seems reasonable, however, to reconsider these implantation candidacy criteria. Advances in cochlear implant technology now enable some children to achieve aided hearing levels that are within the range of mild hearing loss. Under such a view, it is to be expected that children with moderate to severe hearing loss would receive more oral communication benefit from a cochlear implant as compared to the classical hearing aid they are currently fitted with. Evidence in favor of such a benefit is slowly building up: pediatric cochlear implanted children have been shown to compare to children wearing classical hearing aids not only by reaching similar levels of aided hearing thresholds which are within the range of mild hearing loss, but also with respect to the levels of verb morphology production they achieve (see Hammer, 2010). Ongoing research will need to investigate whether the observed findings are also found with respect to speech perception and production and for different components of language grammar.

3.2. Age at implantation

From the point of view of developmental psycholinguistics, the close relation between early access to oral language input and the ability to achieve normal levels of oral language proficiency comes as no surprise. In the light of more general background assumptions about the plasticity of the young brain, it is commonly accepted that there is an optimal biological time-window for native language development which comprises at least the first six years of a child's life (Lenneberg, 1967; Curtiss, 1977, a.o.). Research in developmental cognitive neuroscience shows that in this respect, language is not different from other cognitive systems: during a certain period in development the brain exhibits plasticity, i.e. it has the ability to modify pre-existing neural synaptic connections dedicated to language, depending on the quantity or quality of the linguistic stimuli (Neville and Bruer, 2001; Shouval and Perrone, 1995). This implies that language skills that are not acquired during this particular sensitive window will remain deficient for life.

Under such a view, intervention during the sensitive window in children who are at risk for developmental language disorders may have a positive influence on their phonological, morphological and syntactic competence in adulthood. In this sense, early access to oral language stimuli thanks to cochlear implantation can possibly make the difference between temporary and persisting linguistic deficits.

Previous studies based on populations of oral deaf children with a CI show that the optimal time-window for the development of language begins to close at age two: children receiving CIs in the third and fourth year of life show important general language delays compared to children implanted before that age (Govaerts et al., 2002; Waltzman and Cohen, 2005; Geers et al. 2003; Svirsky, 2005). Until a few years ago, no clear evidence has been reported in favor of a further benefit of lowering the age of implantation before the second year of life (Svirsky and Holt, 2005), although predictions have been made in this direction (Nicholas and Geers, 2006; Valencia et al., 2008).

Only recently, there has been a growing body of literature indicating that cochlear implantation as early as the first 18 months does have a significantly positive effect on oral language development. In a retrospective study by Hammes et al. (2002) based on several spoken language measures it was shown that children implanted before the age of eighteen months consistently demonstrate rates of language growth similar to those of their normal hearing peers. In a similar vein, Coene et al. (2011) have shown that deaf infants who have received their cochlear implant during the first sixteen months of life are more likely to develop age-appropriately with respect to several early language milestones, measured in terms of canonical babbling ratios, vocabulary diversity and grammatical morpheme emergence.

During the last few years, evidence in favor of additional benefits in infants implanted within the first year of life is steadily growing. It points in the direction of significantly improved auditory skills which contribute in better speech perception, speech production and oral language outcomes already at a very young age. The current literature indicates that cochlear implantation prior to one year is both safe and efficacious: infants who receive their implants at this young age do not show higher rates of complications than children who are implanted at an older age (Cosetti and Roland, 2010; Colletti et al., 2012; Vlastarakos et al., 2010), yet the fact that they have access to auditory information earlier on in life allows them to reach age-appropriate speech and language skills already by the age of two. Older pediatric implantees will not reach this same level of oral language development before they are three and a half years old (Holman et al., 2013).

3.3. Post-cochlear hearing factors influencing oral language development

The mere detection of speech stimuli is a necessary but hardly a sufficient condition for successful speech understanding. It is generally accepted that both bottom-up factors (i.e. sensory encoding at the level of the cochlea) and top-down factors (i.e. cognitive, language and other high-order functions) influence the processing of speech input. Jointly, they determine the language user's ability to understand auditory information. As such they are a crucial factor in the development of oral language grammar in the young child.

By dissociating the two types of processes involved in speech perception, it becomes possible to identify populations with defective top-down processing of auditory information in the presence of normal hearing thresholds. Already more than half a century ago, it was suggested that there were children with normal peripheral hearing who could not process verbal information in the same way that other children did. In spite of normal hearing, these children had particular difficulties in interpreting speech (Myklebust, 1954). Over the years, there has been an increased interest in auditory processing deficits as the potential underlying cause for particular language learning difficulties. Several scholars have postulated that Specific Language Impairment (SLI), a developmental disorder that has traditionally been associated with a deficit of language that is intrinsically grammatical, actually stems from an underlying auditory processing deficit that particularly concerns the processing of temporal aspects of sound (Rosen, 2003). This implies that many children with primary language impairment need more time than normally developing children to process brief, successive acoustic signals (Tallal and Stark, 1981; Tallal et al., 1993). The fact that these children need hundreds of milliseconds instead of tens of milliseconds to process rapidly changing acoustic information is taken to have an important impact on their speech perception and phonological development. More precisely, this so-called auditory deficit account of SLI takes the deficient performance of these children not to be intrinsically grammatical in nature, but to be caused by perceptual difficulties due to which particular grammatical elements are easily missed in incoming speech. In this respect, it has been claimed that the acquisition of a morpheme is particularly troublesome if it is perceptually low salient, i.e. if it has no vowel (e.g. the English 3rd person singular marker -*s* or the regular past morpheme -*d*) or a short, unstressed vowel (e.g. the indefinite and definite articles *a, the*), see Leonard et al. (1992).

More recently, for this particular population of atypical language learners, substantial deficits have also been attested more generally for speech perception in difficult listening conditions, including different contexts of masking noise. Importantly, under optimal listening conditions (i.e. in a quiet environment), many children with SLI do not show substantial speech perception deficits. However, in the presence of masking noise, they perform significantly worse with respect to phoneme identification tasks as compared to age-matched typically developing children. As the observed speech-in-noise perception deficit seems to persist even in comparison with language-matched children, it has been argued to be the cause rather than the consequence of the children's language impairment. Interestingly, just as their typically developing hearing children, children with SLI perform better in fluctuating than in steady-state noise backgrounds (Ziegler et al., 2005; Baer and Moore, 1994; Miller and Licklider, 1950). This is because in fluctuating noise, both populations of children are able to make use of the short temporal ''release of masking'' in the noise to detect speech cues. Such detection is possible if the listener is able to use the fluctuations in temporal fine structure (TFS, i.e. relatively rapid variations) encoded in speech sounds (Rosen, 1992). A successful use of TFS cues is critical for understanding speech in background noise in the sense that it enables the listener to decide whether the signal in the dips of the noise is part of the target speech (Moore, 2008; Lorenzi et al., 2006). The fact that children with SLI are able to make use of release of masking indicates that their language deficit results from a central deficit in feature extraction rather than from low-level, temporal, and spectral auditory capacities (Ziegler et al., 2005).

Bearing in mind that the oral language development of children with hearing impairment often shows deficiencies that are very similar to those found in children with SLI (e.g. omission of tense and plural morphemes, noun determiners, auxiliaries and agreement markers on the verb) the following question automatically follows from the above findings: do deaf children wearing cochlear implants compare to children with SLI in showing an equally poor performance with respect to speech perception in noise? And if so, could it be induced by a deficient 'dip listening' performance which is directly related to cochlear damage? Research based on speech perception in adults with sensori-neural hearing loss shows that their ability to encode or use TFS cues is indeed impaired (Moore and Skrodzka, 2002; Santurette and Dau, 2007). Often when audibility is controlled for listeners achieve a nearly normal ability to identify speech in quiet, but at the same time they will still show extremely poor speech identification in background noise.

Although the auditory deficit in children with hearing impairment and children with SLI has a different underlying cause (cochlear damage in the first case vs. auditory processing disorder in the second case), the negative effect it has on their oral language outcomes is very similar. This holds both in terms of a deficient speech perception and an atypical developmental pattern of oral grammar. Following a developmental theory of language which takes analytical language mechanisms to fully activate only when sufficient lexical material has been stored (Locke, 1997), reduced access to or intake of oral language input will lead to a shortage of stored lexical items. In the absence of sufficient lexical material the child will not be able to discover regularities and eventually to apply grammatical rules and build a linguistic grammar.

Summarizing, the potential similar effect of peripheral auditory deficits and central auditory processing deficits on oral language seems to duly justify a more detailed comparison of morphosyntactic development in children with hearing impairment and in children with SLI. Two of the papers in this volume specifically tackle aspects of morphosyntactic development which are subject to difficulty both in the context of hearing loss and of specific language impairment (see Hammer et al.; Tuller and Delage, below).

4. The contributions to this volume

The majority of studies investigating short-term linguistic outcomes in children with cochlear implants and, more generally, children with a hearing impairment, have focused on improved speech perception and production (Calmels et al., 2004; Richter et al., 2002; Svirsky and Meyer, 1999; Tobey et al., 2003). However, speech skills do not necessarily reflect linguistic competence, as the latter can be defined by a set of internalized grammatical rules possessed by native speakers of given language. Lately, research efforts have been made to investigate the development of different linguistic domains, including phonology, morphology, syntax and pragmatics (see Schauwers et al., 2005 for a detailed overview).

This volume aims at bringing together new insights both with respect to the effect of attention to speech, visual support of the speech signal, perceptual salience and processing of the acoustic signal and the acquisition of the linguistic system itself. As for the latter, developmental language data of typologically different languages are investigated for different populations of children with hearing impairment and compared to children with language impairment. With respect to the development of the core components of grammar, the different contributions provide an in-depth analysis on the acquisition of morphosyntax, focusing on verbal morphology in Dutch, on the syntax of subject and object relatives in Italian and on general morphosyntactic abilities in French. In addition, two studies sketch the end-state of a morphosyntactic developmental path in a group of adolescents and adults with conventional hearing aids. The obtained data could serve as a background for morphosyntactic prognosis in pediatric cochlear implanted children and as such shed some light on a potential long-term prognosis for language development in this population.

The main goal of the paper by **Derek Houston** and **Tonya Bergeson** is to explore the possibility that attention to speech be the potential source of variance in oral language performance of deaf children wearing cochlear implants. They do so by reviewing Peter Jusczyk's Word Recognition and Phonetic Structure Acquisition (WRAPSA) model (Jusczyk, 1993), a comprehensive model of early language comprehension to show that the infant's attention to speech depends in large part on the nature of the speech presented to them. Within this model, they discuss how attention to speech may shape basic components of the perceptual system through learning associations between the sound patterns of words and their referents. In view of a comparison between normal hearing infants and infants with cochlear implants, they review the recent research on attention-getting characteristics of speech and their potential effect on speech perception and early language acquisition.

Marie-Thérèse Le Normand and **Ignacio Moreno Torres** are concerned with the grammatical development of native French-speaking children with cochlear implants. They specifically look at the interactions between grammar and other language components such as lexicon and prosody. The central question raised in their paper is whether children wearing cochlear implants are able to use the lexical and prosodic information in language input that facilitates oral grammar development or whether poor perception prevents them to benefit from these implicit learning strategies which are typically found in hearing peers. The results of their analysis of the recordings of spontaneous language samples from both hearing-impaired children and hearing controls shows that children with cochlear implants acquire their lexicon and grammar at a steadily slower rate than their typically developing hearing peers. Yet, their productions of nominal determiners and pronominal clitics are subject to prosodic constraints in a similar way to typical children, indicating that hearing children and children with CIs benefit from the same implicit learning strategies. Here, the source of variation amongst children wearing CIs is found primarily in environmental factors as witnessed by a strong association between the socio-cultural level of the family and the grammatical development of the child.

The study by **Francesca Volpato** and **Mirna Vernice** targets the acquisition of complex syntax in children with a hearing impairment. Volpato and Vernice have elicited the production of subject and object relatives in Italian by seven-to-ten year old Italian-speaking children wearing cochlear implants and compared the outcomes to those found in hearing controls matched on morphosyntactic abilities, chronological age and hearing age. Importantly, both hearing children and children with CIs showed better performance on subject relatives than on object relatives. Again, the group of cochlear implanted children shows a large variability: whereas a number of children perform age-appropriately, others replace the targeted relative clause by a variety of ungrammatical alternatives which the authors take to represents a sign of the linguistic delay associated to hearing impairment.

The paper by **Annemiek Hammer**, **Martine Coene**, **Johan Rooryck** and **Paul Govaerts** is the first of two in which the morphosyntactic development of hearing impaired children is compared to that of children with Specific Language Impairment. Their study compares the production of finite verb morphology in four-to-seven year old children in spontaneous language samples. The results show that both populations under investigation produced significantly more verbal agreement errors than their hearing peers. Yet, when comparing children with CIs to children with SLI, the authors found that the first population had better outcomes than the latter. This was also reflected in the linguistic profiles of the children: whereas 75% of the SLI children scored below age-expectations on overall grammatical development (measured in terms of MLU) and finite verb production, only 35% in the group of children with CIs did so, which is a strong indication for a more pervasive linguistic deficit of the first population as compared to the second.

In the second paper comparing morphosyntactic development in hearing impaired with language-impaired populations both receptive and expressive grammar is evaluated. **Laurice Tuller** and **Hélène Delage** have assessed the ability of children and adolescents with mild-to-moderate hearing impairment to produce a variety of specific grammatical morphemes, including nominal, adjectival and verbal inflexion, irregular plurals, prepositions, passives, and pronominal clitics. Based on standardized testing the authors show that children with mild-to-moderate hearing loss have an (often severely) impaired morphosyntax, yet their results are still significantly better than those found in children with SLI. A qualitative analysis indicates that the aspects of morphosyntax which are particularly impaired include the production of nominal determiners, object clitics and embedded clauses. However, these were not specific to the context of hearing loss but were also found in other atypically developing populations (children, with SLI, epilepsy) and in second-language learners. As for the factors which could be potentially responsible for the variation within the population of individuals with mild-to-moderate hearing loss, the authors found no direct link between the degree of hearing loss and the observed language impairment.

Finally, the contribution by **Elke Huysmans**, **Jan de Jong**, **Julie van Lanschot-Wery**, **Joost Festen** and **Theo Goverts** deals with long-term effects of congenital hearing impairment on language performance in adults. The main aim of their study is to examine the end-state of oral grammar development in moderate-to-severe congenital hearing impaired language users. In order to do so, the authors compare elicited language samples of native Dutch-speaking adults with hearing impairment to those recorded from hearing controls. Their analysis is based on measures of morphosyntax evaluating correctness and syntactic complexity based on standardized tests of oral language performance. The data discussed in the paper show that moderate-to-severe congenital hearing impairment may lead to a persisting lower level of mastery of nominal determiners, bound morphemes and adverbs. Importantly, morphosyntactic correctness is related to degree of congenital hearing impairment, and not to age. As such, the data indicate that language impairment which is triggered by severely reduced access during the sensitive period for language development is probably irreversible.

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