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Long-term effects of congenital hearing impairment on language performance in adults

E. Huysmans [a,*], J. de Jong [b], J.H. van Lanschot-Wery [a], J.M. Festen [a], S.T. Goverts [a]

[a] *ENT/Audiology and the EMGO+ Institute for Health and Care Research, VU University Medical Center, Amsterdam, the Netherlands*
[b] *ACLC University of Amsterdam, Amsterdam, the Netherlands*

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Abstract

Aim: The aim of this study was to examine long-term effects of moderate to severe congenital hearing impairment (MSCHI) at an age when language development is completed, i.e., in adults.
Method: We studied language performance in Dutch in 10 normal-hearing (NH) adults and 20 adults with MSCHI, using analysis of elicited language samples on morphosyntactic correctness and syntactic complexity.
Results: The data show long-term effects of MSCHI in the domain of morphosyntax: MSCHI may lead to a persisting lower level of mastery of the determiner use constraint and a lower level of performance in using bound morphemes and adverbs, compared to NH adults. In the MSCHI group, morphosyntactic correctness is related to degree of congenital hearing impairment, and not to age. For syntactic complexity, no group differences were found.
Conclusion: The study results give a language-specific description of aspects at risk when language is acquired with an inferior auditory input. MSCHI especially may lead to problems in the use of low salient bound and free morphemes, as well as to problems with aspects of the language that are relatively complex. Thus, the consequences of MSCHI may remain after language development is completed.

Keywords: Congenital hearing impairment; Adult; Long-term effect; Language performance; Speech samples

1. Introduction: language in people with congenital hearing impairment

Language acquisition of children with a congenital hearing impairment (henceforth CHI) has been the topic of many studies. In CHI children, limitations in auditory sensitivity affect the process of language acquisition from birth onwards, which may result in deficiencies in various language domains (see Moeller et al., 2007 for an overview). The current study focuses on the occurrence of long-term, persisting problems in the linguistic performance of persons with CHI.

When children acquire a language, grammar-building depends on a specific type of input that is not equal to mere available language in the child's environment. Regarding the linguistic context of language acquisition, a distinction is made between *input* and *intake* (Kumaravadivelu, 1994): *input* represents the speech that is directed to or spoken in the

Abbreviations: NH, normal-hearing; CHI, congenital hearing impairment/impaired; MSCHI, moderate(ly) to severe(ly) congenital hearing impairment (impaired); PTA, pure tone average; FGST, Favourite Game or Sports Task; STAP, Spontane Taal Analyse Procedure 'Procedure for Analysis of Spontaneous Language'; SLI, specific language impairment; NLI, non-specific language impairment; TLD, typically developing; MLU, mean length of utterance.

* Corresponding author. Tel.: +31 20 4440969; fax: +31 20 4440983.
E-mail address: e.huysmans@vumc.nl (E. Huysmans).

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environment of the child, while *intake* is what the child has perceived or processed, and hence can be used in grammar-building. Congenital hearing impairment affects both input and intake: CHI may cause parents to offer a hearing-impaired child a less complex linguistic input than is offered to normal-hearing peers (Gallaway et al., 1990; Gregory et al., 1979; Nienhuys et al., 1984), while the intake of the linguistic input is affected by the impediment CHI poses on the perceptual abilities of the child. Though reduction in complexity of the linguistic input may hinder language acquisition, it is suggested that adaptations in the input that are in line with the language level of the child, may also facilitate language development (Gallaway et al., 1990; Nienhuys et al., 1984). As for the auditory intake of language, however, CHI is taken to have a clearly negative effect due to a significant reduction in speech audibility in combination with the detrimental effect of background noise that affects hearing-impaired individuals disproportionally (Stelmachowicz et al., 2000). Though early auditory rehabilitation minimises the effects of hearing impairment on language acquisition (Yoshinaga-Itano et al., 1998), a child with CHI acquires its spoken language with an intake consisting of degraded auditory speech, even with hearing aids or cochlear implant(s).

The central theme of this study is the possible effect of a congenital problem in speech perception on linguistic skills in adulthood. Because adaptations in the linguistic input cannot be characterised retrospectively, we will focus on the effect of CHI on the *intake* of language. Linguistic theories that account for the role of auditory perception in acquisition are therefore relevant to the topic of the study. The most relevant theories are briefly discussed below.

1.1. Linguistic theories and the role of auditory perception

Language impairment has been studied in various populations. A vast amount of research concerns the linguistic performance of people with specific language impairment (SLI), resulting in various theories that account for (part of) the observed deficits in this population. Several researchers have posited impairments in the syntactic representations in people with SLI. These studies have led to the identification of specific linguistic markers of SLI (see Clahsen, 2008 for an overview). These views attribute SLI to an innate grammatical deficit that causes problems with the processing of grammatical features. However, in the population of our study, i.e., CHI adults, an innate grammatical deficit may not be assumed: the only factor in which CHI people differ from individuals with normal hearing is their congenital speech perception deficit. Hence, CHI children are assumed to have the same innate linguistic aptitude as typically developing children and to suffer primarily from a reduced intake of degraded speech. Therefore, linguistic theories explaining deficits in SLI assuming an innate grammatical deficit are by hypothesis not applicable when studying the effect of CHI on linguistic performance.

Other linguistic theories approach SLI from the perspective of limitations in the processing of a language. In the 'surface account' (Leonard, 1989; Leonard et al., 1997), the assumption is made that SLI children do not suffer from an innate grammatical deficit, but from auditory processing limitations, which in turn may influence the building of grammatical representations. Although SLI children do, by definition, not present hearing loss, they often have difficulties processing bound morphemes. In many languages, bound morphemes have a relatively short duration and often consist of a single consonant or an unstressed syllable. Leonard et al. (1997) state that these specific surface characteristics of bound morphemes make them more likely to be affected by the limited auditory processing capacities of SLI children. This would imply they are possibly not part of the intake. As a result, a greater number of exposures to these brief grammatical morphemes is required to establish the inflectional paradigm (Leonard et al., 1997).

Because the surface account assumes a processing deficit that hinders the *intake* of linguistic input, analogues with congenital hearing impairment emerge. In CHI, the intake is hindered by the speech perception problem associated with the hearing impairment: bound morphemes may thus be even more difficult to perceive for CHI children, given their surface characteristics. The audibility problem is likely to put additional strain on auditory processing and may lead, as in individuals with SLI, to problems in the establishment of morphological paradigms.

Svirsky et al. (2002) adopted the idea that surface characteristics of morphemes may influence grammatical development and formulated a specific hypothesis for the development of grammatical skills in CHI children who are using a cochlear implant. A cochlear implant is an electronic hearing device that is used in persons who are severely hearing impaired or deaf. It transmits sound directly to the auditory nerve. The quality of sound with a cochlear implant differs from natural hearing, as less sound information is received and processed by the brain. The 'perceptual prominence hypothesis' of Svirsky et al., which echoes Leonard's surface account, predicts that ''cochlear implant users develop grammatical skills in a sequence that is determined by the perceptual prominence of the corresponding acoustic markers'' (Svirsky et al., 2002, p. 109). In their study, children with a cochlear implant showed more difficulties in the production of less perceptually prominent morphemes than of more prominent morphemes, which was in accordance with the perceptual prominence hypothesis. Their results suggest that the establishment of morphological paradigms in hearing impaired children is affected by their congenital speech perception deficit. Under such a view, CHI may thus lead to a persisting and long-term reduced auditory intake during the language acquisition age that is reflected in morphosyntactic performance at the adult age. The perceptual prominence hypothesis therefore predicts possible differences in the linguistic performance of CHI adults and NH adults in the current study.