Summary
People who are born with a hearing impairment (congenital hearing impairment, CHI) may be hindered in their communicative interactions by the consequences of CHI on their language production and language reception abilities. This thesis describes a series of studies in adults with moderate to severe CHI that examine aspects of communication that might be impeded by the consequences of acquiring an oral language with inferior auditory input. Because the development of morphosyntax is specifically vulnerable when an oral language is acquired with CHI, the studies in this thesis focus on the use of morphosyntactic knowledge in language production and sentence recognition.

For the studies described in chapter 2 and chapter 3, we elicited a sample of spoken and of written language in Dutch from two groups of adults, i.e., from adults with moderate to severe CHI and from adults with normal hearing (NH). In both modalities, no difference was found between the groups for the syntactic complexity of their language samples. With regard to the morphosyntactic correctness of the output, however, a difference between modalities emerged: in spoken language production, adults with moderate to severe CHI made significantly more morphosyntactic errors than adults with NH. The adults with CHI showed specific difficulties with the use of present tense markers for subject-verb agreement, as well as with the use of determiners in an obligatory context, and with adverbs. These error types concern aspects of Dutch that are low in perceptual salience or are considered to be relatively complex to acquire. The observed errors therefore likely reflect the effect of inconsistent access to linguistic input, due to auditory perceptual limitations during language acquisition. In contrast to the findings for the spoken modality, no group differences were found for the morphosyntactic correctness of the samples in written language production. The data in chapter 2 and 3 thus showed that CHI-induced weaknesses in the use of specific morphosyntactic markers when producing spoken language did not surface when producing written language.

The observed difficulties in the spoken performance of the adults with moderate to severe CHI were discussed in view of the ‘vulnerable marker hypothesis’. This hypothesis states that performance errors in the application of morphosyntactic markers that are vulnerable in their acquisition, may surface in conditions that strain the processing capacity of the language production system. Thus, our data suggest that acquiring an oral language with moderate to severe hearing impairment leads to a CHI-induced vulnerability in the use of specific morphosyntactic markers that are low in perceptual salience or relatively high in grammatical complexity. However, these vulnerabilities only appear in challenging conditions. Given the differences between the spoken and written modality in language production processing, the demands of the written task seem to put less strain on the language production system. As a result, CHI-induced vulnerabilities in the use of morphosyntax do not surface in writing like they do in speech.

In both modalities, the frequency of occurrence of morphosyntactic errors in the language production of the adults with moderate to severe CHI was related to the severity of their
hearing loss during childhood (degree of CHI). This finding is in line with the ‘inconsistent access account’, which predicts that more limited access to linguistic input during language acquisition results in more pronounced effects on linguistic abilities. At the individual level, this implies that long-term effects of moderate to severe CHI on written language performance may be evident in adults with a more severe degree of CHI.

In chapter 4, the distortion-sensitivity approach is introduced. The applicability of this method to assess the use of linguistic cues in the process of sentence recognition was examined in two groups of adults with an evident difference in their linguistic abilities, i.e., in 13 native and in 10 non-native users of Dutch. Compared to the native group, the non-native group showed reduced performance on a sentence recognition task in both the auditory and the visual modality. In the visual modality, the Text Reception Threshold (TRT) was determined for the recognition of grammatically correct sentences and sentences in which syntactic, lexical, or semantic cues were distorted. Differences between the groups in sensitivity to the syntactic and lexical distortions suggested that the non-native adults’ reduced performance on the original TRT task could be attributed to a reduced use of syntactic and lexical cues. These differentiated results on the use of specific linguistic cues in the two groups showed the potential of the distortion-sensitivity approach to assess the use of linguistic cues in sentence recognition.

In chapter 5, the influence of differences in linguistic abilities on sentence recognition performance was examined for sentence recognition in the visual modality, thus independent of current auditory perceptual limitations. Morphosyntactic correctness of spoken language production was used as a measure for linguistic abilities, while visual sentence recognition was examined by using the Text Reception Threshold (TRT) test, a visual proxy of the auditory Speech Reception Threshold (SRT) test. To examine the participants’ use of specific morphosyntactic cues in sentence recognition, the TRT task was assessed in accordance with the distortion-sensitivity approach, using grammatically correct sentences and sentences in which morphosyntactic cues were distorted. Three groups of adults participated, i.e., adults with moderate to severe CHI, adults with acquired hearing impairment (AHI), and NH adults. For the morphosyntactic correctness of spoken language production, the data of this study confirmed and extended the findings of chapter 2: adults with moderate to severe CHI made more morphosyntactic errors in spoken language production than adults with NH, while there was no difference in performance between the AHI and NH group. This outcome pattern sustained when comparisons were restricted to subgroups of AHI and CHI adults, matched for current auditory speech reception abilities. We therefore concluded that deviancies in the spoken performance of the CHI adults were likely to be a consequence of reduced hearing in early life. The data on visual sentence recognition showed that moderate to severe CHI generally did not impede performance in masked language recognition in the visual modality, as measured in this study with short, degraded sentences.
In chapter 6, the question was answered whether auditory limitations during language acquisition affect the relative contribution of bottom-up auditory abilities and top-down linguistic abilities to auditory sentence recognition in hearing-impaired adults. The study described in this chapter was conducted in the same groups of adults with AHI and CHI as the study of chapter 5. The participants performed auditory sentence recognition tasks in quiet, using their own hearing devices, with grammatically correct sentences and sentences containing a morphosyntactic error. Following the distortion-sensitivity approach, groups were compared in their performance on the original sentence recognition task and in their sensitivity to the morphosyntactic distortions. Data showed that poorer recognition of grammatically correct sentences in the CHI group, compared to the AHI group, could not be attributed to a CHI-induced impediment in the use of specific morphosyntactic cues. This finding was in line with the findings for the visual modality, as described in chapter 5. By using regression analysis, the contributions of bottom-up auditory abilities (assessed with the digits-in-noise task) and top-down linguistic abilities (assessed by analyzing the morphosyntactic correctness of spoken language production) to auditory sentence recognition were further examined within each group. Analysis showed that the predictive value of these factors differed between the two groups: within the AHI group, variance in auditory sentence recognition was more strongly related to bottom-up auditory abilities than in the CHI group. Within the CHI group, it was notable that the measure for linguistic abilities contributed significantly to auditory sentence recognition, while it did not in the AHI group. Additional analysis on the data on visual sentence recognition from chapter 5 even showed that linguistic abilities also explained (part of) the variance in the CHI adults’ performance on the TRT task. Hence, the impact of moderate to severe auditory limitations during language acquisition on linguistic proficiency does seem to affect sentence recognition performance in adults, independently of modality. Further research is needed to gain more specific insight in the mechanisms within the process of sentence recognition that are affected by moderate to severe CHI.

The last chapter of this thesis (chapter 7) presents a final evaluation of the outcomes of this series of studies. As we found subtle though relevant long-term effects of moderate to severe CHI on language production and language reception, we discuss the importance of fine-grained linguistic diagnostics in children with CHI during the course of language development. Because our data yield information about the morphosyntactic aspects of Dutch that are specifically vulnerable when acquired with a hearing loss, we consider it possible that an extra focus on these aspects in the diagnostics and rehabilitation of CHI children may prevent long-term consequences of CHI as observed in the studies of this thesis.