SUMMARY

The thesis reports on investigations into influences of auditory thresholds and auditory and cognitive suprathreshold factors on speech understanding in adverse conditions for listeners of varying ages and with varying degrees of hearing acuity. Effects of auditory suprathreshold processing were examined with measures of monaural auditory temporal processing abilities for periodicity cues, envelope cues, and fine-structure cues. Cognitive contributions to speech understanding were examined for verbal working memory (WM) capacity, linguistic closure abilities, general information processing speed, and general cognitive ability (Montreal Cognitive Assessment; MoCA). The term ‘linguistic closure’ represents the ability to fill in linguistic information that is missing from text or speech. In this thesis, linguistic closure abilities were measured with thresholds for reading partially masked sentences (text reception thresholds; TRT). Adverse listening conditions were created for the tests of speech understanding by using maskers that varied in their informational overlap with the target speech along the dimensions of temporal structure, semantic content, voice, and spatial location.

After a general introduction (Chapter 1), Chapter 2 presents an experiment that examined contributions of age, education, sex, linguistic closure abilities, WM span, and processing speed to speech understanding in steady-state and temporally modulated noise in participants from a wide age range and without reductions in pure-tone hearing acuity. The experiment’s primary purpose was to further develop the existing TRT test that has been designed to measure the modality-independent cognitive and linguistic abilities involved in speech understanding as measured by the speech reception threshold (SRT). Based on suggestions from earlier research, new test versions were developed with the aim to increase the shared variance of TRT and SRT by making the TRT more dependent on working memory capacity and processing speed. The experiment identified one of the revised TRT versions as the most suitable TRT test for the test battery employed in the remaining experiments of the project.

The experiment described in Chapter 2 had uncovered some fundamental differences between the abilities measured by the TRT test and verbal WM span. Therefore, the main purpose of the study presented in Chapter 3 was to follow up these previous observations by performing a literature review that investigated the relationships of TRT and WM span, respectively, to SRTs in different masking conditions. Furthermore, Chapter 3 formally introduces the Dutch WM span test developed within the thesis project and presents an experiment exam-
ining modality differences (reading vs. listening) in verbal WM span and associations of WM span in the different modalities to speech understanding in temporally modulated noise. Younger adults without reductions in pure-tone hearing acuity participated in this study.

Chapter 4 presents a study of speech-in-speech understanding with a twofold focus: First, age group differences were assessed in SRTs for speech-in-speech listening with and without spatial separation and with or without voice differences between target and masker speech. Second, the experiment examined how speech understanding in these listening situations was influenced by age, audiometric thresholds, auditory processing of temporal envelope and fine-structure cues, general cognitive ability, and linguistic abilities. The study included listeners without clinically significant hearing loss in two age groups, namely younger (18–27 years) and older (66–82 years).

Chapter 5 presents a study that served to investigate differences in how auditory and cognitive suprathreshold processing influences speech understanding in older listeners with or without a sensorineural hearing loss. In addition, the study examined influences of suprathreshold processing on speech understanding for several masking conditions. Speech understanding was measured in steady-state and fluctuating noise-maskers and with an interfering talker of the same sex as the target talker. SRT outcomes were examined in dependence on age, audiometric thresholds, auditory temporal processing, WM capacity, general cognitive ability, and linguistic abilities.

The last chapter (Chapter 6) provides an overview and a general discussion of the findings from the experiments conducted in the thesis project. A key question addressed by the thesis research was how the different auditory and cognitive abilities combine in speech understanding depending on the masking condition. Taken together, the results of the conducted studies suggest that both processing domains, auditory-temporal and cognitive processing, contribute to speech understanding in adverse conditions. However, these contributions differ depending on hearing status: Speech understanding of listeners with normal hearing is predicted by cognitive abilities in most listening situations, whereas temporal-processing abilities only predict NH listeners’ speech understanding in situations where target speech and masker are very similar (speech in speech). In contrast, for hearing-impaired listeners, cognitive influences were observed only for speech-in-speech understanding, whereas SRTs in other conditions were predicted by temporal-processing abilities. Overall, influences of monaural auditory-temporal processing were observed for processing of temporal-envelope and fine-structure cues, when masker and target speech were not spatially separated. Contributions to speech understanding were observed for all cognitive abilities assessed in this thesis, except for information-processing speed. Importantly, the specific combination of factors determining the ability to
understand speech in an adverse condition depends both on the listener’s age, their hearing status, the type of the masker, and the spatial configuration of the listening situation.