In terms of disability and handicap, problems in auditory function involve much more than a reduced sensitivity to soft sounds, the most commonly used measure of hearing impairment. Indeed, in daily life, many hearing-impaired (HI) listeners suffer more from impaired processing of audible sounds than from missing inaudible sounds. For example, people can have difficulties understanding speech in noisy situations or localizing sounds (from what side is a car coming?). The degree of these types of disabilities does not only depend on hearing thresholds, i.e. the ability to detect soft sounds, but also on other aspects of the auditory system. Factors proven to be relevant for speech perception in noise are loudness recruitment and spectral and temporal resolutions as well as non-auditory factors, such as cognition. In addition to speech perception in noise, spatial hearing is extremely important for auditory function in HI listeners and has a large impact on the degree of handicap experienced by HI persons. Several tests and questionnaires have been developed to estimate disability in spatial hearing. All these aspects in hearing are widely investigated in research settings using many different, often time-consuming tests, but there are very few applications in clinical audiology.
Clinical audiology traditionally focuses on medical diagnostics rather than functional diagnostics. Tests for medical diagnostics include pure-tone audiometry, tympanometry, oto-acoustic emissions, and auditory evoked potentials. For functional diagnostics and counselling, pure-tone audiometry is used and sometimes supplemented with speech audiometry. In many clinics, no additional measurements are performed for hearing aid fitting. As a result, many hearing aid fittings are based on audiogram data only, although modern hearing aids have a large number of fitting parameters that should ideally be set based on individual hearing capacities. Altogether, there appears to be a need for more detailed information with two important restrictions: the information needs to be derived from well-standardized tests and these tests should be designed to be easily applicable in clinical audiology.

Therefore, the present thesis focuses on clinically applicable tests that could complement the pure-tone audiogram for functional diagnostics. The clinical usability and relevance of these specific tests for speech perception or broader auditory function is investigated. The end result is a battery of tests that could serve as a standard in extensive diagnostics or in audiological research: the (preliminary) Auditory Profile. For example, the profile can be used for research on the consequences of certain individual hearing capacities for hearing-aid fittings. This may stimulate future applications of the Auditory Profile for clinical auditory rehabilitation.

In the present chapter, we first briefly summarize the preceding chapters before we review a number of issues that are important across all studies in this thesis: the influence of presentation levels, the effects of subgroups, the meaning of ‘clinical applicability’ and the validation of individual tests and of the preliminary Auditory Profile. Finally, we will discuss the status quo and future of the Auditory Profile.

6.1 The main findings of this study

6.1.1 Measuring spectral and temporal resolution (Chapter 2)
In our first experiment, we focused on measuring spectral and temporal resolution. Two clinically applicable tests (‘tone test’ and ‘sweep test’) that simultaneously measure both spectral and temporal resolution were compared.
6.1 The main findings of this study

Clinical applicability of both tests was investigated in 5 normally hearing (NH) and 15 HI listeners. We established that test-retest reliabilities of both tests are comparable, and only one learning effect was found, which could be considered clinically negligible. Therefore, both tests are accurate enough to be used in clinical practice. The major difference between the two tests was the measurement duration, which is much shorter for the tone test (10 min) than for the sweep test (25 min). Next, results from the tone test and the sweep test were compared to results from conventional spectral and temporal resolution tests. It was found that the tone test corresponds much better to conventional methods than the sweep test. Finally, results of both tests were related to speech perception in noise scores. We concluded that the tone test seems to be more relevant for speech perception than the sweep test and that the tone test is preferred as a clinical test.

Altogether we concluded that the tone test is a fast and reliable test, which is suitable for measuring spectral and temporal resolution in a clinical setting. However, there were a few aspects of the tone tests that could be improved. Therefore, we suggested two modifications to further improve the test-retest reliability and to avoid an undesired continuity effect that some listeners experienced. These modifications were implemented in the next version of the test, which is included in the preliminary Auditory Profile, the subject of our subsequent studies.

6.1.2 Evaluation of tests from the preliminary Auditory Profile (Chapter 3)

In our second study, we considered many more aspects of auditory communication, for the preliminary Auditory Profile. This battery of tests includes measures of loudness perception, listening effort, speech perception, spectral and temporal resolution, spatial hearing, self-reported disability and handicap and cognition. These tests were evaluated in a multi-centre study with five centres from four different countries with over one hundred listeners (30 NH listeners and 72 HI listeners) included. Some tests are language-dependent: the speech perception tests, the questionnaire and the test on cognitive abilities. Most auditory tests were conducted on each ear separately. Clinical applicability and comparability across different centres were investigated for each test.

We found that centre effects were virtually absent in NH results and in HI results for language-independent tests. However, differences between languages have to be taken into account when interpreting HI results from...
the language-dependent tests. Reference data, for the language-dependent tests for the four languages separately, were provided for all tests. It was found that, in general, the tests are applicable in a wide variety of NH and HI listeners. Correspondence between test and retest results (test-retest reliability) proved to be at least statistically significant, and no clinically relevant learning effects were found. Although the complete battery of tests probably takes too long for clinical use, the individual tests are each an acceptable duration.

We concluded that most tests are clinically applicable and usable in the four different languages; but, for HI listeners, differences between test materials have to be taken into account for the language-dependent tests, even after a baseline correction. Moreover, as a first validation step, we compared the results from the preliminary Auditory Profile with previously published data. For most tests, good agreement was found.

6.1.3 Relations between speech perception in noise and psychophysical measures of hearing from the preliminary Auditory Profile (Chapter 4)

In another analysis, we investigated the relationship between several tests from the preliminary Auditory Profile and speech perception in noise. This served primarily as a second step in the validation of the Auditory Profile, but the results also provided insight into the causes of reduced speech understanding in noise. It allowed us to evaluate the potential usefulness and relevance of the test battery in a clinical setting. More specifically, we examined whether the well-known correlations between speech perception, recruitment, spectral and temporal resolution and cognitive abilities can be reproduced in the results from the preliminary Auditory Profile in four languages, as a further step in the validation of the preliminary Auditory Profile. In addition, we investigated the added value (relevance) of the preliminary Auditory Profile for speech perception in noise by identifying predictors of speech perception in noise after accounting for the pure-tone audiogram and age.

Based on correlation analyses, we concluded that previously published relationships between recruitment and speech perception in noise and between spectral and temporal resolution and speech perception in noise can be reproduced using the preliminary Auditory Profile data set in four
languages. However, no significant correlation between cognitive abilities and speech perception in noise was found in our test population. This may be specific to the newly developed lexical-decision making test that was used and to the significant centre effects in the data. It may also reflect a relatively small range of cognitive abilities in the test population.

According to stepwise linear regression analyses, spectral and temporal resolutions are the most important factors for the prediction of speech perception in noise, after accounting for the pure-tone audiogram and age. Recruitment, although significantly correlated with speech perception in noise, did not add much information to the predictions for reduced speech perception in noise based on the hearing thresholds themselves. The lexical decision-making test did not contribute significantly to the linear regression models. A comparison of these results with models predicting speech perception in noise based on all audiogram thresholds and age showed that the preliminary Auditory Profile increases the percentage of explained variance for speech perception in fluctuating noise, in addition to the audiogram and age, at least for the range of hearing abilities included in our test population.

We concluded that spectral and temporal resolution are important factors for explaining speech perception in noise, in addition to the pure-tone audiogram.

6.1.4 Relations between psychophysical measures of spatial hearing and self-reported spatial-hearing abilities (Chapter 5)

In addition to speech perception in noise, spatial hearing is extremely important for auditory function in HI listeners. Spatial hearing has a large impact on the degree of handicap experienced by HI persons, and it is known that listeners with asymmetric hearing loss are more disabled in spatial hearing than listeners with symmetric hearing losses. Several tests and questionnaires have been developed to estimate disabilities in spatial hearing. In order to know which psychophysical tests are indicative of disability in everyday hearing, comparison of self-reported data with psychophysical test results is essential. Nevertheless, only a few researchers have investigated the agreement between self-reported sound localization abilities and psychophysical measures of binaural hearing. In our last study,
we compared psychophysical and self-reported measures of binaural hearing from the preliminary Auditory Profile dataset to gain insight into how representative the psychophysical measures of spatial hearing are to self-reported spatial-hearing abilities, which presumably reflect everyday listening for the participants.

We found that the minimum audible angle test (MAA test) and the spatial SRT benefit test have predictive power for self-reported binaural functioning. The MAA test best represents self-reported localization, while the SRT benefit test turned out to be the most important for self-reported listening to speech in spatial situations. The binaural SRT benefit test was not found to be relevant to self-reported spatial hearing performance. Unexpectedly, asymmetry of hearing loss did not show any significant correlations with or predictive power for self-reported localization performance. Perhaps, this was related to the small number of listeners with asymmetric hearing losses and to the limited average asymmetry in this group.

### 6.2 Procedural aspects

#### 6.2.1 Influence of measurement levels

If both NH and HI listeners participate in one experiment, one has to decide on which test levels to use. Often the dilemma is whether to measure all listeners at equal sound pressure levels (equal SPLs) or at equal sensation levels (equal SLs). Both methods have their advantages and disadvantages. Most importantly, measuring at equal SPLs minimizes undesired effects of absolute presentation levels. On the other hand, the selected presentation level may be uncomfortably loud for NH listeners or inaudibly soft for HI listeners. Measuring at equal SLs, on the other hand, minimizes the effect of audibility but risks effects of absolute presentation levels. Moreover, due to the reduced dynamic range of HI listeners, it may be difficult to find a suitable SL for all listeners.

For the experiments in this thesis, we chose a method that is close to the equal SL method. We conducted all tests at equal subjective loudness levels, as derived individually from the Acalos test. The main reason for testing at these equal loudness levels was an attempt to test at equal “suprathreshold”
level for all listeners. As we were mainly interested in factors other than the audiogram, we aimed to minimize the influence of reduced audibility or relative loudness on performance. Ideally, this would lead to a stronger relationship between the factors of interest and hence higher correlation values. On the other hand, the minimized influence of audibility can also reduce the result range which, in turn, may reduce the percentage of variance that theoretically can be explained by a certain model.

The most important disadvantage of measuring at equal loudness levels in our experiments is the fact that temporal resolution abilities have shown to improve with increasing absolute test levels. However, this effect is much smaller than the typical variation in HI listeners, as we reviewed in Chapter 2. The alternative approach, measuring at a fixed level (at equal SPLs) or two fixed levels, one for NH and one for HI listeners, was not suitable in our experiments because of the large range in hearing losses of the participating listeners. Indeed, analyses of the Acalos results (see Chapter 2) confirmed this expectation because it was impossible to find one fixed presentation level at a comfortable point for the complete HI group.

6.2.2 Influence of subgroups
In all studies in this thesis, there were different groups of subjects rather than one homogeneous group. In both experiments, NH and HI listeners were included. Moreover, because the Auditory Profile aims to be a diagnostic tool for listeners with a wide variety of hearing loss from different countries, in the multi-centre study listeners with asymmetrical and conductive or mixed hearing losses were included (besides listeners with symmetrical sensorineural hearing losses) and listeners from different centres and countries participated. We will explain our choices regarding the inclusion of the different groups and their consequences in the subsequent analyses.

NH and HI listeners
The tests we investigated were meant to differentiate between degrees of reduced auditory processing abilities in HI listeners, rather than to distinguish between NH and HI listeners. Indeed, as all of our studies were targeting the clinical relevance of tests, we were especially interested in the
added value of the tests in addition to the pure-tone audiogram. Therefore, the most important analyses would be in the group of HI listeners. Adding NH listeners would possibly overestimate the strength of our conclusions as a result of the difference between the NH and HI groups.

Nevertheless, because of the low number of listeners in our first study (Chapter 2), we initially chose to perform analyses on the pooled data of NH and HI listeners. However, to verify the conclusions in the HI group, we repeated the most important analyses in the HI group alone. Based on these analyses, we concluded that it was valid to perform the analyses on the total group.

In the second experiment, the international multi-centre study, many more listeners were included (30 NH listeners and 72 HI listeners) than in the first study. Because of the reasons explained above, we performed analyses on the group of HI listeners in the papers about this experiment (Chapters 3, 4 and 5). Results from NH listeners from this experiment were used as reference data only.

**Different centres and languages**

In the multi-centre study, in which the preliminary Auditory Profile was measured (Chapters 3, 4 and 5), listeners speaking four different languages were included. This was in line with the purpose of the Auditory Profile and an important part of our first evaluation of the preliminary Auditory Profile (Chapter 3) therefore regarded the comparability of tests across the different centres. We found that, after accounting for differences in hearing thresholds, centre effects were virtually absent in NH results and in HI results for language-independent tests. However, significant differences among languages have to be taken into account when interpreting HI results from the language-dependent tests (e.g. SRT tests, cognition test).

Because of the significant differences between centres in the SRT results, we investigated in Chapter 4 whether these differences were also associated with a significant effect on the regression analyses. To that end, the linear regression models were evaluated separately for the different centres. Based on scatter plots of predicted versus measured SRT scores by centre and analysis of residuals, we concluded that similar regression models apply for predicting the SRTs in noise at the different centres.

For the tests and questionnaire considering spatial hearing, no signif-
significant centre effects were found. Therefore, the analyses in Chapter 5 were performed on pooled data of HI listeners from all five centres.

Conductive and asymmetrical hearing losses
Because the Auditory Profile should be applicable for listeners with a broad range of hearing losses, listeners with conductive and asymmetrical hearing losses were also included in the multi-centre study. The percentages of missing data were low (Chapter 3) both in the group of listeners with symmetrical sensorineural hearing losses and in the group of listeners with asymmetrical and/or conductive/mixed losses (5% in both groups), indicating that most tests are indeed applicable to listeners with a wide variety of hearing losses. However, as potential differences between groups of HI listeners had to be taken into account, subsequent analyses of auditory tests in Chapter 3 were performed on the total group of HI listeners as well as on a reduced group of HI listeners with symmetric, sensorineural hearing loss. We found that there were only very few significant differences between the two groups.

In the two following papers about the multi-centre study (Chapters 4 and 5), we therefore chose to perform analyses on the total group of HI listeners. Including only the reduced group would harm the original purpose of the Auditory Profile and our evaluation in Chapter 3 did not give major arguments to exclude specific subgroups. In both papers, we did not expect any notable effects from conductive components. Regarding asymmetry of hearing loss, analyses were conducted for left and right ears separately in the SRT analyses in Chapter 4. In the analysis of spatial hearing (Chapter 5), asymmetry was included as a factor in the models for predicting self-reported localization abilities, but it did not show any significant correlations with or predictive power for self-reported localization performance.

6.3 Clinical applicability

Because the Auditory Profile is meant to be a diagnostic instrument used in (specialized) hearing centres and clinics, an important part of the evaluation in this thesis is related to its clinical applicability. We already con-
cluded that the tests from the preliminary Auditory Profile are applicable in listeners with a wide variety of hearing losses. Several additional aspects of clinical applicability were considered and will be reviewed below: duration of tests and need for training, test-retest reliability, learning effects and effects of ear or side.

6.3.1 Duration of tests and need for training
Important requirements for a test to be clinically applicable are that it is fast and can be conducted without extensive training. In the first experiment (Chapter 2, measuring spectral and temporal resolution), we conducted the tests the way they were described by the authors: we started the tone test with a short practice session, whereas the sweep test started immediately with the actual measurement. We found that, with the practice session included, the tone test was of acceptable duration (10 min) and much faster than the sweep test (25 min). All listeners were able to finish both tests with this limited amount of training, but the tone test was selected for the preliminary Auditory Profile because of its shorter measurement time.

Regarding the tests of the preliminary Auditory Profile (Chapter 3), durations of the individual tests range from 5 to 20 min. The full preliminary Auditory Profile takes 90 min of effective testing time for measuring both ears, but up to three hours for a full session including breaks and instruction. Therefore, clearly, the complete battery of tests from the preliminary Auditory Profile takes too long for clinical practice. However, the individual tests are each of an acceptable duration for clinical use. Of course, parts of the preliminary Auditory Profile can be used selectively, depending on the specific disabilities and complaints of the subject to be diagnosed. Moreover, a selection of frequencies or conditions to be measured (e.g. noise types, one versus two ears) can be made for most tests to further reduce measurement time. Another possibility is a hierarchical structure with limited tests in each of the areas of interest and more detailed tests in areas in which problems appear. In any case, it is important to note that time is sparse in clinical practice. This means that, even if a test is very fast, it needs to be valuable for medical diagnosis, functional diagnosis, or the selection of rehabilitation strategies, before it will be used. In other words, the time invested should be worth the patient’s benefit of performing that extra test, for instance a better hearing aid fitting based on the individual
6.3 Clinical applicability

Test results. We will discuss the potential benefit of the Auditory Profile for clinical practice below (see ‘Status Quo and Future of the Auditory Profile’).

The amount of training needed for the tests of the preliminary Auditory Profile ranges from no training to completing two measurements before the start of the test. The percentage of missing data in the multi-centre study was low (5%), suggesting that most listeners could complete all tests. However, the test with the highest number of missing data (the MAA test, 10% of missing data) proved to be too difficult for a considerable number of listeners, despite its initial practice session.

Besides ensuring that listeners understand the task, reducing learning effects is also an important purpose of training before a measurement. We will discuss the presence or absence of learning effects below.

6.3.2 Test-retest reliability and learning effects

All measurements in this thesis are conducted in separate test and retest sessions, which enables an evaluation of test-retest reliability (the degree of correspondence between test and retest results) and learning effects (systematic, significant differences between test and retest results).

In the first study (Chapter 2), only one significant learning effect was identified in the sweep test. In the preliminary Auditory Profile (Chapter 3), significant positive learning effects were found for the MAA test and the effort-scaling test. For all three tests, the estimated differences between test and retest were relatively small, being at least a factor of three times smaller than within-subject standard deviations (SDs). This means that the learning effects are, although sometimes significant on a group level, unimportant when interpreting individual results.

Concerning test-retest reliability of the spectral and temporal resolution tests (Chapter 2), we concluded that both the tone test and the sweep test are reliable in terms of test-retest measurements, as test-retest correlations of both tests were significant and of the same order of magnitude as those from conventional spectral and temporal resolution tests. Test-retest reliability of the preliminary Auditory Profile tests (Chapter 3) was reported in terms of intra-class correlations (ICCs). We found at least substantial correspondence between test and retest results (i.e. ICC > 0.06) for the majority of tests. There were a few exceptions with ICCs very close to 0.6.
6.3.3 Effects of ear or side

For the interpretation of test results in clinical practice, it is important to know whether there is an expected difference between results from left and right measurements, independent of possible inter-aural differences in hearing thresholds.

In the first study (Chapter 2), measurements were conducted on the better ear of each listener only, so no comparisons between ears were possible. In the multi-centre study (Chapter 3), on the other hand, most auditory measurements were performed on both ears or sides. Significance of the ear or side tested was examined with ear-specific hearing thresholds as covariates. Significant side effects were found for the two binaural speech tests: the spatial SRT benefit test and the binaural spatial benefit test. In both tests, listeners perceived more spatial or binaural benefit with noise from the left side. Although the effect was considerably smaller than within-subject SDs, the significance of both effects suggests that listeners consistently perform better in the condition with noise from the left side than in the condition with noise from the right side. This is in line with the right-ear advantage for speech perception, which is found in numerous behavioural studies (see Tervaniemi & Hugdahl, 2003, for a review).

Besides the results of the individual tests from the preliminary Auditory Profile in Chapter 3, relationships among tests were also compared between ears in Chapter 4. Very similar correlation patterns among SRT results and other tests were found for left and right ears. Furthermore, the validity of the regression models that were based on right-ear data was tested on left-ear data. This analysis showed that the predictive power of the regression models was even slightly higher for the left-ear data set than for the right-ear data set from which they were derived.

The right-ear advantage for the binaural SRT benefit test that was reported in Chapter 3 seems to have consequences for the predictions of self-reported spatial hearing abilities in Chapter 5. We found that correlations between self-reported performance and the measurement with noise from the left side were significant, whereas its correlations with the measurement with noise from the right side were very low and even negative. This suggests that the measurement with noise from the left side (the measurement on which listeners generally performed better) was more closely related to subjective binaural functioning than the measurement with noise from the
right side. This may imply that the right-ear advantage is important for everyday binaural functioning.

6.4 Status quo and future of the Auditory Profile

6.4.1 Validation of the preliminary Auditory Profile

After a comparative study for inclusion of a spectral and temporal resolution test in the Auditory Profile (Chapter 2), this thesis contains three papers (Chapters 3, 4 and 5) that focus on the evaluation and validation of the preliminary Auditory Profile. Both parts start with a comparison of test results with previously published results. In general, we found good agreement between our results and previously published results for individual tests both for the spectral and temporal resolution tests (Chapter 2) and for the tests that make up the preliminary Auditory Profile (Chapter 3). The only exception was the sweep test (Chapter 2) that did not show significant correspondence to results of conventional spectral and temporal resolution tests and was not selected for the preliminary Auditory Profile. Subsequently, we examined whether the well-known correlations among speech perception, recruitment, spectral and temporal resolution and cognitive abilities could be reproduced from the preliminary Auditory Profile in four languages, as a further step in the validation of the Auditory Profile in Chapter 4. Altogether we conclude that the test results and relationships among tests of the preliminary Auditory Profile agree with previously published results. The exception was the test of cognitive abilities for which no significant correlation with speech perception in noise was found in our study sample, contrary to previously published results. This may be specific to the newly developed lexical-decision making test that was used and to the significant centre effects in the data. It may also reflect a relatively small range of cognitive abilities in the test population.

6.4.2 Follow-up research for further validation of the Auditory Profile

As follow-up research outside the work of this thesis, a second international multi-centre study was conducted to further validate the Auditory Profile
In that study, two tests from the preliminary battery of tests were omitted on the basis of the results of the first multi-centre study (this thesis): the MAA test and the effort-scaling test. Both tests proved to be a poor choice for several reasons:

- Regarding the MAA test, a substantial number of listeners were unable to perform this test, the inter-individual spread within the groups of NH and HI listeners was large, and no difference between listeners with symmetrical and asymmetrical hearing loss was found.
- The effort-scaling test had insufficient clinical applicability because of its learning effect, relatively poor test-retest reliability, and questionable validity (it is unclear what is rated and, as suggested by the small differences between NH and HI listeners, listeners appear to use their own personal reference when responding).

Moreover, another approach for the selection of measurement levels was applied, based on pure-tone hearing thresholds, to avoid statistical dependence on loudness results while maintaining comfortable levels for all listeners. In this second study, the added value of spectral resolution at 0.5 kHz in the prediction of speech perception in noise was confirmed, although the effect of supra-threshold deficits was less clear than in this thesis.

After this study the HearCom project finished, and this reduced version of the preliminary Auditory Profile was considered the final version of the Auditory Profile (Vlaming et al, 2011). This final Auditory Profile is a standardized battery of tests that covers six domains of hearing: loudness perception, spectral and temporal resolution, speech perception (in noise), spatial hearing, cognitive abilities and self-reported disability and handicap. The tests are applicable in listeners with a wide variety of hearing losses and in four different languages. Some of the tests have proven to be relevant for auditory functioning.

All tests are implemented on one measurement platform and can be conducted using the same simple set-up (PC, soundcard, amplifier and
headphones). The Auditory Profile therefore enables uniform testing in research and clinical settings with comparable results across different countries. Although test durations of individual tests are limited, the measurement time needed for a complete Auditory Profile is still too high for a broad introduction in clinical practice. Therefore, a stepwise approach, with limited tests in each of the areas of interest and more detailed tests in areas in which problems appear, may be a sensible step in further implementation of the Auditory Profile. Further research is needed to develop such an approach.

### 6.4.3 Future of the Auditory Profile: clinical applications

Above we reviewed the clinical applicability and validity of the tests of the preliminary Auditory Profile. These aspects are important requirements for the Auditory Profile to become usable in clinical application. Moreover, the implementation of all Auditory Profile tests on a common software platform running on a standard PC, providing the same look and feel for all tests and enabling the storage and analysis of test results within a single database, further facilitates clinical use.

Diagnostic tests in clinical audiology serve several purposes such as assessing auditory function, allowing counselling in regards to the resulting disabilities, and obtaining valuable data to make the right choices in rehabilitation strategy (often hearing aid fitting). Therefore, apart from being valid, clinically applicable and thus clinically usable, the Auditory Profile has to be of added value for counselling or rehabilitation (or both) to become valuable for and applied in clinical diagnostics. More specifically, the Auditory Profile should provide useful information for counselling or rehabilitation that is not deducible from commonly used test results, such as the pure tone audiogram.

A first step towards demonstrating the added value of the preliminary Auditory Profile to assess auditory function and counselling was taken in this thesis. In Chapters 4 and 5, we show that (some of) the tests of the preliminary Auditory Profile are relevant for speech perception in noise and self-reported spatial hearing, in addition to the pure-tone audiogram and age. These two aspects of hearing are extremely important for auditory
functioning and the degree of experienced handicap of HI listeners. Therefore, this surely makes the Auditory Profile a useful tool for diagnostics and counselling.

Ideally, the Auditory Profile will become important for rehabilitation of individual patients too. This would make the Auditory Profile a lot more attractive for clinical application. A crucial step to achieve this would be to examine the relationship between test results and the choices made or settings used in auditory rehabilitation. One could, for instance, think of investigating the relationship between temporal resolution and preference for (or benefit of) shorter or longer attack and release times in hearing aids, or the possibility to select the best amplification strategy based on individual loudness curves. A first modest step was made by Houben et al (2009). They tested 55 subjects, which participated in a study on the evaluation of noise reduction schemes (Luts et al, 2010), with tests of the Auditory Profile. They found that some noise reduction strategies were preferred relatively well by subjects with sloping audiograms and others by subjects with relatively poor frequency resolution.

The concept of an Auditory Profile for application in clinical practice has also been worked out by Lecluyse et al (2013). There are some essential differences with our Auditory Profile. Most importantly, the Auditory Profile of Lecluyse et al focuses on a subset of measures that are included in the present Auditory Profile: absolute thresholds, frequency selectivity and compression, all measured across a spectrum of frequencies. Moreover, measurement procedures are different from the methods in the present study. Despite the differences, Lecluyse et al also conclude that measures of supra-threshold processing are informative for clinical functional diagnostics, which further confirms the need for a clinically applicable Auditory Profile.

6.4.4 Future of the Auditory Profile: applications in research projects

Besides pure clinical applications, the Auditory Profile can also serve as a better basis for a number of audiological research projects. As the Auditory Profile characterizes the individual’s auditory impairment profile in a comparable way across Europe, more detailed comparisons of audimetric results across different centres and countries are allowed, even for the
speech tests. The Auditory Profile can therefore be a helpful tool for all future multi-centre studies that require assessment on one or more of the testing fields of the Auditory Profile. More specifically, the battery of tests can be used for research on the consequences of certain individual hearing capacities for hearing aid fitting. This may stimulate the future application of the Auditory profile for clinical auditory rehabilitation. In addition, the Auditory Profile can become a valuable tool for characterizing participants in audiological research projects in an objective and internationally standardized form.