

Oldenburg Measurement Applications

Software package for
audiometric and diagnostic
measuring methods

Operation manual

Hagerman sentence test



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2 General remarks

The following documentation describes the operation of measurement application 'Hagerman sentence test' using the software environment 'Oldenburg Measurement Applications'. This documentation subject to change without notice.

3 Starting the Hagerman sentence test

You can start the measurement application 'Hagerman sentence test' from the start dialog of the 'Oldenburg Measurement Applications' by clicking the corresponding button. If there is no user and/or client selected you are prompted automatically for y selection. This operation is described in the documentation of the start dialog.

The next dialog shows a selection of all available measurements for the actual client (Figure 1). This dialog may vary for different speech tests.

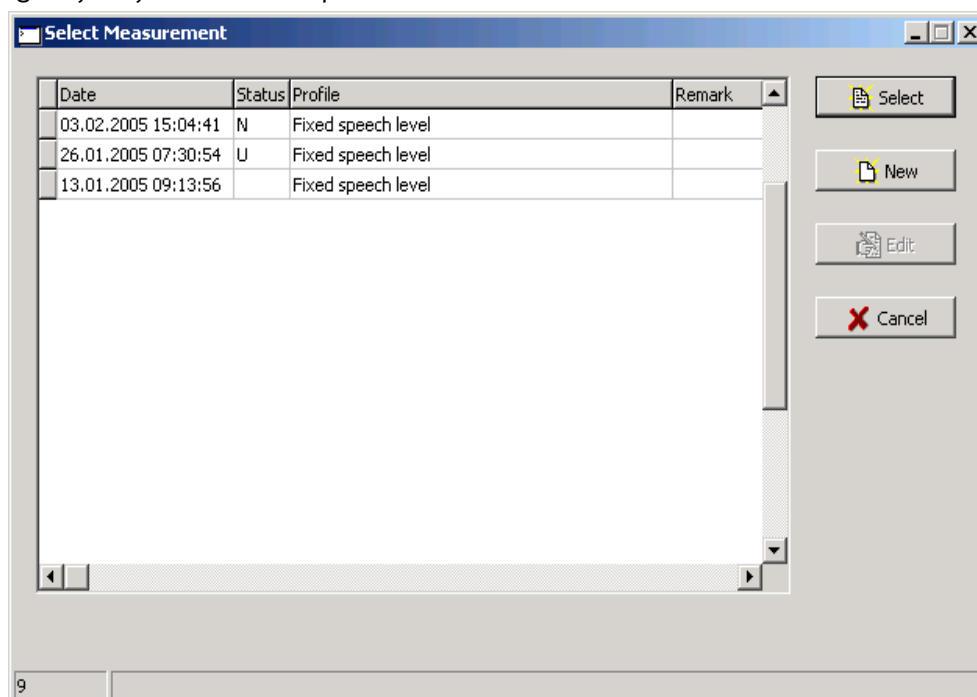


Figure 1

If there are no existing measurements present for the selected client the next dialog show a selection of measurement profiles (Figure 2). In this case please proceed with paragraph 4 'Creating a new measurement'.

In this dialog you can restart all newly configured (Status 'N'), incomplete (Status 'U') or completed (Status empty) measurements by selecting the corresponding line and clicking 'Select'. If you are going to restart an incomplete measurement or show a complete measurement please proceed with paragraph 5 'The measurement dialog'

4 Creating a new measurement

The measurement profile selection dialog (Figure 2) is shown if no stored measurement data exist for the actual client, or if you click 'New' in the dialog with existing measurements. The number and names of selectable profiles may vary between different speech tests. For a description of all existing measurement profiles please refer to paragraph 6 'Measurement profiles'.

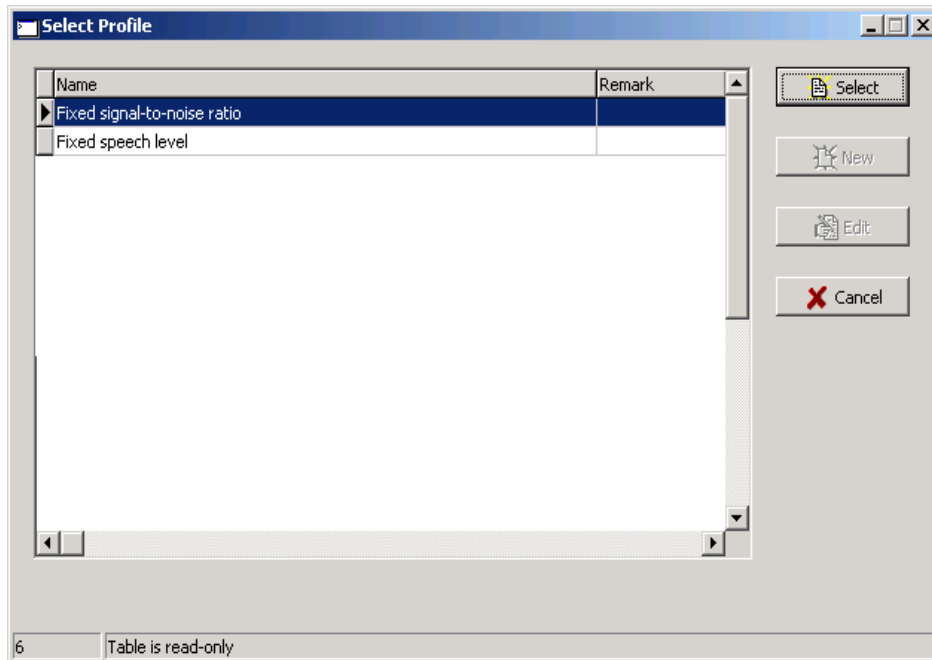


Figure 2

Select the desired profile and click 'Select'. The following dialog will guide you through the measurement configuration procedure in several steps (Figure 3). Depending on the speech test and the version some selections and/or options may not be selectable or may be missing.

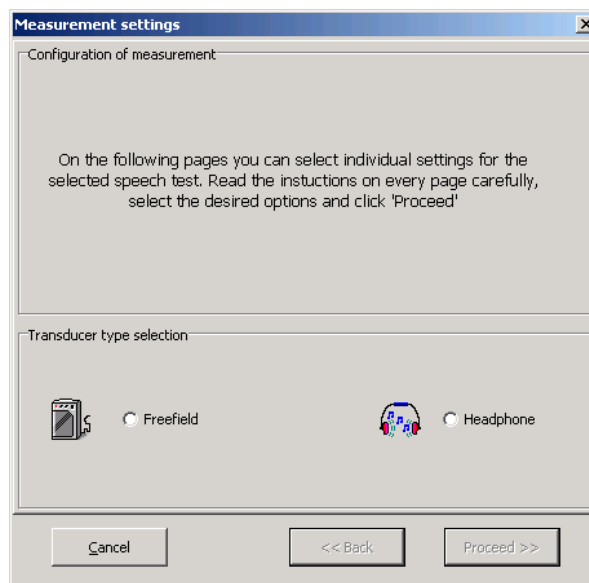


Figure 3

On the first page please select a freefield measurement or a headphone measurement respectively and click 'Proceed'. On the next pages further measurement parameters can be adjusted, where the selectable parameters depend on the speech test and the selected

measurement profile. For example some speech tests may only support measurements in quiet, or some additional parameters may be fixed in one particular test.

4.1 Measurements in quiet

On the next page select the channel for the output of the speech signal (Figure 4, headphone left panel, freefield right panel).

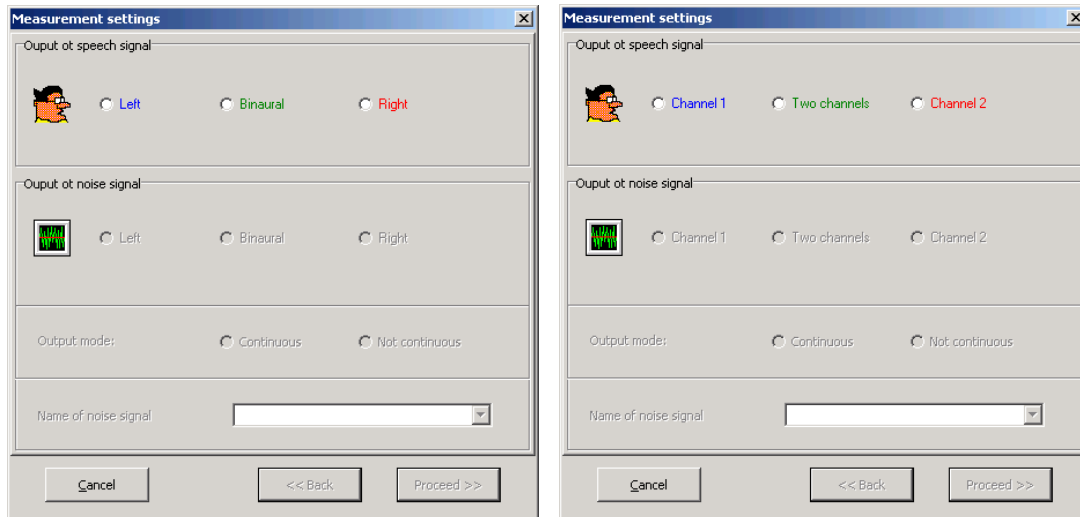


Figure 4

After clicking 'Proceed' you can enter the starting presentation level (Figure 5). Click 'Proceed to enter the next page and proceed with paragraph 4.3 'Final settings'.

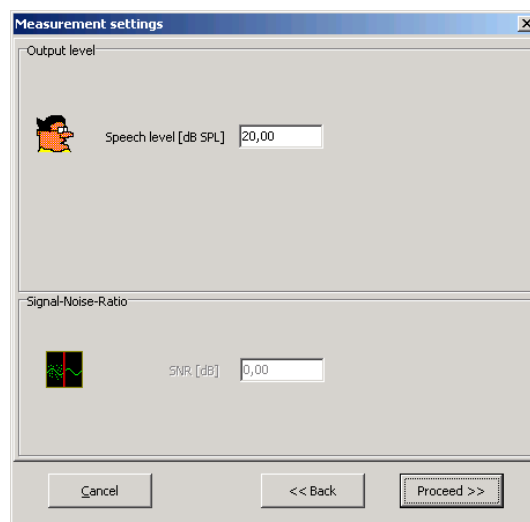


Figure 5

4.2 Measurements in noise

If you have selected an ILD/BILD measurement please continue with chapter 4.2.2.

4.2.1 Standard measurements

Select the desired output channels for the speech and noise signal on the next page (Figure 6: headphone left panel, freefield right panel). If the noise signal should be presented continuously select 'Continuous' output mode or 'Not continuous' if the noise should be stopped between the trials. Depending on the speech test and the configuration you may select different noise signals by clicking the arrow on the lower selection box. Click 'Proceed' after completing all settings and continue with chapter 4.2.3.

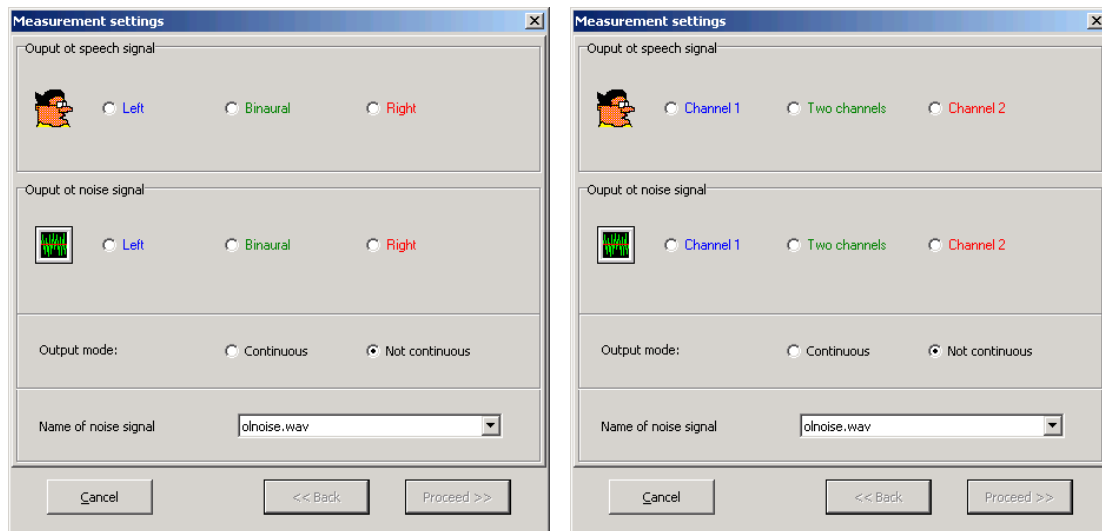


Figure 6

4.2.2 ILD/BILD measurements

On the next page please select the ILD/BILD situations that should be measured (Figure 7). For more information on ILD/BILD measurements please refer to the annex of this document.

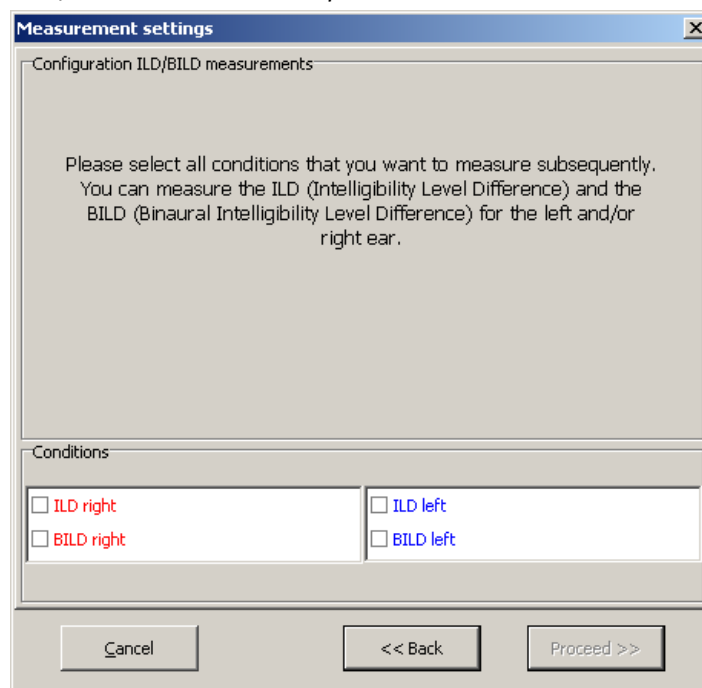


Figure 7

4.2.3 Level settings

On the next page enter the noise level at the edit field 'Noise level' (Figure 8, left panel). In measurements with adaptive level control you can select if the noise level or the speech level should be fixed during the measurement. If you select 'Fixed speech level' you have to enter the speech level rather than the noise level (the labels are changed accordingly, Figure 8, right panel).

Enter the starting signal-noise-ratio into the edit field 'SNR' and click 'Proceed'.

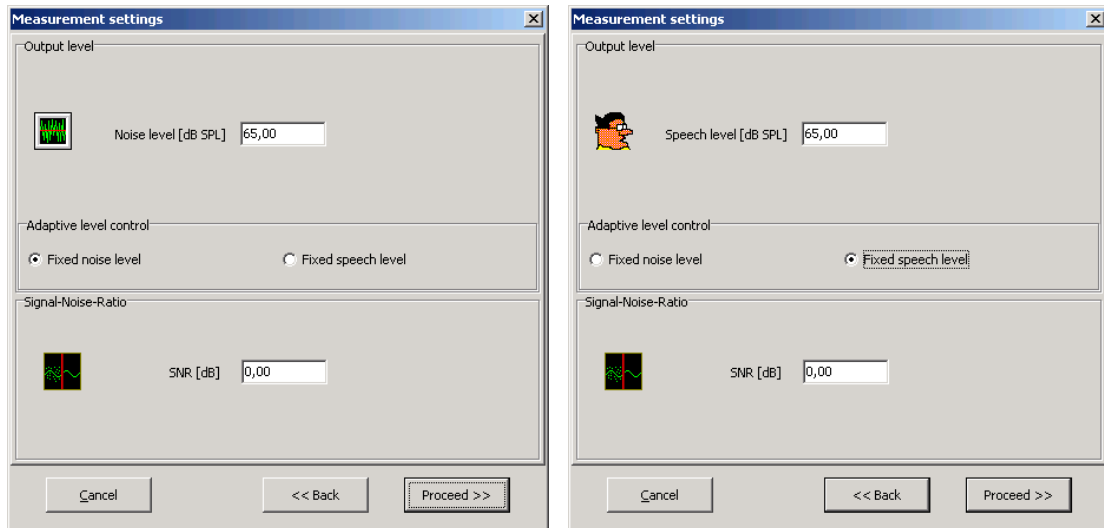


Figure 8

4.3 Final settings

On the last page of the measurement configuration dialog the testlist is selected and some measurement mode settings can be adjusted. (Figure 9):

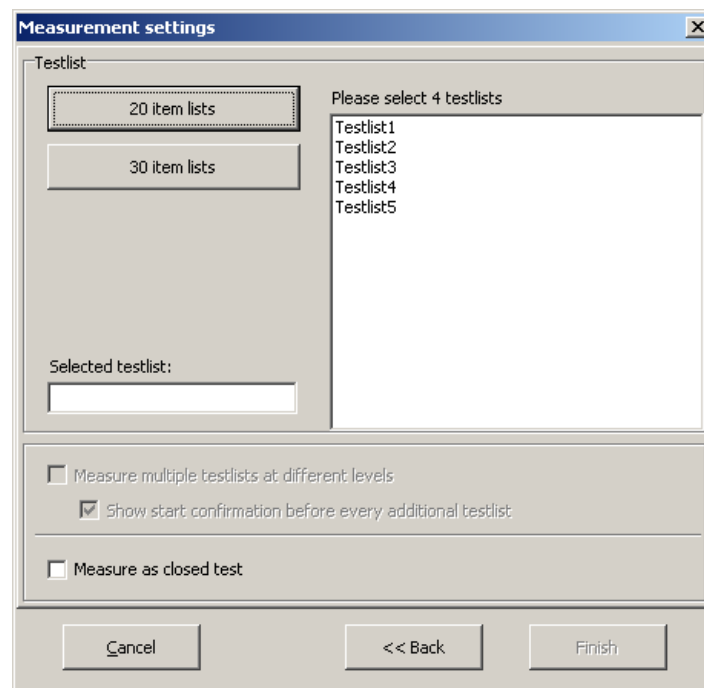


Figure 9

Depending on the speech test and the configuration one or more buttons for different testlist types may be shown. If no button is visible, all existing testlists are listed in the listbox. Eventually click the desired testlist type button and select a testlist or enter its name directly into the edit

field 'Selected testlist'. For ILD/BILD measurements you may have to select multiple testlists. The number is shown above the list. Select the testlists by clicking on them subsequently.

Be sure that you do not use the identical testlist for the same client multiple times!

In measurements without adaptive level control you can measure multiple testlist at different speech levels or SNR's respectively within one measurement. To achieve this please check the checkbox 'Measure multiple testlists at different levels'. You will be prompted for the settings of the next testlist after completing each testlist. If you want to be prompted for the measurement to be continued on the input box after completing settings for an additional testlist please set a checkmark at 'Show start confirmation before every additional testlist' This option is especially recommended if the answers are given by an investigator in open speech tests.

Depending on the speech test and the configuration an open speech test may be performed as a closed version without an investigator. To select this alternative please check the option 'Measure as closed test' (eventually refer to paragraph 5.3 'The measurement procedure').

Depending on the speech test and the configuration an additional option 'Confirmation of answers necessary' is shown. Checking this option requires a confirmation of the investigator after each answer of the client.

Finally click 'Finish'.

5 The measurement dialog

After the successful creation of a new measurement or the selection of an incomplete or complete measurement the measurement dialog is shown. Figure 10 exemplary shows the measurement dialog for a new created measurement (fixed speech level, headphone, binaural presentation):

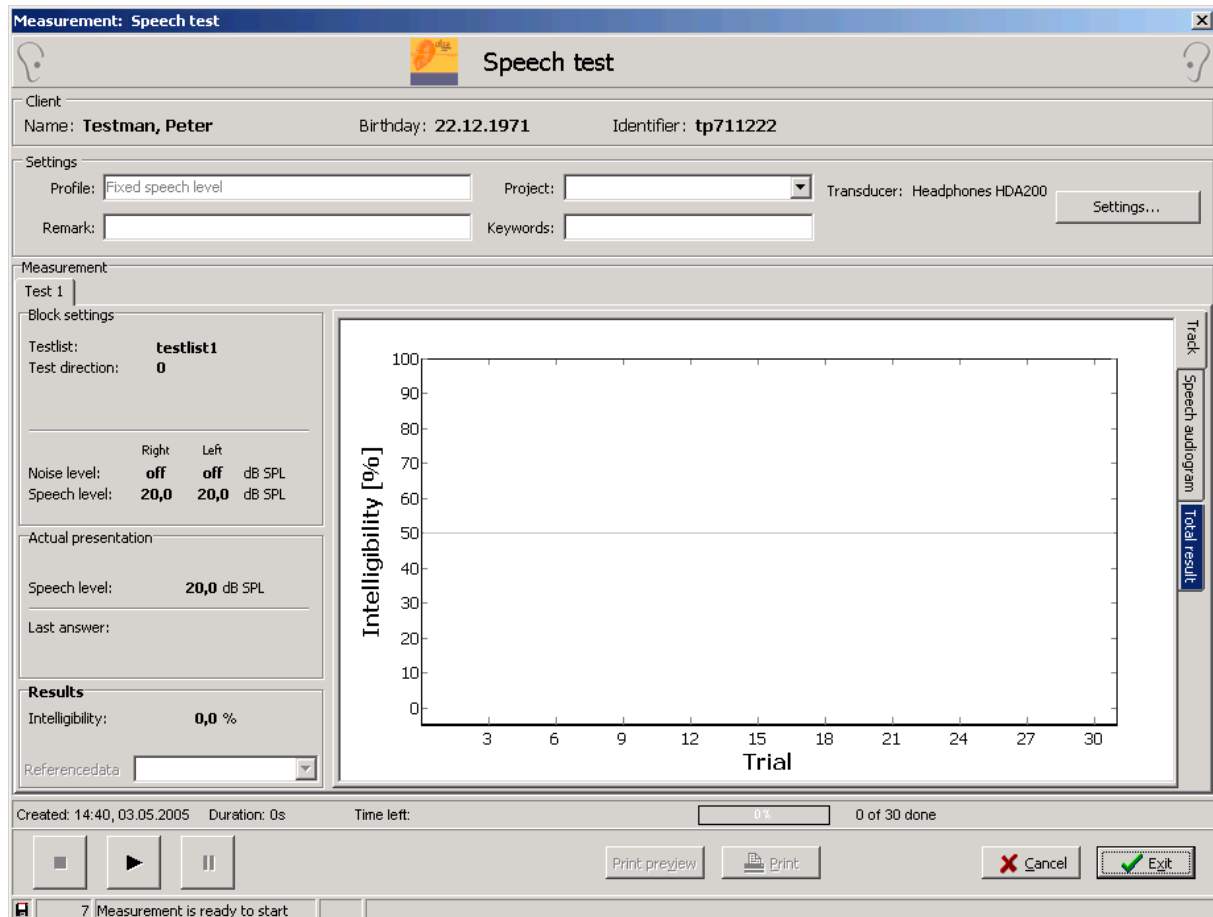


Figure 10

5.1 Common functions

The measurement dialog consists of three functional areas. The upper area contains client data and common settings (Figure 11). The lower area contains information about the status and progress of the actual measurement and measurement procedure control elements (Figure 12). The middle area contains measurement specific data and thus the contents depend on the application and the measurement configuration. In the following the common functions and labels in the upper and lower area of the measurement dialog are described.

The area 'Client' in the upper part of the measurement dialog (Figure 11) contains the actual client data. The region 'Settings' below contains the name of the actual measurement profile at the left. You can enter an optional remark into the edit field 'Remark' below.

You can assign the actual measurement to any project by from the user defined project list by selecting it in the field 'Project'. Projects can be added by adding them to the project list (see paragraph 'Project list' in the documentation of the start dialog). You can enter arbitrary keywords into the field 'Keywords'. You can search for these keywords in the database if the database query supports the field 'keywords'.

At the right the transducer type and transducer name is shown. Depending on the application, the measurement profile and the configuration you can click ‘Settings...’ to call the measurement settings dialog again. There you may change one or more parameters of the measurement. Only measurements in the stopped state can be changed.

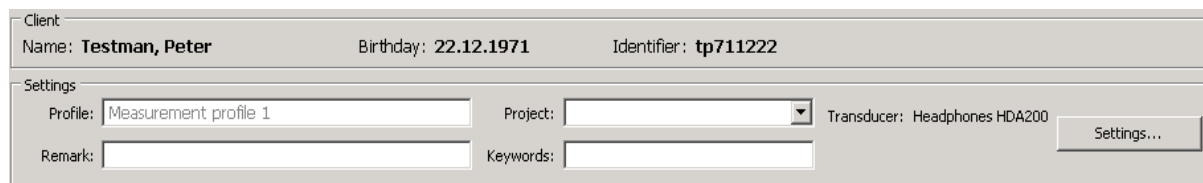


Figure 11

The lower area of the measurement dialog contains all measurement control elements and measurement progress data (Figure 12):

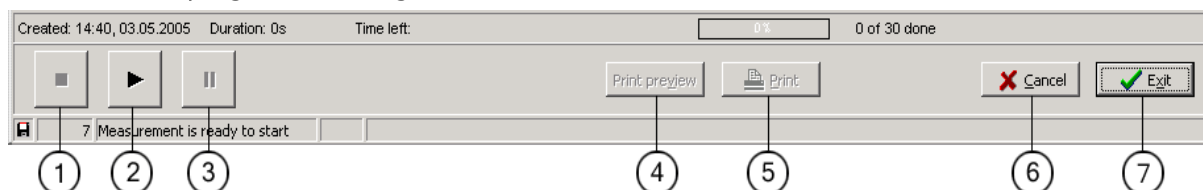



Figure 12

①	Stop	The measurement is stopped and can be restarted using the start button. Depending on the measurement type some or all measurement data will be rejected.
②	Start	The measurement is started or resumed after a break.
③	Pause	The measurement is set to paused state and can be resumed by clicking Pause again.
④	Print preview	The print preview dialog is shown (see below).
⑤	Print	The actual measurement is printed.
⑥	Cancel	The actual measurement is cancelled (data and/or changes are rejected).
⑦	Exit	Exits the actual measurement. Data and/or changes are stored.

Depending on the application, configuration and measurement state one or more buttons or functions may be disabled. For example a measurement can only be started or stopped, print preview and printing is only enabled if measurement data are present. Some measurement applications may not support all listed controls.

The measurement progress is shown above the buttons. During the measurement you can see (from left to right): time and date of measurement creation, actual net measurement duration, estimated remaining time, number of measured trials and total number of trials for this measurement. The latter is shown as text and with a progress bar. Please note that the total number of trials may be just a rough estimate in measurements using adaptive procedures and may change during the measurement. The estimation of the remaining time depends on the number of trials and therefore may change during the measurement too. For completed measurements the following information is shown (left to right): time and date of measurement creation, net measurement duration, time and date of measurement completion.

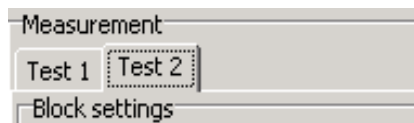
Below the buttons some information about the measurement status are shown in the status bar.

At the left the floppy symbol  may indicate that data have been changed. The next two fields show the global status where the first field contains a clock showing the time elapsed in the actual measurement state. The last two fields contain application specific information, where the first contains a clock showing the time elapsed since the last state change.

5.2 Measurement data

The region 'Measurement' in the middle of the measurement dialog contains specific data for the actual measurement.

In measurements with multiple testlists (see paragraph 4 'Creating a new measurement') an enumerated tab is created for each started testlist (see figure at the right). Use these tabs to show the settings of the corresponding testlist. During a measurement the display is updated and the actual testlist is selected automatically.



On the left panel various parameters for the selected testlist (or single testlist respectively) within the actual measurement are shown (see Figure 13). The upper part 'Block settings' contains settings for the complete list and the actual speech and noise level.

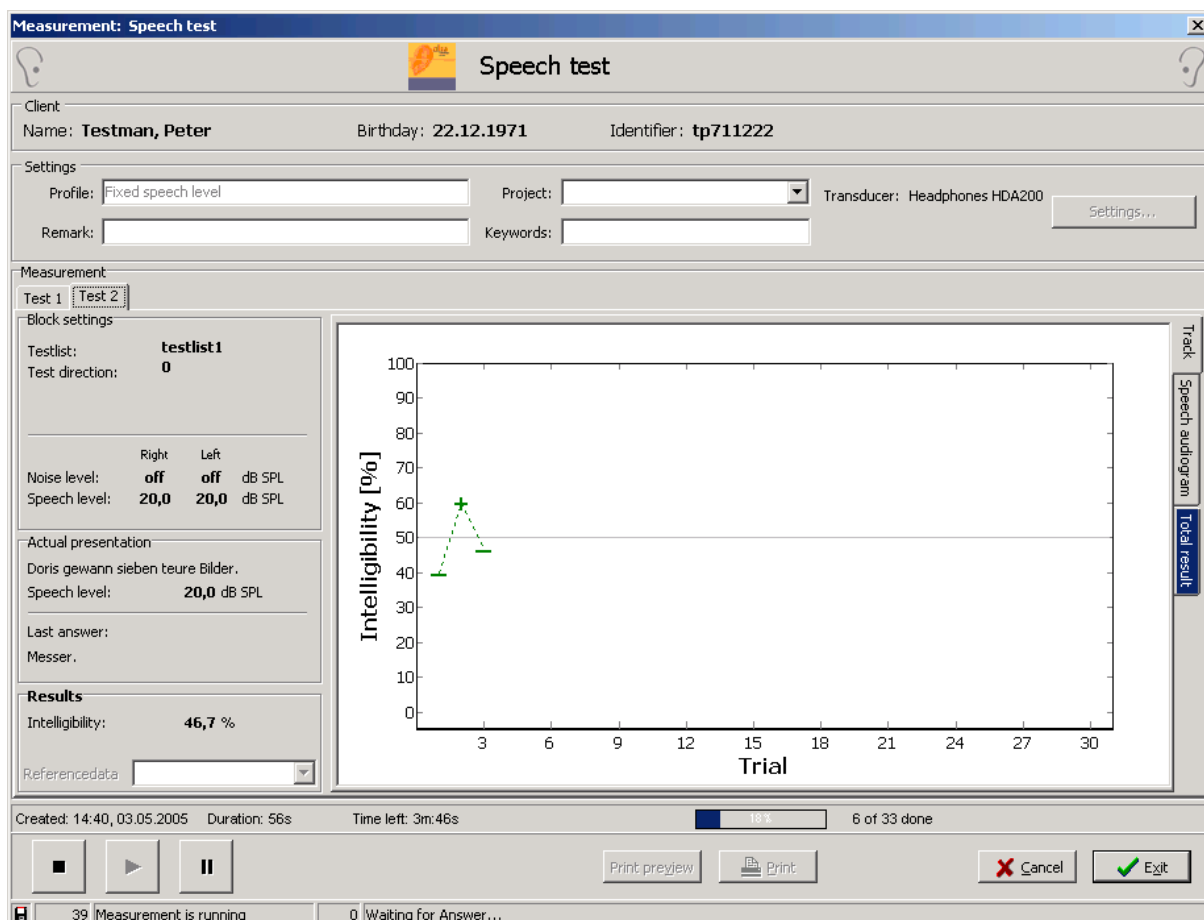


Figure 13

In the box 'Actual presentation' all parameters for the actual trial are shown (actual trial or selection on the input box, presentation level or SNR respectively, and last answer). The results (number and names depend on the measurement profile) are shown below. Depending on the configuration and the measurement profile different reference data may be selected at the bottom of the 'Result' section.

The right panel contains the graphical representation of the actual measurement. Depending on the configuration and the measurement profile you may select between three different visual presentations using the tabs on the right border of the chart:

Track (Figure 13)	<p>In this presentation the course of one measurement parameter (depending on the measurement profile) during the measurement is shown. The symbols representing the trials have the following meaning:</p> <p>+ More than 50 % were recognized for this trial</p>
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	<ul style="list-style-type: none"> - Less than 50 % were recognized for this trial = 50 % were recognized for this trial • Actual trial: no answer received yet o Level for this trial (for measurements with level controls using this symbols it is not meaningful to connect the single trials with a line) <p>Please note that different word weights for the single words of a sentence may be taken into account when the intelligibility is computed. Therefore three recognized words in a sentence with six words do not necessarily have to be equivalent to an intelligibility of 50 %</p> <p>Depending on the measurement profile and configuration reference data may be shown in gray.</p> <p>This presentation type is available for all measurements.</p>
Speech audiogram (Figure 14, left panel)	<p>Presentation of the measurement results for the selected testlist in a speech audiogram. Results for complete testlists are shown with a cross symbol, Results for incomplete testlists are show with a dot, because they are preliminary estimates only. The slope is shown as a tangent if the measurement does an estimation of the slope too.</p> <p>This presentation type may be missing depending on the speech test and the configuration.</p> <p>Depending on the measurement profile and the configuration the psychometric function may be plotted in gray.</p>
Total result (Figure 14, right panel)	<p>Presentation of all measurement results in one combined speech audiogram. The results of the single testlists are shown as in the speech audiogram (see above).</p> <p>This presentation type may be missing depending on the speech test and the configuration.</p> <p>Depending on the measurement profile and the configuration the psychometric function may be plotted in gray. This presentation is only visible in measurements with multiple testlists and if all parameters (other than testlist name and levels) are identical.</p>

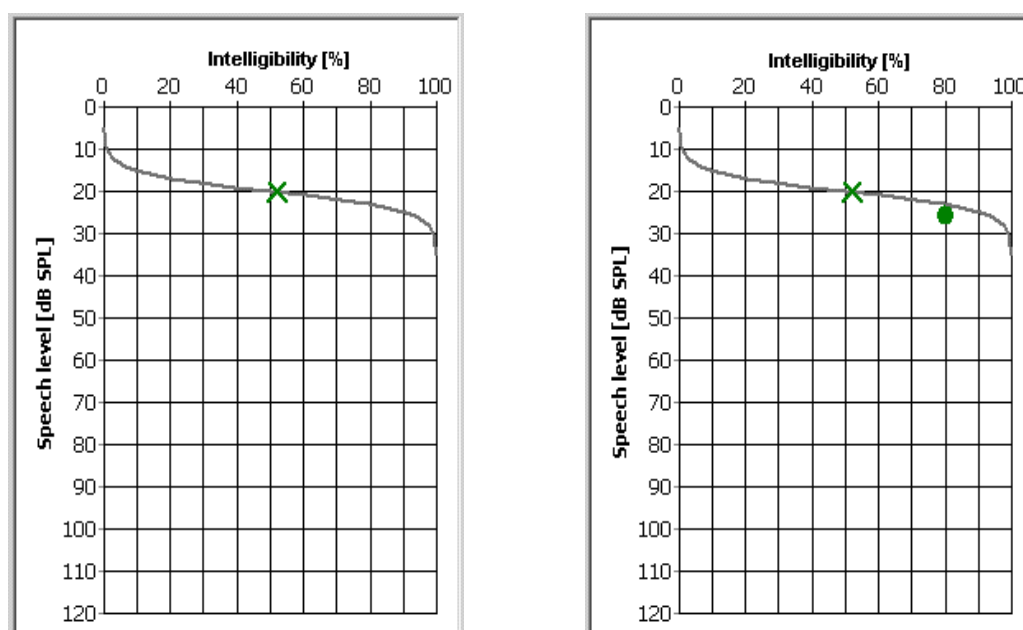


Figure 14

5.3 The measurement procedure

The measurement procedure of the Oldenburg sentence test is different for the open and the closed version of the test.

5.3.1 Open sentence test

Pressing the start button runs the measurement. A starting request is shown on the response box (Figure 15):

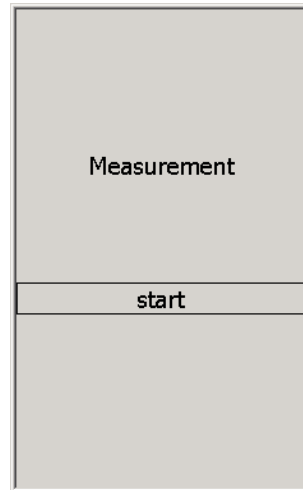


Figure 15

The display may vary depending on the used response box. For the configuration of the response box please refer to the paragraph 'Response box settings' in the chapter 'Menu: Tools' in the documentation of the start dialog.

The first trial is presented after pressing 'start'. At the same time the sentence is shown on the response box (Figure 16, left panel):

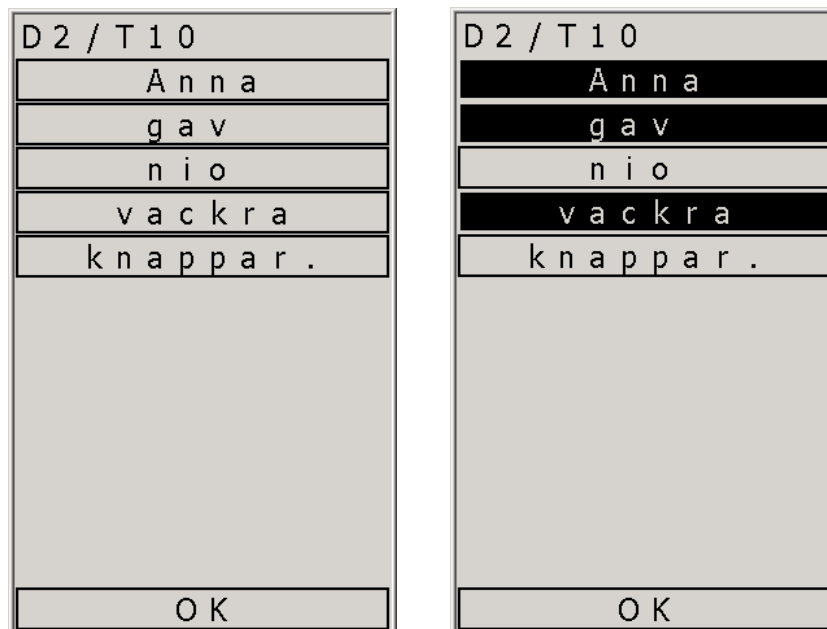


Figure 16

In the first line the progress of the actual testlist is shown (D = actual trial, T = total number of trials). Select the words that were recognized by the client by clicking on them (Figure 16, right panel). These words are displayed inverted (black background, light font). In the example the words 'Anna', 'gav' and 'vackra' were recognized. You can deselect words by clicking them again (displayed with black font on light background); the corresponding words are registered as 'not recognized' again. After selecting/deselecting all words in m correspondence to the clients

answer please click 'Ok'. The measurement will be continued with the next trial. Now proceed with the paragraph 'Subsequent measurement procedure'.

5.3.2 Closed sentence test

The closed version is not available yet for the 'Hagerman sentence test'.

5.3.3 Subsequent measurement procedure

If you measure the ILD/BILD (if available) with freefield speakers the situation that will be measured next will be shown on the response box. The client has to be placed accordingly in front of the speakers and one ear has to be plugged eventually:

Situation	Description
SoNo	Speech and noise are presented from the same direction using the left speaker.
ILD rechts	SoN90-Situation. Speech is presented via the left speaker, noise is presented via the right speaker.
ILD rechts	SoN90-Situation. Speech is presented via the right speaker, noise is presented via the left speaker.
BILD rechts	SoN90-Situation. Speech is presented via the left speaker, noise is presented via the right speaker. Right ear has to be plugged.
BILD rechts	SoN90-Situation. Speech is presented via the right speaker, noise is presented via the left speaker. Left ear has to be plugged

If you are running other measurements with multiple testlists you will be prompted for the parameters for the next testlist after completing one testlist. For this purpose the 'Measurement settings' dialog is called again (see paragraph 'Creating a new measurement'). If don't want to measure another testlist click 'Cancel' and select 'Exit' in the measurement dialog (and confirm the corresponding request with 'Yes'). In a final dialog you can select if you want to continue the measurement with additional test lists later on (Figure 17).

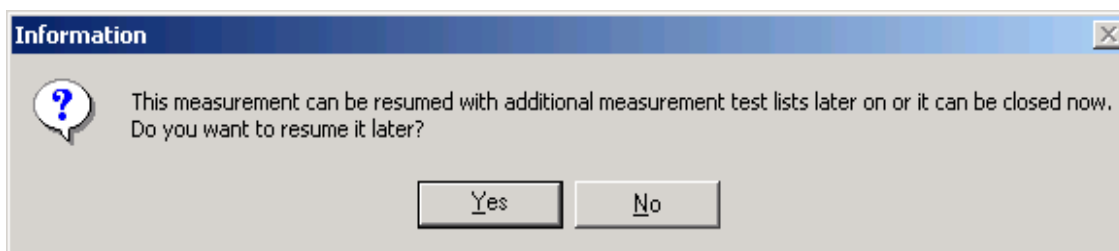


Figure 17

The measurement is continued after completing the settings for the next testlist. A corresponding hint is shown on the response box meanwhile.

If the measurement is paused from the main screen a corresponding hint is shown on the response box. After all presentations are performed and all answers are received a hint indicating the end of the measurement may be shown on the response box (depending on response box and its configuration).

You can print out a complete measurement directly or you can load and print it again later (see below). By clicking 'Exit' you return to the start dialog of the 'Oldenburg Measurement Application'.

5.4 Print preview and printing

If you click button ⑦ 'Print' (see above) the standard printer configuration dialog is shown. If you click button ⑥ 'Print preview' a dialog with a print preview containing some controls for the configuration of the printout (Figure 18):

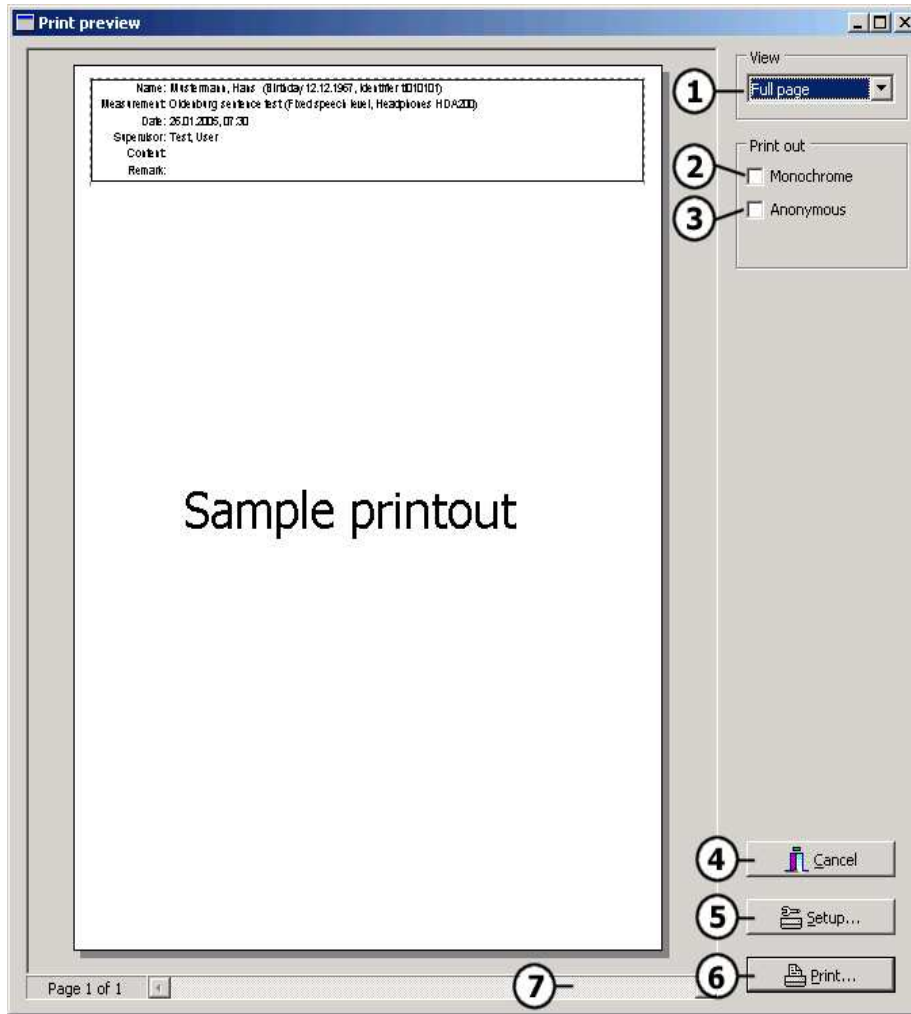


Figure 18

The dialog contains the following controls:

①	View	Select the desired zoom for the print preview. This setting has no effect on the printout.
②	Monochrome	Select here if you want to print monochrome or colored. The default setting depends on the installed printer model.
③	Anonymous	If you check this option the names of the investigator and the client are hidden, only the client identifier is printed.
④	Cancel	Exits the print preview.
⑤	Setup...	Calls the standard printer configuration dialog. For details refer to the Windows manual and the documentation of your printer.
⑥	Print...	The standard print dialog is called. For details refer to the Windows manual.
⑦	Scrollbars	Use the scrollbars to navigate through the pages if the printout contains more than one page.

For some measurement applications an additional checkbox 'Track' may appear below „③ Anonymous“. Use this option to toggle the visibility of the measurement track on the printout.

6 Measurement profiles

In this section the measurement profiles, i.e. the subtype available default configuration sets for the measurement 'Hagerman sentence test' are described.

6.1 SRT in quiet

Measurement of the speech recognition threshold (SRT) in quiet using an adaptive level control.

6.2 SRT in noise, fully modulated noise

Measurement of the speech recognition threshold (SRT) in fully modulated noise using an adaptive level control.

6.3 SRT in noise, slightly modulated noise

Measurement of the speech recognition threshold (SRT) in slightly modulated noise using an adaptive level control.

6.4 Fixed speech level

Measurement of the speech intelligibility in percent at a fixed speech level in quiet

6.5 Fixed signal-to-noise ratio, fully modulated noise

Measurement of the speech intelligibility in percent at a fixed signal-to-noise ratio in fully modulated noise.

6.6 Fixed signal-to-noise ratio, slightly modulated noise

Measurement of the speech intelligibility in percent at a fixed signal-to-noise ratio in slightly modulated noise.

6.7 ILD/BILD – (Binaural) Intelligibility Level Difference, fully modulated noise

Measurement of ILD/BILD – (Binaural) Intelligibility Level Difference using fully modulated noise. Depending on the selection of the situations to measure several testlists for different spatial conditions are measured. The ILD/BILD can be calculated from the speech recognition thresholds (SRT) measured for different conditions. The sentences are spoken by a female speaker.

6.8 ILD/BILD – (Binaural) Intelligibility Level Difference, slightly modulated noise

Measurement of ILD/BILD – (Binaural) Intelligibility Level Difference using slightly modulated noise. Depending on the selection of the situations to measure several testlists for different spatial conditions are measured. The ILD/BILD can be calculated from the speech recognition thresholds (SRT) measured for different conditions.

7 Calibration

For measuring 'Hagerman sentence test' the following signals have to be calibrated (see also calibration manual):

Transducer	Signal
Freefield speaker	sehagermanfumnoise (for fully modulated noise) sehagermansmnoise (for slightly modulated

	noise)
Headphone Sennheiser HDA200	sehagermanfumnoise_od_hda200 (for fully modulated noise) sehagermansmnoise_od_hda200 (for slightly modulated noise)
Headphone Beyer DT48	sehagermanfumnoise_od_dt48 (for fully modulated noise) sehagermansmnoise_od_dt48 (for slightly modulated noise)
Headphone Telephonics TDH39	sehagermanfumnoise_od_tdh39 (for fully modulated noise) sehagermansmnoise_od_tdh39 (for slightly modulated noise)
Headphone Telephonics TDH39p	sehagermanfumnoise_od_tdh39p (for fully modulated noise) sehagermansmnoise_od_tdh39p (for slightly modulated noise)

For measuring ILD/BILD with ‘Hagerman sentence test’ using headphones and virtual acoustics the following signals have to be calibrated (see also calibration manual):

Transducer	Signal
Headphone Sennheiser HDA200	sehagermanfumnoise_bild_od_hda200 (for fully modulated noise) sehagermansmnoise_bild_od_hda200 (for slightly modulated noise)
Headphone Beyer DT48	sehagermanfumnoise_bild_od_dt48 (for fully modulated noise) sehagermansmnoise_bild_od_dt48 (for slightly modulated noise)
Headphone Telephonics TDH39	sehagermanfumnoise_bild_od_tdh39 (for fully modulated noise) sehagermansmnoise_bild_od_tdh39 (for slightly modulated noise)
Headphone Telephonics TDH39p	sehagermanfumnoise_bild_od_tdh39p (for fully modulated noise) sehagermansmnoise_bild_od_tdh39p (for slightly modulated noise)

8 Literature

For detailed information about the ‘Oldenburg sentence test’ please refer to:

9.1 Restrictions in the demo mode

Besides the restrictions in the demo mode of the 'Oldenburg Measurement Applications' described in the documentation of the start dialog, the following additional restrictions apply if you are running the measurement 'Hagerman sentence test' in demo mode:

- 1) Only one fixed testlist can be used
- 2) Only the standard noise shipped with the 'Hagerman sentence test' can be used
- 3) A demo version hint is played at a random position within the testlist before one trial.

9.2 Installation of additional noise signals for speech tests

You can install user defined noise signals for use in multiple speech tests of the 'Oldenburg Measurement Applications'. Select 'Measurements' from the main menu of the start dialog and select 'Noise for speech tests' -> 'Install'. The dialog shown in Figure 19 appears.

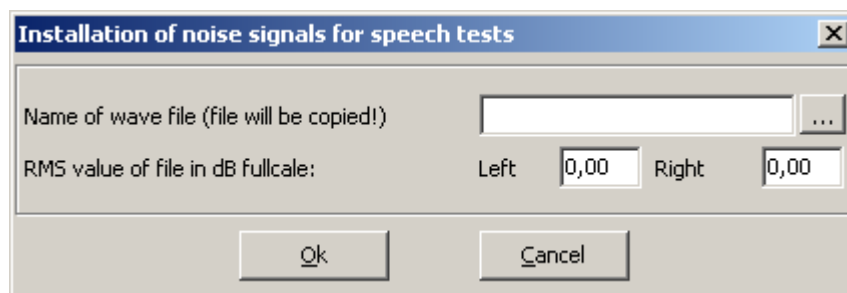


Figure 19

In the field to the right of 'Name of wave file' enter the full filename of signal to install or click the button at the right to open a 'File open' dialog to select the signal from your disk.

The following restrictions apply for noise signals:

- The file has to be a Windows PCM-wave-file (44100 Hz, 16 Bit, stereo).
- If the test should run using an audiometer that does not apply any freefield deconvolution, then the file itself has to be deconvoluted itself (the only supported audiometer that applies a deconvolution is the Siemens Unity)!
- If your audiometer does apply a freefield deconvolution, all signals are used from the 'Freefield speaker' and therefore all user defined noise signals have to be installed for the 'Freefield speakers' only, even if you want to use it with headphones.
- If you want to use the noise signal in measurements with continuous noise presentation the wave file has to be cut in a way that it can be looped without any audible distortion.

Enter the RMS value in dB full scale for the left and the right channel in the last line. Note: a full conducted rectangle signal has a RMS of 0 dB full scale; a full conducted sine signal has a RMS of -3.01 dB full scale.

Attention: The RMS values have a great influence on the absolute output level of the noise signal. If you use for example a heavy modulated noise signal with long periods of silence in it and you enter the mean RMS here, then the 'louder' regions of the signal will be output with higher levels than selected in the speech test. So the RMS values have to be adjusted for example by entering the RMS of the plateau (depending on your application).

Attention: If a speech test is performed using another noise signal than the original noise signal for the specific test, then the output levels are still calculated in a fixed relation to the original noise. Therefore the amplitude of other noise signals must be adjusted in relation to the original noise signal. This does not necessary mean identical RMS but 'suitable' for the desired purpose.

9.3 Response box settings

9.3.1 Response box for the open sentence test

For the configuration of the response box please refer to the paragraph 'Response box settings' in the chapter 'Menu: Tools' in the documentation of the start dialog.

9.3.2 Response box for the closed sentence test

You can adjust the appearance of the response box for the closed sentence test (**Fehler! Verweisquelle konnte nicht gefunden werden.**) for your needs by selecting 'response box settings closed version' in the submenu 'Oldenburg sentence test' from the menu 'Measurements' on the start dialog. The empty response box appears. Open the context menu by clicking with the right mouse button on the response box (Figure 20).

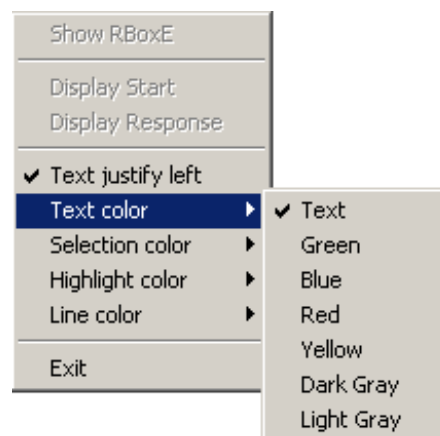


Figure 20

The menu contains the following items:

Menu item	Function
Text justify left	Select here if the button captions should be left justified or centered.
Text color	Text color on the buttons
Selection color	Text color of selected words
Highlight color	Text color below mouse cursor
Line color	Line color for connecting selected words
Exit	Exits the response box and stores the settings

The color 'Text' corresponds to the Windows standard color for captions. This color may vary between individual settings and Windows versions.

Adjust all desired settings here and finally select 'Exit' to store the changes and return to the start dialog.

9.4 ILD/BILD measurements – (Binaural) Intelligibility Level Difference

Measurements where speech signal and interfering noise are presented from different directions represent all-day situations much better than measurements with both signals from the same direction. The determination of binaural parameters with such measurements may for example show the benefit of a second hearing aid compared to one hearing aid. The next paragraphs describe the measurement of the 'Intelligibility Level Difference' (ILD) and the 'Binaural Intelligibility Level Difference' (BILD). These parameters can only be measured with headphones

using virtual acoustics or in well suited freefield rooms. A room is suitable if the ILD for normal hearing persons is higher than 6 dB and the BILD is higher than 3 dB.

9.4.1 Intelligibility Level Difference (ILD)

The intelligibility level difference (ILD) quantifies the benefit that a listener has from separating speech and noise sources. The ILD is the difference between the binaural SRT when speech is presented from the front and noise is presented from the side (S_0N_{90}) and the binaural SRT when both speech and noise are presented from the front (S_0N_0 , see Figure 21, upper panel). Because of the benefits achieved from the head shadow effect and from binaural processing in the brain, the separation of speech and noise sources can lead to an improvement of the SRT. This benefit is estimated by the ILD test, and it is about 6-12 dB in normally hearing subjects.

9.4.2 Binaural Intelligibility Level Difference (BILD)

For differentiating between the head shadow effect and binaural processing in the brain, the binaural intelligibility level difference (BILD) test can be used (see Figure 21, lower panel). The SRT in a binaural situation with S_0N_{90} presentation is compared to the SRT in the same situation but with plugging of the ear that is directed towards the noise source. Because of the benefits achieved from binaural processing, the results without the plug (binaural presentation) can be better than those with the plug (monaural presentation) by as much as 3-6 dB in normally hearing subjects. This difference is called the BILD. It is not actually measured using plugs, but because the measurement is implemented as a headphone test using head-related transfer functions, the plugging of the ear that is pointed towards the noise is achieved by switching off the headphone on that side.

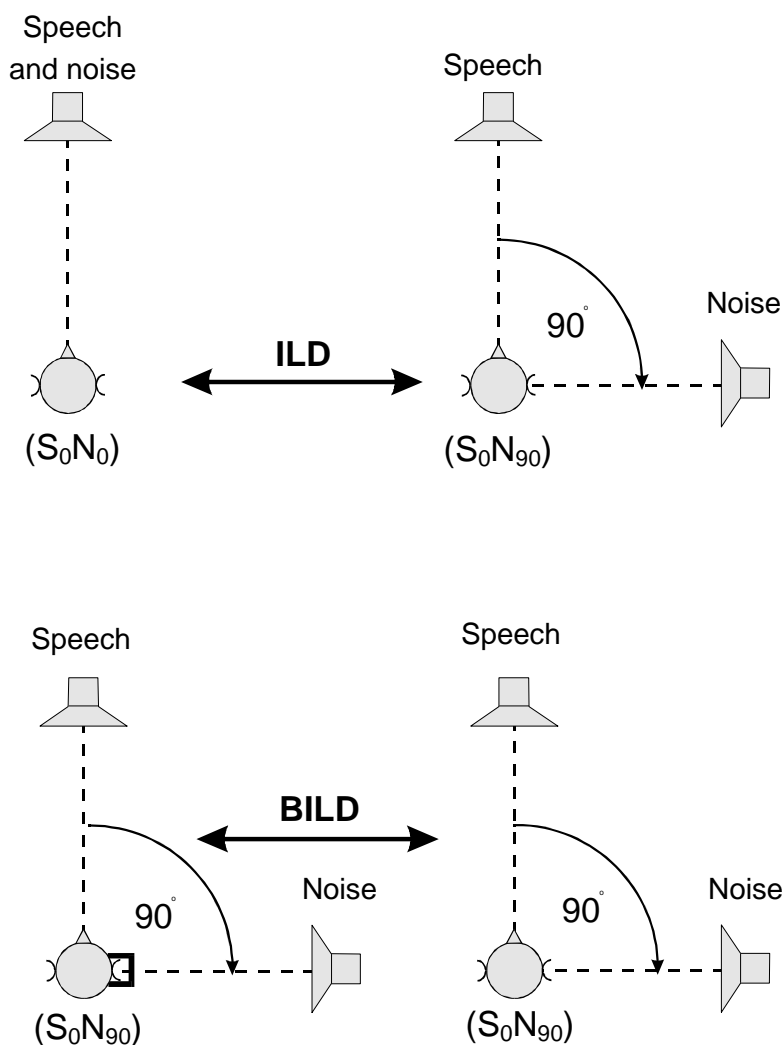


Figure 21

The signals for measuring the ILD/BILD with headphones using virtual acoustics (if shipped with this test) were generated using the HRTF measurements by the MIT Media Laboratory with a KEMAR dummy head (<http://sound.media.mit.edu/KEMAR.html>).