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	<p><b>Title:</b></p> <p>Version of the remote speech recognition tool with appropriate test settings, red flags and user feedback facility</p> <p>January 2016 – April 2016</p>	
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	<p><b>Type of Document:</b> Public Demonstrator</p>	

## Introduction

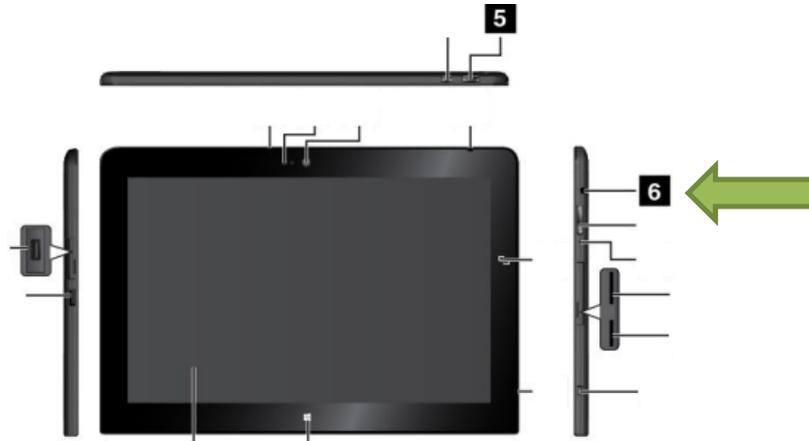
In this document, we demonstrate the use of the tool that has been developed to assess speech recognition in quiet and in noise outside of the clinical setting in adult cochlear implant users. Assessment of speech recognition in the home environment is effectuated by

- instructing the cochlear implant user how to connect the cochlear implant processor to the tablet on which the assessment tool runs (1)
- a user friendly design of the user interface (2-3-4)
- offering feedback to the user about the test results: presenting the outcomes of different test moments in a graph (5)
- signaling drops in performance by offering feedback to the user when the outcome of the speech recognition in noise task differs significantly from the outcomes of earlier assessments (6)

Detailed information about the tool has been reported in separate documents:

- User feedback on the design and feasibility [SHiEC Additional report WP3 – Remote testing\_user panel]
- Technical requirements of the tool [CATS functional specification]
- User study to determine the feasibility and reliability of the assessment tool for testing in the home environment [SHiEC Deliverable 3.2 – Validation of a remote speech recognition tool in adults CI users]
- Cut-off values, sensitivity and specificity of the digits-in-noise test, and the procedure to present the results of the remote tests to the CI user [SHiEC Additional report WP3 – Development of feedback to the user]

## 1. Connecting the cochlear implant processor to the tablet



## 2. Starting the CATS tool (Cochlear Acoustic Test Software) for self-testing

a. Opening the CATS-tool from the desktop



b. Screen for opening the first task: recognition of words in quiet, test 1



### 3. Performing the tasks for word recognition in quiet

#### a. Instructions

**Instructies**

U krijgt een aantal korte woorden te horen.

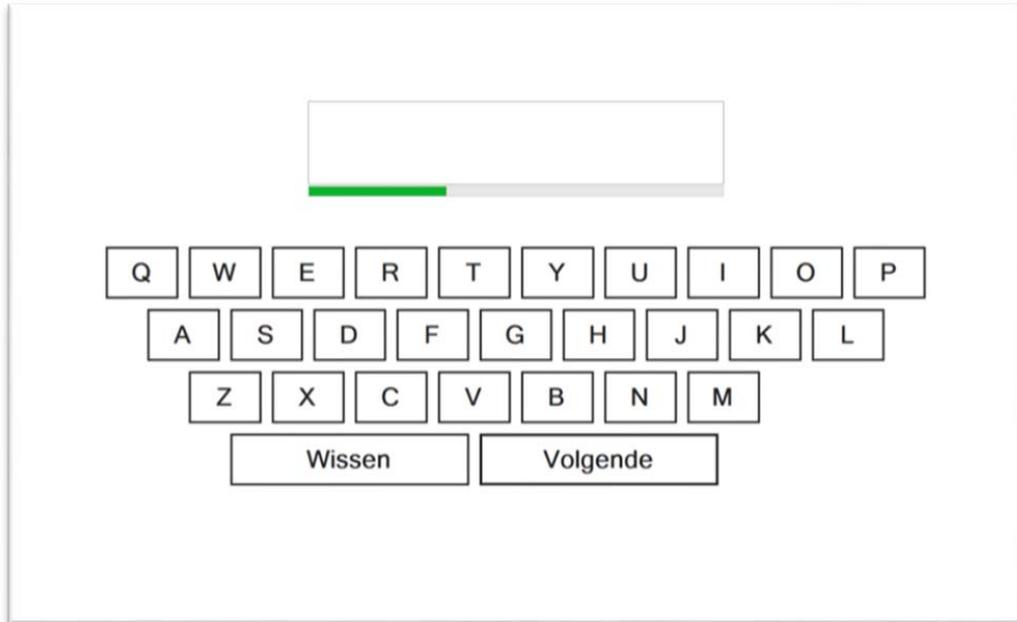
U typt precies wat u denkt dat er werd gezegd, ook als het geen echt woord is en ook als het alleen een enkele klank is (bv. een a of een p). U mag ook gokken. Typefouten kunt u corrigeren.

Als uw antwoord klaar is, drukt u op 'Volgende' om het volgende woord te horen. Als u geen enkele klank hoort, hoeft u niets te typen. Druk dan wel op 'Volgende' om het volgende woord te horen. Gebruik alleen letters, geen spaties of andere symbolen. Op het moment dat een woord wordt aangeboden, ziet u een luidsprekersymbool.

#### b. Screen to start the test

Q	W	E	R	T	Y	U	I	O	P
A	S	D	F	G	H	J	K	L	
Z	X	C	V	B	N	M			
Wissen				Volgende					
<input style="width: 150px; height: 20px;" type="button" value="Start de test"/>									

c. Screen with keyboard to enter the responses



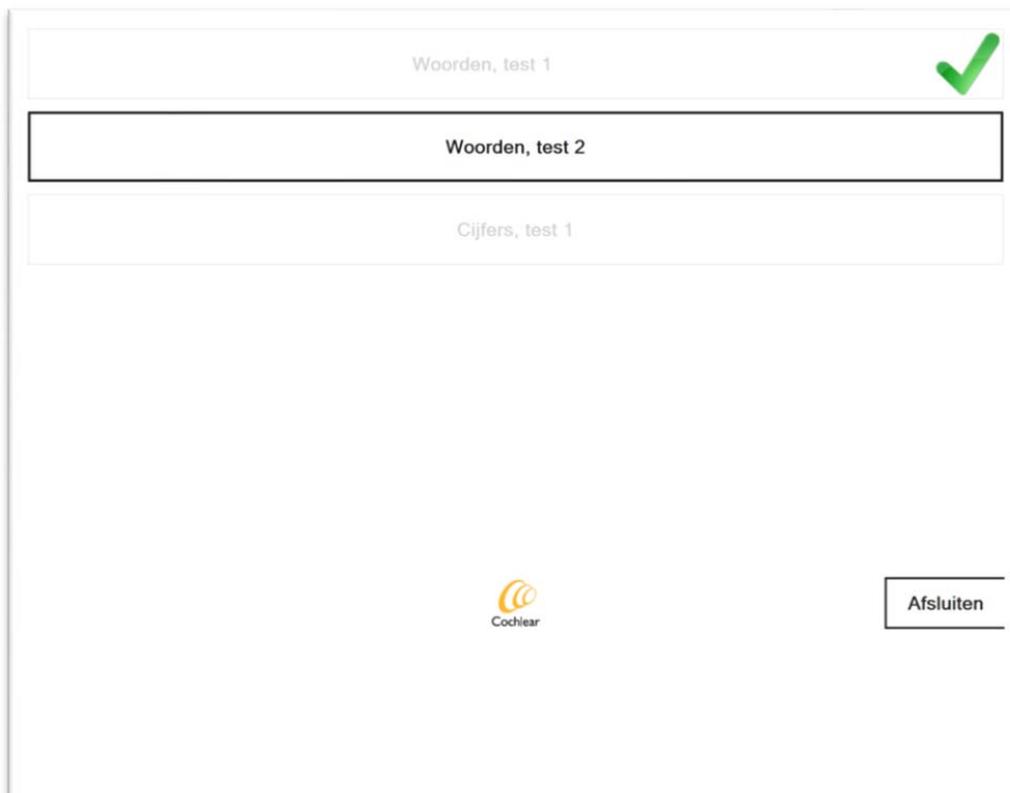
d. Feedback during the test when a user has not pressed Next yet ('Enter your response or press Next')



e. Screen after finishing the test ('Ready!')



f. Screen for opening the next task: recognition of words in quiet, test 2



## 4. Performing the task for digit-triplet recognition in noise

a. Screen for opening the next task: recognition of digits in noise



Woorden, test 1 ✓

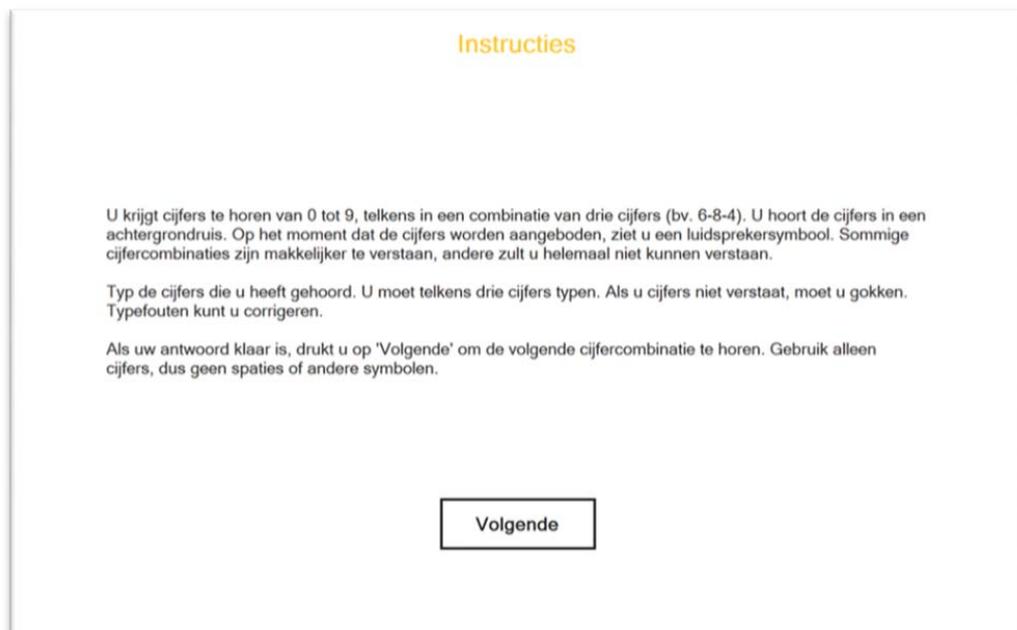
Woorden, test 2 ✓

Cijfers, test 1

Afsluiten

Cochlear

b. Instructions



**Instructies**

U krijgt cijfers te horen van 0 tot 9, telkens in een combinatie van drie cijfers (bv. 6-8-4). U hoort de cijfers in een achtergrondruis. Op het moment dat de cijfers worden aangeboden, ziet u een luidsprekersymbool. Sommige cijfercombinaties zijn makkelijker te verstaan, andere zult u helemaal niet kunnen verstaan.

Typ de cijfers die u heeft gehoord. U moet telkens drie cijfers typen. Als u cijfers niet verstaat, moet u gokken. Typefouten kunt u corrigeren.

Als uw antwoord klaar is, drukt u op 'Volgende' om de volgende cijfercombinatie te horen. Gebruik alleen cijfers, dus geen spaties of andere symbolen.

Volgende

c. Screen to start the test



d. Test screen with keyboard to enter the responses



e. Feedback during the test after entering three digits ('Press Next')

The screenshot shows a calculator interface. At the top, a display box contains the number '8 2 5'. Below the display is a numeric keypad with buttons for digits 7, 8, 9, 4, 5, 6, 1, 2, 3, 0, and a 'Wissen' button. Below the keypad is a 'Volgende' button. At the bottom of the interface, an orange bar contains the text 'Druk op volgende'.

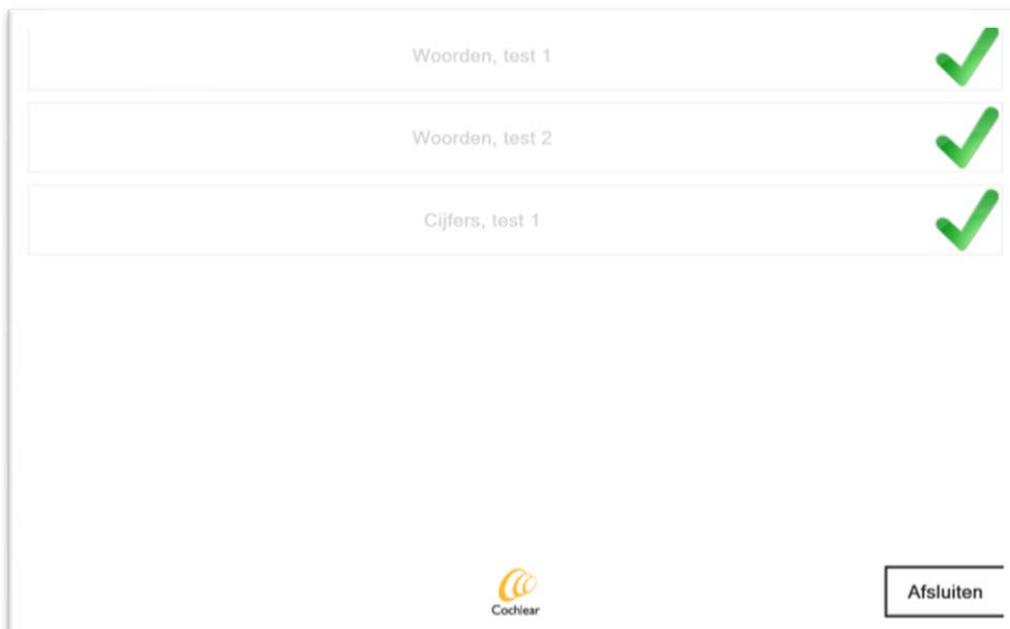
f. Feedback during the test after entering less than three digits ('Enter three digits and press Next')

The screenshot shows a calculator interface. At the top, a display box contains three dashes '---'. Below the display is a numeric keypad with buttons for digits 7, 8, 9, 4, 5, 6, 1, 2, 3, 0, and a 'Wissen' button. Below the keypad is a 'Volgende' button. At the bottom of the interface, an orange bar contains the text 'Vul drie cijfers in en druk op volgende'.

g. Screen after finishing the test ('Ready!')



h. Screen after completion of all tasks

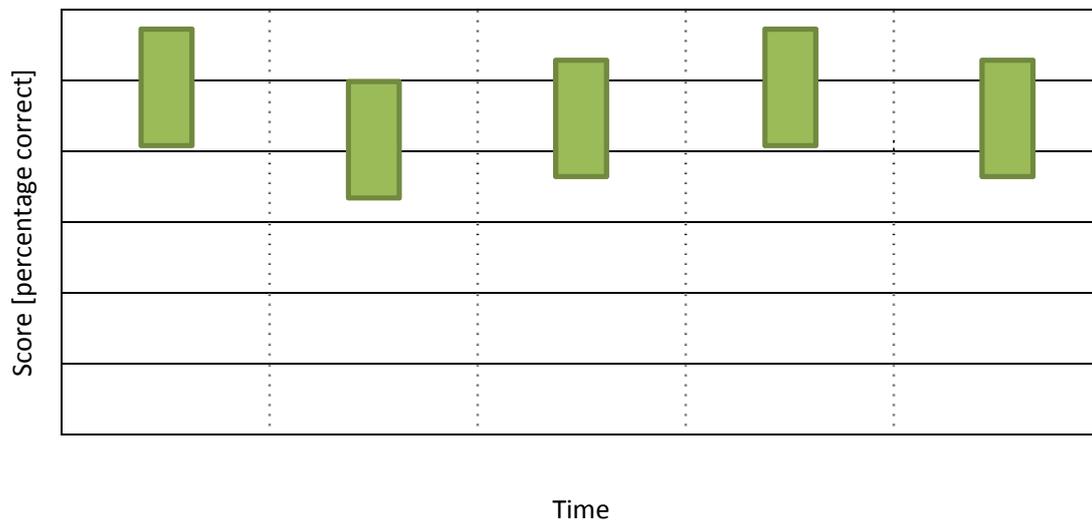


## 5. Feedback to the user on the outcomes of the test

In contrast to speech recognition testing in a clinical setting, the outcomes of home assessment need to be interpreted automatically and then presented directly to the CI user. When core outcome values are presented to a patient without indicating that there is normal variance around the measured value, patients may incorrectly interpret differences within normal variance as real progression or real deterioration of their abilities. Therefore, the results of the remote tests are presented to the CI user in a way that prevents misinterpretation.

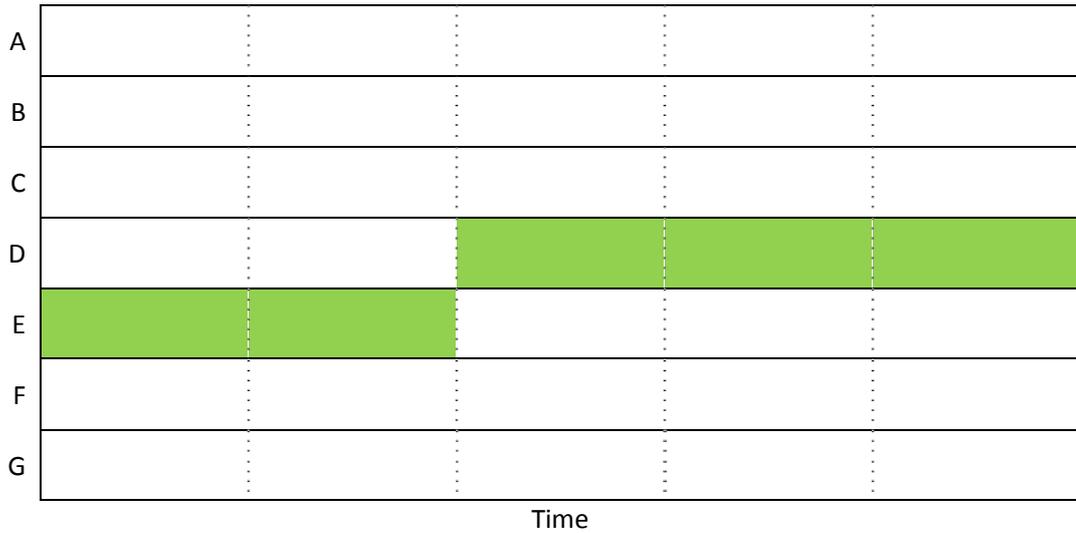
### 5.1. Feedback on performance in speech recognition in quiet

At each moment of testing, speech recognition in quiet is assessed with two lists of CVC words. After each list, the percentage phonemes correct is shown to the patient. To allow a patient insight in the development of his speech recognition abilities over time, the overall outcome of a testing moment is represented by a vertical bar with a mean value corresponding to the average score on the two lists and a length of twice the standard deviation.



### 5.2. Feedback on performance in speech recognition in noise

Speech recognition in noise is assessed with one measurement of the SRT using the digits-in-noise test. As the outcome value of the digits-in-noise test (i.e., the signal to noise ratio at which a user repeats 50% of the digit triplets correctly) is hard to interpret for a layman, the test result is categorized into one of seven categories (A – G). The procedure for categorizing each test result is described into detail in [SHiEC Additional report WP3 – Development of feedback to the user]. The outcomes of various test moments are presented in a categorical plot.



## 6. Signaling drops in performance for the speech in noise task (red flag)

The digits-in-noise test can also be used as a screening test for CI users who experience a deterioration in performance. A simulation study was performed to define a procedure that is sensitive and specific enough for this screening purpose. Details of this procedure are described in [SHiEC Additional report WP3 – Development of feedback to the user].

In the screening version of the digits-in-noise task, the user receives feedback on the outcome as follows:

- In case of a 'pass':  
    "Your score is within normal limits."
- In case of a 'refer':  
    "Your score is not as good as expected. Please contact your CI team to discuss the results."