Remote Healthcare

Working Memory Test

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Overview

Background
Working memory has been found to play a significant role in hearing performance. This finding is changing our current theoretical models of listening performance in both hearing aid and cochlear implant recipients. It is hypothesised that, while surgery and the implant technology play an extremely important role in a cochlear implantee’s hearing performance, a more holistic view (one that includes the recipients ability to process information) may provide a deeper understanding and uncover new ways to improve implant performance.

Our Research
This project is centred around the hypothesis that as the signal to noise ratio (SNR) increases, people are forced to spend more time processing the information using their working memory. This, in turn, leads to a decrease in the amount of information actually stored.

In order to test this hypothesis we created a self-administered, working memory test application. The application requires users to complete visual, listening and listening with noise working memory tests.

It is our hope that this application will provide a platform to help researchers answer questions such as: "Does the amount of processing required decrease as implantees become accustomed to their implants?" and "Why do some people produce good listening test scores but still report difficulties hearing in the real world?"

Design

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The working memory tests used in this application are each based on the 'digit' span test. The digit span test requires participants to listen or watch as a string of digits is presented to them before repeating the digits back in reverse order.

Given the simple nature of these digit span-based tests, it is possible to allow participants to self-administer the examination. This makes the testing process far easier for participants as they do not need to travel to and from the testing clinic. It also makes it possible to collect larger amounts of data.

Digit Span Test
The digit span test was chosen for a number of reasons including:
- the ease of implementation from a technical standpoint
- the minimal time required to explain the tests to subjects
- the wider range of cognitive abilities that are able to partake
- the minimal dependency on language skills

This testing platform has the potential to obtain powerful performance metrics which may reshape the way cochlear implant technology works. It will allow researchers and implant users to track their performance over time and learn more about the role working plays in hearing.

The Design
The test is broken into two stages. The first stage consists of a digit discrimination hurdle and a 100% intelligibility in noise measurement. The digit discrimination ensures the participants are capable of listening in noise while 100% intelligibility in noise measurement determines the maximum level of background noise in which the participant is still able to hear every number.

The second stage consists of three working memory tests. The first test is a visual working memory test which provides us with a baseline working memory capacity. The listening and listening in noise working memory tests will then stress the participants working memory in the auditory domain.

Results

Industry Value
The finished prototype is able to capture data from any internet connected device capable of running a modern browser. This data can then be stored in a central database where audiologists, engineers and clinicians are able to access and analyse it.

Plans have been made to roll out a trial run in April 2015.

Student Learnings
Both students learnt a great deal about web application development, interaction design, project management, cochlear implant technology and audiolology. These learnings, while interesting in and of themselves, will, no doubt, come in very useful for future projects undertaken by the students.

Future Possibilities
A successful trial of this project may lead to new results and answer some of the most difficult questions in audiolology. These results would, in turn, improve both pre-operation outcome predictions and post-operation rehabilitation for cochlear implant recipients.

References

