Neolexon – a therapy app for patients with aphasia

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Abstract

Neolexon is an app for self-paced language training for patients suffering from aphasia. Auditory and reading comprehension as well as oral and written naming tasks are the most common types of exercises in aphasia therapy. For best effects, the exercises must be repeated with high frequency, and they must be adapted to the specific requirements of each patient.

The app was designed specifically for tablet devices and implements the four common types of exercises. Due to the patients’ cognitive and motor restrictions it features a radically reduced graphical user interface that does not distract from the task and requires only minimal gestural interaction. The content of exercises is dynamically specified by the therapist according to the specific needs of a patient; the material is selected from a deeply annotated database of exercise items.

The app was developed as a student project and successfully evaluated by patients and therapists.

Index Terms: human-computer interaction, aphasia, HTML5

1. Introduction

Following brain damage (e.g., stroke, tumor, or traumatic brain injury) individuals may suffer from language disorders termed aphasia. In consequence all language modalities, i.e. language comprehension and production, reading and writing, may be affected [1]. Although symptoms vary widely between individuals, all of them exhibit difficulties in retrieving names of objects or actions (“lexical retrieval”). Aphasia may strongly impact participation and activity in everyday life.

Individuals with aphasia receive language therapy for the improvement of communication. Major exercises for the improvement of lexical retrieval problems comprise auditory and reading comprehension as well as oral and written naming. In order to conduct these exercises therapists traditionally use analog materials such as picture cards which do not allow a fully individualized training as the number of words available is restricted. Although the treatment guidelines recommend at least five to ten sessions a week [2], therapy usually takes place only once a week in Germany [3].

To face this problem an app is developed that allows patients to practice their skills independently and additionally to therapy. The Neolexon app is developed for tablet computers, as their touchscreen supplies an easy input method. To fit the special needs of individuals with aphasia, the Neolexon app needs an easily understandable, user-centered interface design. This design has to ensure that the app is also usable with motor impairments as aphasia is often combined with such.

There are already apps for tablets (e.g. SpeechCare Aphasia oder multeBook Aphasia), but these are not sufficiently adjusted to the patients’ needs. Their graphical user interfaces have too many small elements and are therefore not suited for individuals with aphasia. To develop a better-suited interface for persons with aphasia, the guidelines presented by Brandenburg et al [4] are used as an orientation. Unlike other apps Neolexon also provides a remote access for therapists to customize exercises matching the patients’ individual skills and therapy goals.

2. Data

A German database with about 10,000 entries will be built for the special needs of speech and language therapy. It will include deeply annotated pictures, videos and specific lexical features relevant to therapy. These features will be obtained from the web-based G2P service [5]. In therapy, therapists may easily create individual training sets for every patient via web access. The synchronization with the app enables patients to train individually relevant words at home to ensure high-frequency therapy.

3. Implementation

Figure 1: UI of the auditory comprehension exercise.

A prototype of the Neolexon app was developed as a hybrid app using the Ionic Framework [6]. The ionic framework applies AngularJS for the logic and offers layout elements, gestures and tools to create mobile applications with HTML5, CSS and JavaScript. Hybrid apps use the same source code on different mobile operating systems like iOS or Android. In this way the app can be made available rapidly for many patients. To create packages for the different mobile operating systems Apache Cordova is used. Apache Cordova also offers plug-ins
to access the native resources of the device (e.g. GPS, Camera or Microphone) directly. The prototype uses the plug-ins ‘Media’, ‘File’, and ‘FileTransfer’ to record, save and upload audio files to a server. Before every exercise session the app connects to the server and downloads the patient’s current exercises in the JSON Format.

To simplify the operation of the app the patient only has to solve the exercise which is currently displayed. After that the next exercise will be presented automatically. The patient never has to navigate through menus as the therapist remotely sets all settings. There are exercise types for language comprehension (see Figure 1), language production (see Figure 3), writing (see Figure 2) and reading. To provide assistance all exercise types offer a blue button that starts a video of a person’s mouth reading out the current word.

In the auditory and reading comprehension exercises the patient has to choose the demanded word from a set of four pictures. Additional to the target picture there are pictures of a phonologically similar word, a semantically similar word and a word without any relation to the target.

The writing exercise requires the patient to put the letters into the correct order. A touch gesture is used for the selection instead of the drag and drop gesture that is used in other apps as it is simpler to perform by patients with motor impairments. To meet the different requirements there are two versions of the exercise. The easy version offers only the required letters while the more difficult one shows the entire alphabet.

For the oral naming exercise the patient has to record the requested word. In order to make the exercise intuitive, the buttons to start and stop the recording are animated in colour and size to be processed pre-attentively. The recording is sent to a server where it can be accessed by the associated therapist. The exercise displays two buttons that start assistance videos. The first reads out only the initial sound of the demanded word in order to facilitate lexical retrieval. If the patient needs more assistance, the second button that starts a video of the whole word is enabled.

4. Evaluation

To test the usability, individuals with aphasia and speech therapists tested the app. The exercises were presented without instruction and were only explained if the test person did not know what to do. The evaluation showed that even the participants with motor impairments were able to successfully operate the app. Almost all exercise types could be operated intuitively; only in rare cases further assistance was necessary. Improvements like an additional assistance for the writing exercise were uncovered by the evaluation and implemented afterwards. The interaction design can therefore be considered successful, as all test persons were able to operate the app independently after a short explanation.

5. Conclusion

A tablet app that offers patients who suffer from aphasia self-paced language training was developed. The app created as a hybrid-app using the Ionic Framework and Apache Cordova and can therefore be installed on different mobile operating systems. Only when accessing the devices native resources to record and upload audio files, a few platform dependent quirks have to be considered.

It was of particular importance to create a graphical user interface that can be used by individuals with cognitive and motor restrictions. During an evaluation the test persons with aphasia showed interest in practicing at home with the app and also were able to operate it independently.

The next step is to create a large database and a back-end access that allows therapists to create individual training sets for the patients.

6. References