Virtual individualized therapy of aphasia (VITA) platform for SMARTER model of cognitive neuropsychological intervention approach

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Introduction

When selecting the goals for chronic aphasia interventions, many Ukrainian adults with aphasia acquired due to various brain accidents prefer to recover their language as much as possible to be able to communicate independently again. Given that aphasia therapy is objectively a long process, individualised and evidence-based interventions are crucial to enhance improvements generalized in real life social interactions. In the light of ongoing aggressive war of Russia against Ukraine, the number of people with acquired aphasia is steeply growing and majority of them are working-age adults. At the same time speech and language therapy in health care system is a nascent field and the number professionals remain extremely low for such a demand. Therefore, the goal of the project presented here is to present a platform that would equip clinicians with a tool to design and manage individualized therapeutic interventions as well as monitor the progress their efficiency.

To date, one of the ways of overcoming inaccessibility of speech and language therapy is usage of aphasia apps that allow self-paced training to people with aphasia (e.g. Palmer et al., 2020). Unfortunately, these tools have been developed mainly in English and are not applicable to the Ukrainian language and context. However, even in English, there is still a great variability of outcomes in computerized therapy due to the lack of control for numerous variables that could be substantial for the therapy such as: intensity of practice, frequency, the application of cognitive neuropsychological approach to intervention. Brady et al. (2021) reported in their meta-analysis that frequent, functionally-oriented interventions with intensive home practice showed higher outcomes. Whitworth et al. (2014) showed the importance of considering psycholinguistic characteristics in task designs such as: frequency, imageability, length. For instance, for people with auditory impairment minimally related pairs of long words might be easier to process than maximally related short words.

Unfortunately, the existing tools may focus on functionality, but they do not allow one to control for the psycholinguistic characteristics of items selected for the intervention, they do not collect data from the patient performance (e.g. frequency, intensity, and progress of individual practice). This in turn does not allow to develop computerised intervention following SMARTER model (e.g. Hersh et al., 2011) that would allow continuous monitoring of the improvement. Therefore, we decided to develop a new virtual individualized therapy of aphasia that would address the existing issues and incorporating best technological advancements with dedicated modules for both speech and language therapist and the patient.

Methods

Virtual individualized aphasia therapy is a platform with dedicated modules for clinician and a patient to enable SMARTER model of intervention and incorporation of psycholinguistic characteristics in task design, monitoring, and controlling the progress. Clinician's module allows to add patients, design tasks, monitor frequency and intensity of practice as well as the progress in performance via dedicated data dashboard and raw data. The patient module contains tasks with easy to navigate UI/UX design interface and encouragement for moving on as well as acknowledgement of their progress and simplified dashboard of personal progress. The security of the recorded data will follow best industry standards for data protection and existing regulation to protect privacy and avoid data breach.

Tasks design

The platform aims to provide a variety of templates for designing various tasks at word and sentence levels (e.g., word/sentence picture matching, discrimination, naming etc.) as well as texts in modalities of comprehension, reading, speaking, and writing. Every task will be created and stored in a library and will be available for reusage or remodification as well as sharing with colleagues and export to excel.
In creating a list of items at word level, the platform will provide psycholinguistic characteristics of frequency, length, semantic category to every item. In selecting the distractors to the target item, it will be possible to define the types of relations.
Once finalized, the task can be added to the patient profile ready for practice.

Procedure of intervention

Every intervention will include phase of assessment and intervention. Assessment will allow to measure reference point in task performance and based on this clinician can select the task for the intervention. During assessment, no feedback will be provided, and all the items will be presented. During therapy, only selected items will be available for practice, and with every next iteration only items responses to which were incorrect will be prioritised. Every task will include familarisation and practice phases.

Data analysis

All the responses will be recorded and available to speech and language therapist in a raw table as well as processed dashboard with key components. In comprehension tasks, the platform will record every response and automatically classify the accuracy by considering the type and the time of response. These responses will be preprocessed and preanalised and report will present key results of descriptive and inferential analysis. The tasks that require motor output will be recorded and available to the clinician for the analysis. However, the usage of AI and deep reinforced learning aims to support and facilitate this analysis in the future.

Discussion and Results

The aim of this project to pilot online individualized therapy of aphasia platform that incorporates cognitive neuropsychological approach to the aphasia therapy and technological advancement

in cloud computing and machine learning. It will allow clinician to design tasks taking manipulating psycholinguistic characteristics and relations between the items, monitor the progress of the patient by observing, frequency, intensity, and accuracy of the responses. For a person with aphasia, it will be an opportunity to practice as much as possible to reach a goal and achieve either generalisation or relearning effect of the intervention.
The alpha version as well as primary results of the piloting will be presented in a poster.

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