Design, construction, acquisition and targeting of resources in the domain of cognitive impairment

Dimitrios Kokkinakis, Kristina Lundholm Fors, Eva Björkner, and Arto Nordlund, University of Gothenburg, Göteborg

Introduction Cognitive and mental deterioration, such as difficulties with memory and language, are typical phenotypes for most neurodegenerative diseases including Alzheimer’s and other dementias. This paper describes the first phase of a project that aims at collecting various types of cognitive data, acquired from human subjects, both with and without cognitive impairments, in order to study relationships among linguistic and extra-linguistic observations. The project’s aim is to identify, extract, process, correlate, evaluate, and disseminate various linguistic phenotypes and measurements and thus contribute with complementary knowledge in early diagnosis, monitor progression, or predict individuals at risk.

Methods Automatic analysis of the acquired data will be used to extract various types of features for training, testing and evaluating automatic machine learning classifiers that could be used to differentiate individuals with mild symptoms of cognitive impairment from healthy, age-matched controls and identify possible indicators for the early detection of mild forms of cognitive impairment. Features will be extracted from audio recordings the verbatim transcription of the audio signal and from eye-tracking measurements.

Results Currently we do not report concrete results since this is work in progress. Nevertheless, features will be extracted from (i) audio recordings: we use the Cookie-theft picture from the “Boston Diagnostic Aphasia Examination” which is often used to elicit speech from people with cognitive impairments and also reading aloud a short text from the “International Reading Speed Texts” collection, (ii) the manually produced verbatim transcription of the audio: during speech transcription, attention is paid to non-speech acoustic events including speech dysfluencies, filled pauses, false-starts, repetitions as well as other non-verbal vocalizations such as laughing, and (iii) from an eye-tracker: while reading, the eye movements of the participants are recorded while interest areas around each word in the text are defined by taking advantage of the fact that there are spaces between each word. The eye-tracking measurements are used for the calculation of fixations, saccades and backtracks.

Discussion We believe that combining data from three modalities could be useful, but at this point we do not provide any clinical evidence underlying these assumption since the analysis and experimentation studies are planned for year 2 of the project (2017). Therefore, at this stage, we only report a snapshot of the current stage of the work. We also intend to repeat the experiments two years after the current acquisition of data in order to assess possible changes at each level of analysis.

Conclusion We present work in progress towards the design and development of multi-modal data resources and measures (features) to be used both for evaluation of classification algorithms to be used for differentiating between people with mild cognitive problems and healthy adults, and also as benchmark data for future research in the area. Evaluation practice is a crucial step towards the development of resources and useful for enhancing progress in the field, therefore we intend to evaluate both the relevance of features, compare various machine learning algorithms and perform correlation analysis with the results of established neuropsychological, memory and cognitive tests.