Automatic detection of naming latency from aphasia patients – using an extended threshold-based method

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Word finding difficulties represent the major symptom in aphasia which can be trained and diagnosed using naming exercises. Existing evaluation tests in German for aphasia are based on subjective assessments. No quantitative evaluation tools exist so far able to objectively identify changes in speech performance in aphasia patients with time. The naming latency, i.e. the time it takes until a patient says the word after showing him an image of an object f. ex. could be a candidate. The aim of the present study was to develop an automatic naming latency detection algorithm and to evaluate its potential as such a quantitative parameter.
Eight aphasia patients were included during an observational study (BASEC-ID: 2019-00083). Audio data were collected from four consecutive evaluations through 20 images of the naming test of the German Aachener Aphasie Test (AAT). In total 272 recordings were available.
Manual determination of the naming latency was performed as a gold standard.
An extended threshold method based on three parameters was implemented to automatically determine the naming latency. The first parameter describes how long the envelope of the speech wave must be over the threshold. The second one tells how long the envelope may fall below the threshold during a word. The third parameter is the value of the threshold itself. To define those three parameters, the Nelder-Mead algorithm (fminsearch function from Matlab®) was selected as an optimization method. With these three optimized parameters, the speech latency of all available patients was measured and statistically compared to the manually determined ones using a two one-sided t-test and the Pearson correlation.
The optimization showed the highest performance with a threshold value of 19.8% of the signal amplitude, a minimal word-length of 105ms and a time under threshold of maximal 417ms. The comparison of the automatically measured naming latency based on these three parameter values with the manually determined ones, showed a variance of -229ms and +323ms with the two one-sided t-test with a 95% confidence interval and a Pearson correlation coefficient of 0.98 with a p-value < 0.01 (2.1*10-192).
The result shows a high correlation between the automatic measured naming latencies using an extended threshold-based method and the manually measured ones. It has the potential to be implemented for automated progress evaluation in aphasia patients during naming exercises performed at home or during naming tests for diagnosis.