Modulation of verbal fluency tasks using a device combining prismatic adaptation and serious games

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Objectives

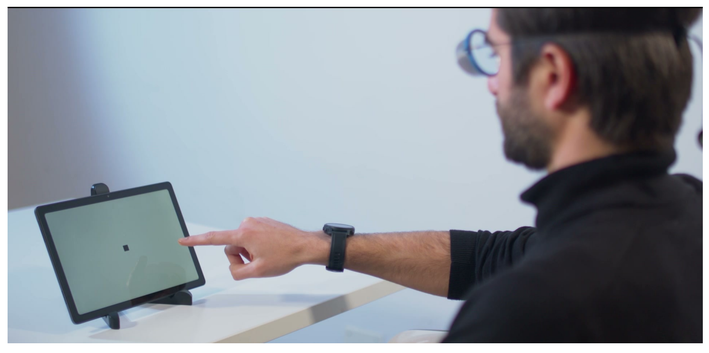
To evaluate the effectiveness of a digital medical device, MindLenses Professional, in modulating verbal fluency functions in mild AD. MindLenses combines digital prismatic adaptation (PA) with serious games targeting attention and executive functions. PA can modulate the activation of the hemisphere ipsilateral to prismatic deviation and boost phonological fluency (1).

Materials and Method

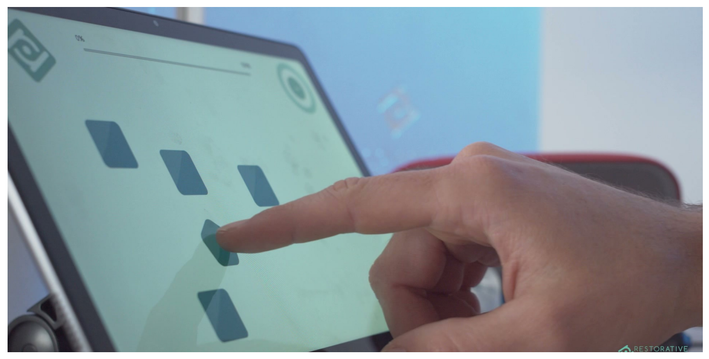
Sixteen patients who met the diagnostic criteria for mild AD (5 women, mean age: 77.1, SD: 7.6 years; mean education: 10, SD: 5.6 years) underwent a baseline neuropsychological investigation using digital tasks assessing phonological and semantic fluency.

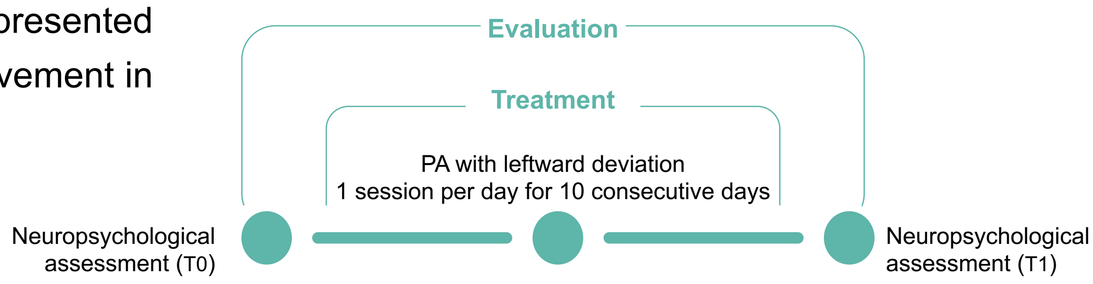
Patients underwent two weeks daily training using MindLenses. In each session, adaptation to leftward PA (20 diopters) was made recording pointing movements to 90 visual stimuli presented on a tablet. Following PA, patients executed seven serious games challenging executive functions and semantic associations. After two weeks the patients were evaluated again with fluency tasks.

Prismatic Adaptation



Serious Games training executive functions

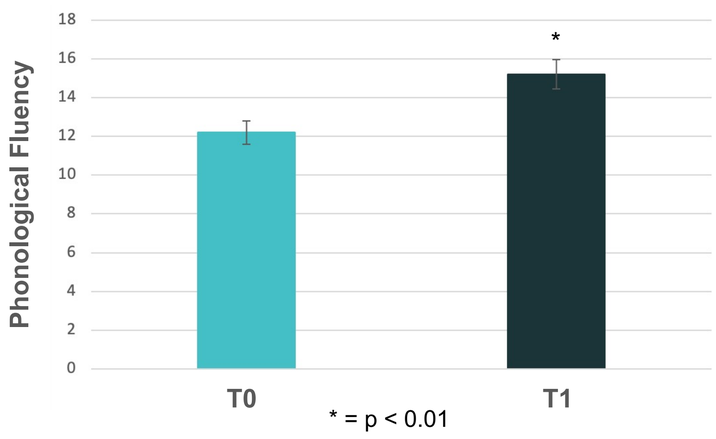


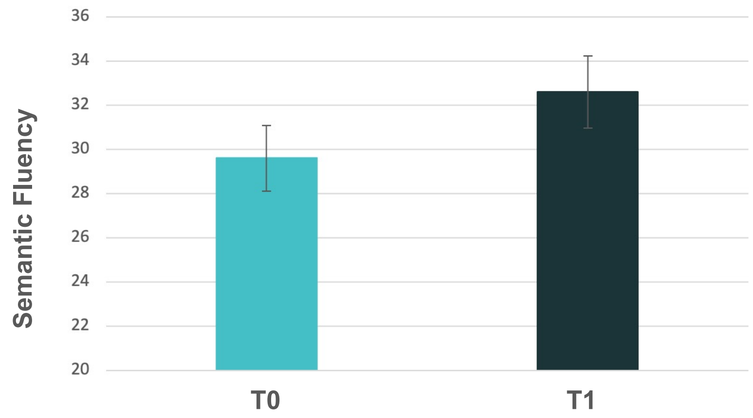


Results

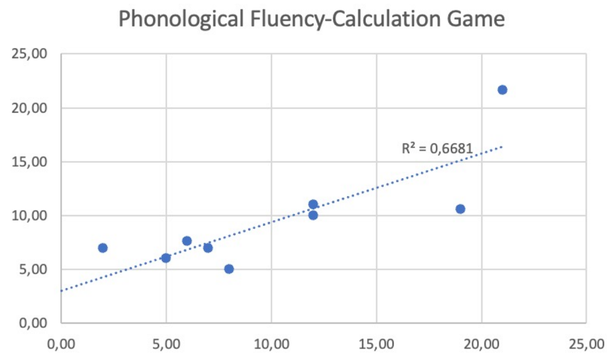
The training improved phonological fluency ($p = 0.006$), while semantic fluency showed a trend towards facilitation ($p = 0.13$). Performance of all serious games showed a progressive improvement of performance across the 10 sessions for all serious games ($p < 0.01$). Both Phonological and Semantic Fluency Tasks correlated with the baseline performance in a game requiring to make simple calculations on a number resulting from the calculation performed on the preceding trial. Semantic Fluency also correlated with the baseline performance of games requiring to make semantic associations or to perceptually discriminate between visually presented stimuli. The rate of improvement in the latter game correlated with the improvement in semantic fluency.

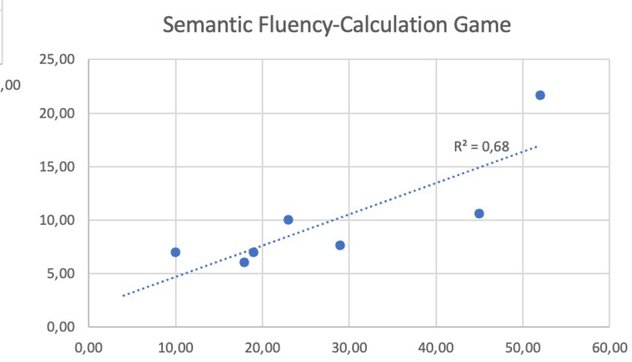
Digital Tasks





Correlation between tests and serious game





Discussion and Conclusions

Results could reflect boosting of activation of left frontal and temporal circuits (1). With regards to serious games, working memory games using arithmetical calculations contribute to improvement in phonological fluency, while games requiring semantic associations on visuospatial material contribute to improvement in semantic fluency.

Recent data explored the role of category and phonological verbal fluency tasks as early cognitive markers of AD (2). This pilot study suggests a new approach for modulation of verbal fluency in AD, that holds promise for its ease of use and time for producing cognitive effects.

References:

1. Turriziani P., et al., Improvement of phonemic fluency following leftward prism adaptation. Sci Rep. 2021;11(1):7313.
2. Marra C., et al., Semantic Memory as an Early Cognitive Marker of Alzheimer's Disease: Role of Category and Phonological Verbal Fluency Tasks. J Alzheimer's Disease, 202; 81(2): 619-627.

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