

# A computer-based training of cognitive functions and its effects on both verbal fluency and mental flexibility of linguistically-competent people aged 70 and above.

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## 1 Background and research question

The natural ageing process can bring about cognitive deficits in older age. This decline is individually varied but affects mainly cognitive performances, such as attention span and/or executive functions.

Restrictions in these mental areas can negatively impact language processing abilities in the sense of so-called

'cognitive dysphasia' [1]. Particularly verbal fluency and cognitive flexibility seem to be very strongly connected [2]. Against this background, the research question asks to what extent a computer-based and preventative training of verbal performance can influence the verbal fluency and cognitive flexibility of elderly people.



figure 1

## 2 Methodology

As part of the exploratory pilot study, four linguistically-competent volunteers aged 70 and above with a cognitive performance profile appropriate to their age, were examined in a pre-post-test-design (see figure 1). The data was collected with the Regensburg verbal fluency test. This test contains exercises for the formal-lexical word fluency as well as for the semantic-categorical verbal fluency, both with and without changes of categories respectively [3]. In the post-test phase, parallel versions of the subtests used in the pre-test phase were utilized. In the computer-based phase of training, participants trained with four language based exercises called 'Password, Eloquence, Dictionary, and Word Craft'. These exercises are part of the NeuroNation exercise training program. During this time, participants independently trained in their

own homes three times a week for 20 minutes per day, for a period of three weeks. Each of the four exercises takes 2 minutes to complete.

In the exercise 'Password' different letters are displayed with which the user has to make up a word. The goal of 'Eloquence' is to add as many words as possible to given first and last letters. 'Dictionary' requires users to come up with different words that are based on a range of given letters.

And the exercise 'Word Craft' includes the quick formation of preferably long words out of given letters. These exercises train both semantic-categorical and formal-lexical dimensions of speech processing (see figures 2 -5).

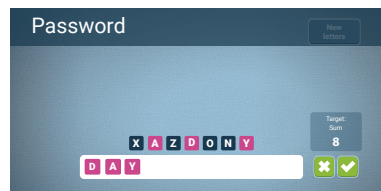


figure 2



figure 3



figure 4

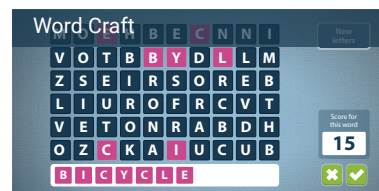


figure 5

## 3 Results

The number of volunteers participating in this pilot study examination was too small for a comprehensive statistical evaluation. Therefore, the results will be presented in a purely descriptive manner.

During the course of training, all participants showed a

specific training effect that resulted from the training material. (see figure 6).

The results of the comparison between pre- and post-test in the Regensburg verbal fluency test are shown in the following four figures.

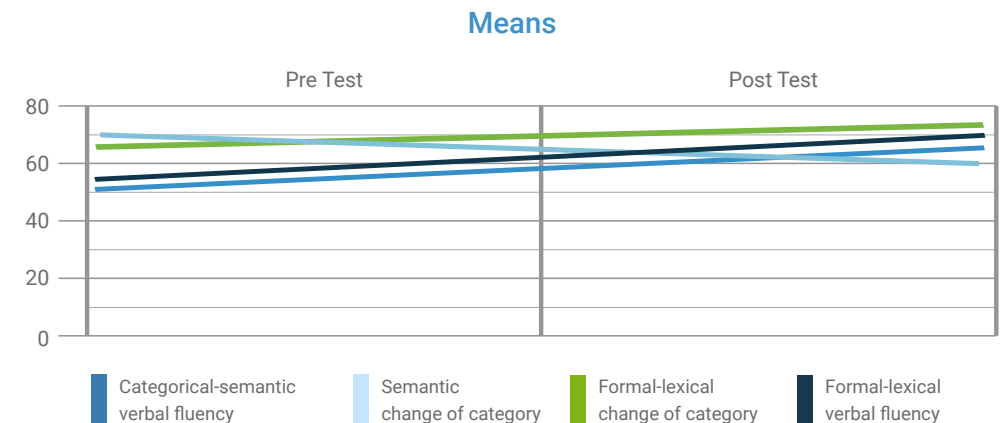


figure 6

## 4 Discussion & Conclusion

All in all, the study gives first indications that computer-based training of verbal fluency can lead to an improvement of verbal fluency in linguistically competent people aged 70 and above. Due to heterogeneous findings, no concrete assertion could be made regarding the efficacy of training for the cognitive flexibility of people aged 70 and above. It is assumed that the reason for this is an underlying bias in the parallel versions of the Regensburg verbal fluency test for pre- and post-test. While in the semantic change of category in the pretest the categories were supposed to be called 'sports-fruits', the parallel version during the post-test used categories of 'clothing-flowers'. Particularly the results in the category 'flowers' showed a significant effect of individual previous experience and a seemingly gender-specific influence on the amount of mentioning in the target category.

Future studies should thus conduct research using a

bigger group of elderly linguistically-competent participants in a RCT-setting to examine whether the training has positive effects on verbal fluency. Regarding the cognitive flexibility that is connected to language, it is essential to replicate the examination of semantic changes of category with an alternative test and not use the Regensburg word fluency test.

[1] Heidler, M.-D. (2006). Kognitive Dysphasien - Differenzialdiagnostik aphasischer und nichtaphasischer zentraler Sprachstörungen sowie therapeutische Konsequenzen. Frankfurt on the Main: Peter Lang GmbH- Europäischer Verlag der Wissenschaften.

[2] Seiferth, N.Y. & Thienel, R. (2013). Exekutive Funktionen. In F. Schneider & G.R. Fink (Hrsg.), Funktionelle MRT in Psychiatrie und Neurologie (S. 359-374). Berlin: Springer-Verlag.

[3] Aschenbrenner, S., Tucha, O. & Lange, K. W. (2000). Regensburg Wortflüssigkeits-Test (RWT). Göttingen: Hogrefe Verlag für Psychologie.