Training Working Memory of Children with and without Dyslexia

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In this study, a software application for elementary school-age children was specifically developed with the aim of improving the operational efficiency of working memory. Short-term effects of the programme could not be proven and only the visuo-spatial Corsi block span exhibited a training effect over a period of three months.

Authors: Claudia Maehler, Christina Joerns, & Kirsten Schuchardt

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A software application for elementary school-age children was specifically developed for this study, with the aim of improving the operational efficiency of working memory. The phonological loop, the visuo-spatial sketchpad, and the central executive were trained in 18 sessions over a period of 6 weeks. The trained test group was composed of Grade 3 students, of which 43 were and 27 were not affected by dyslexia. The untrained control group comprised 41 Grade 6 students with dyslexia and 28 without dyslexia. Short-term effects of the programme could not be proven and only the

visuo-spatial Corsi block span exhibited a training effect over a period of three months.

- Reading problems become evident from the start of a child’s school career, manifesting as difficulties in reciting the alphabet or through delayed (or incorrect) character recognition.
- While affected children improve overall in their literary language performances, they continually lag behind compared to unimpaired fellow students.
- It is no longer controversial that dyslexia constitutes a phonological information processing disorder.
- Dyslexia is accompanied by working memory deficits, particularly in the phonological loop.

Three subsystems of working memory and tasks with which they can be measured

- **A central executive** is often measured by complex span tasks, such as remembering information and recalling it backwards.
- **A phonological loop** is usually measured via a serial reproduction of verbal information (such as word span)
- **A visuo-spatial sketchpad** is typically measured by recalling pictures devoid of content or spatial positions.

The study

The present study evaluates the long-term effects of a training programme. The short-term effects immediately following training sessions have already been reported. The

findings substantiate performance improvements in the visuo-spatial sketchpad and central executive subsystems for the group of typically-developing third-grade students, and only in the central executive for the children with dyslexia.

Research questions:

- Can training effects be maintained over a longer period or could they occur after a certain period of time?
- Can dyslexic children with notably poor working memory performance benefit from the training (show a long-term effect) with regard to their working memory performance?

Participants

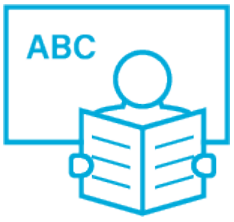
Participants in the study were 139 Grade 3 students from both rural and urban areas. They were assigned to four groups according to whether they had dyslexia and whether they participated in training. The groups were dyslexia trained (n = 43), dyslexia untrained (n = 41), control group trained (n = 27), and control group untrained (n = 28). All children were examined within a pre-test, post-test, and follow-up design, while school performance, intelligence, and working memory capacity were assessed at pre-test and working memory performance was tested at follow-up.

Training

A computer game training-method named AGENT 8-1-0 comprised of 18 training sessions. Five working memory tasks were assigned in each session: two games for improving the phonological loop’s capacity, one game for the visuo-spatial sketchpad, and two games for stimulation of the central executive.

Findings

- Significant differences between dyslexic and non-dyslexic children appeared in all tasks of the phonological loop and the central executive (except for object span and Corsi block backwards). In contrast, no differences were identified in the visuo-spatial working memory tasks.
- Substantial training effects could not be detected in either the phonological loop or central executive tasks.
- Significant improvements in all groups were only found in the Corsi block task (except for the untrained group with dyslexia).
- Improvements cannot be attributed to the training only, since the untrained control group also made progress.
- No significant triple interaction between initial working memory performance, training, and time of measurement could be detected for the tasks performed.
- No significant training effects could be identified, meaning that children with dyslexia (and especially poor working memory performance) do not benefit more from training compared to children with dyslexia who have an initially higher performance.



Summary

- Neither dyslexia-unaffected nor affected children experienced long-term improvement in working memory performance—only the visuo-spatial Corsi block yielded substantial training results.
- For children with dyslexia, and especially

disadvantageous initial working memory performance regarding the three subsystems of working memory, no performance increase through training could be determined.

- Very intensive practice (tri-weekly sessions of 45 minutes over a course of 6 weeks) does not enable the children to process and memorise greater quantities of information over a longer period.
- Within the present controversy over the trainability of working memory, the results seem to support the sceptics regarding the efficacy of such endeavors.
- If increases in capacity through memory expansion or improved automatic processing appear to be impossible, an intervention must focus on the remaining determinants of memory capacity (especially on memory strategies and meta-memory).
- For children with dyslexia, the recommendation of a functional exercise treatment for reading and writing remains valid. Specifically, this should include applied strategies and self-monitoring of the individual reading and writing processes.