Cogmed Working Memory Training

An evidence-based treatment for ADHD and other disorders of working memory capacity

Extensive independently funded, clinical and basic science research
Controlled, randomized studies
Published in highly respected peer reviewed journals
Independently validated

Research overview is organized into three sections:

- Research Overview (links) – Easy to understand summaries of the major clinical studies.
- Klingberg Group Research (PDF's) – Articles from original research group. Includes publications in *Science* and *Nature Neuroscience.*
- Research at Independent Institutions (links) – Links to

Research Overview

Review of Research on Cogmed Working Memory Training

Below is a brief summary of working memory training studies that have been presented at scientific meetings or published in peer-reviewed journals. The studies are arranged in chronological order and unless otherwise noted, incorporate the working memory training program developed by Dr. Klingberg.

Links to more extensive summaries of the different studies are included where available.

2002
Title – Training of working memory in children with ADHD
Journal – Journal of Clinical and Experimental Neuropsychology

This was the first published research on working memory training and included separate small sample studies of children with ADHD and healthy adults. A randomized-controlled design was used. Results indicated improvements on non-trained tasks of working memory as well as on several other neuropsychological tests. The study is important in that it is the first indication that working memory capacity can be increased with training. Limitations include the small sample size, the lack of behavioral measures, and no longer-term follow-up.

2004
Title – Increased prefrontal and parietal brain activity after training of working memory
Journal – Nature Neuroscience

This was the first study to examine brain changes following working memory training. Separate small sample studies of 3 and 8 healthy adults were reported. Using FMRI scans, the researchers documented that behavioral changes following working memory training are associated with changes in brain activity in areas critical for working memory performance. Although the small samples highlight the need for replication, the findings are important in that they provide the first demonstration of changes in brain activity following working memory training.

2005
Title – Computerized training of working memory in children with ADHD – A randomized, controlled, trial
Journal – Journal of the American Academy of Child and Adolescent Psychiatry

This was a randomized-controlled study of working memory training in 53 children diagnosed with ADHD, i.e., a replication of the 2002 study with a substantially larger sample. Results indicated significant gains in non-trained measures of working memory, non-verbal reasoning, and response inhibition. In addition, significant reductions in parent ratings of ADHD symptoms were found, although comparable reductions in teacher ratings were not evident. Gains evident immediately after the training ended were largely intact 3-months later.

2007
Title – Working Memory Training for Early Adolescents with ADHD
Conference – Society for Research in Child Development

This study examined working memory training in 12 12-14 year-old adolescents with ADHD, all of whom were being treated with medication. Results indicated significant gains in non-trained measures of working memory and on a measure of fluid intelligence. In addition, significant reductions in parent ratings of ADHD symptoms were found. The benefits reported were above and beyond whatever benefits were already provided by medication. Changes in teacher ratings approached, but did not fully reach, statistical significance. Limitations of the study include the small sample and the absence of a control group. It is important, however, because it was conducted by researchers from Notre Dame University with no connection to Dr. Klingberg's lab or to Cogmed.

Title – Computerized Working Memory Training After Stroke – A Pilot Study
Journal – Brain Injury

This study examined the impact of working memory training in 18 adult stroke victims who were randomly assigned to working memory training or a no treatment control condition. Training was found to yield significant improvement on non-trained measure of working memory and on attention. Furthermore, participants reported significant improvement in their daily functioning. The study is important because it suggests a potential role of working memory training in the rehabilitation of stroke victims.

Title – Training and transfer effects of executive functions in preschool children
Journal – Developmental Science

This study examined the impact of working memory training in 63 typically developing 4-5 year-old children. Participants were randomly assigned to working memory training or to a video game condition that controlled for simply working on a computer. Results indicated that working memory training yielded significant benefits in non-trained measures of working memory and on attention. Behavioral ratings were not collected, which is a study limitation. The study is important in that it suggests that working memory training may enhance working memory and attention in young children, functions that are critically important for academic success.

Title – Changes in Cortical Activity After Training of Working Memory – a Single-subject Analysis
Journal – Physiology and Behavior

This was a second study examining changes in brain activity after working memory training. Participants were 3 young healthy adults who completed the standard 5-week training program. Brain activity was measured using FMRI before and after training when subjects performed a working memory task and a comparison task that did not require working memory. Subjects showed increased working memory capacity following training and working memory -related brain activity was significantly increased in the middle and inferior frontal gyrus. Although this was a small sample study – not uncommon in FMRI research – it is important because it is the second demonstration of changes in brain activity following working memory training.

2008
Title – A randomized controlled of two forms of computerized working memory training in ADHD
Conference – Annual Meeting of the American Psychiatric Association

This study was conducted by NYU researchers who have no affiliation with Cogmed. They compared the impact of visuo-spatial working memory training to verbal working memory training in 53 children participating in an intensive summer treatment program for ADHD. Results indicated that visuo-spatial training yield greater gains on several non-trained measures of working memory. Furthermore, behavior ratings made by blind observers indicated that visuo-spatial training resulted in significant behavioral improvements. The study is important because it documents an impact of working memory training on children's behavior and suggests that visuo-spatial training is likely to produce greater working memory and behavioral benefits than verbal working memory training.

Title – Computerized training of Working Memory – A controlled, randomized trial
Conference – Annual Meeting of the Cognitive Neuroscience Society

This study examined the impact of working memory training in 55 younger (20-30 year old) and older (60-70 year old) adults in a randomized controlled trial. Results indicated that both groups of adults receiving training showed significant gains in non-trained measures of working memory; gains tended to be somewhat larger in the younger group. Especially noteworthy is that participants who received active training reported improvements in their daily cognitive functioning. Data collected three months after training had been completed indicated that these gains tended to be maintained. The findings are important in that they provide the first demonstration that Cogmed training can enhance working memory and daily cognitive functioning in healthy adults.

Title – Improving fluid intelligence with training on working memory
Journal – Proceedings of the National Academy of Sciences

This study examined the impact of working memory training on fluid intelligence in healthy young adults. The working memory training program used was not Cogmed. Results indicated that training produced significant gains in fluid IQ and that the amount of gain was related to the amount of training. The study is important because fluid IQ underlies a variety of complex reasoning tasks, and has long been believed to be a fixed capacity of individuals. Results from this study challenge that view by demonstrating that this fundamental ability can improve with intensive training of working memory.

2009
Title – Changes in Cortical Dopamine D1 Receptor Binding Associated with Cognitive Training
Journal – Science

This study examined brain changes at the receptor cell level following working memory training. Results indicated that training of working memory, which improves working memory capacity, is associated with changes in the density of cortical dopamine D1 receptors. This study is important as it builds on prior research showing brain changes following working memory training and is the first known demonstration that cognitive training alters fundamental aspects of brain biochemistry.

Title – Adaptive training leads to sustained enhancement of poor working memory in children
Journal – Developmental Science

Forty-two children screened for working memory deficits were randomly assigned to high or low intensity training conditions. Children receiving high intensity working memory training (this is the standard training protocol) showed significant gains on several non-trained measures of working memory that remained evident at 6 months. They also showed improved on a 'real world' measure of listening skills. Furthermore, 6 months after training ended significant gains in a measure of math achievement had emerged. The study is important because it was another independent replication of Cogmed training and the first to demonstrate the working memory training can produce gains on a standardized measure of academic achievement.

Title – Working memory deficits can be overcome: Impacts of training and medication on working memory in children with ADHD
Journal – Applied Cognitive Psychology

This study – conducted by researchers with no affiliation to Cogmed – examined the impact of medication treatment and Cogmed Working Memory Training on the working memory performance and IQ of 25 8-11-year old children with ADHD. Children's working memory performance was assessed 4 times – when they were off medication, when they were on medication, after completed 5-weeks of working memory training, and 6 months after training ended. IQ was measured at the first 3 time points. Results indicated that medication treatment improved performance on visuo-spatial WM, but not on verbal short-term memory, visuo-spatial short-term memory, or verbal working memory. In contrast, working memory training led to significant gains on all 4 memory tasks and moved children's performance into the average range. No impact on IQ was found for either intervention. Follow-up data collected 6 months later indicated that training gains in working memory had persisted. The study is important because it demonstrates that working memory training leads to gains in this key function beyond any provided by medication and that these gains persist after training has ended.

Summary – As is clear from the above research summaries, Cogmed training has been shown to yield significant benefits in a number of studies. No other cognitive training program has been investigated in multiple randomized-controlled trials which include several by independent researchers who have no affiliation with Cogmed. In addition, the research base on Cogmed training is growing as studies conducted by a number of independent research labs are currently underway.

Klingberg Group Research

Karolinska Institutet

Publications

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Research at Independent Institutions

Click through the links below to see the published, presented, and ongoing studies about Cogmed Working Memory Training – as well as related studies – by the name of the Institution that conducted the research.

Duke University Pediatric cancer survivors and WM training

Harvard University - Computer Training of Working Memory for Children with ADHD: A School-Based Feasibility Pilot Study

Indiana University - Feasibility and efficacy of working memory training in children with cochlear implants

New York University - A randomized controlled of two forms of computerized working memory training in ADHD

Ohio State University - A Controlled Trial of Working Memory Training for Children and Adolescents with ADHD

Queens College, City University of New York - WM training and behavioral interventions

Stanford University – Impact of computerized cognitive training on working memory, fluid intelligence, and science achievement

Temple University - A pilot study of effectiveness of a working memory intervention for improving acquisition of math facts

University Hospital Linköping - Training of WM for adults with acquired brain injury

University of Notre Dame - Working Memory Training for Early Adolescents with ADHD

University of Southampton - Working Memory training to improve academic achievement and reduce anxiety

University of Toronto - Effects of a computerized working memory training program on attention, working memory, and academics in adolescents with severe ADHD/LD

University of York - Adaptive training leads to sustained enhancement of poor working memory in children