

Cogmed Working Memory Training - Testimonials and/or Interviews from Independent Researchers

Dr. Susan Gathercole, University of York

Another researcher who chose to evaluate the training was Dr. Susan Gathercole, a world-renowned expert on working memory and head of the psychology department at York University in England. Her highly regarded research on working memory has shed new light on its importance for academic success, but she admits she was skeptical of training. "For many years I believed it simply wasn't possible to train working memory."

As a result, part of her research efforts had focused on finding ways to reduce demands in the classroom for students with weak working memory. "We thought we had to bring the environment to the child, rather than work on expanding working memory," she says.

But having now completed a thorough investigation of the Cogmed program, her views on this matter have changed. "The impact of the Cogmed training program is actually immense," she says. "We started out from a fairly skeptical basis but our data are very clear: you get major gains with working memory training. In fact, we've found that the majority of these kids go from the deficit range to the average or above average range in working memory capacity."

The results of Gathercole's study on working memory training were published in *Developmental Science* in April 2009.

Bradley Gibson, Ph.D., University of Notre Dame

Memory training and attention deficits: interview with Notre Dame's Bradley Gibson

Professor Bradley Gibson is an Associate Professor in the Department of Psychology at University of Notre Dame, and Director of the Perception and Attention Lab there. He is a cognitive psychologist with research interests in perception, attention, and visual cognition. Gibson's research has been published in a variety of journals, including *Journal of Experimental Psychology*, *Human Perception and Performance*, *Psychological Science*, and *Perception & Psychophysics*.



In 2006 he conducted the first independent replication study based on the Cogmed Working Memory Training program we discussed with Dr. Torkel Klingberg.

A local newspaper introduced some preliminary results of the study *Attention, please: Memory exercises reduce symptoms of ADHD*. Some quotes from the articles:

- "The computer game has been shown to reduce ADHD symptoms in children in experiments conducted in Sweden, where it was developed, and more recently in a Granger school, where it was tested by psychologists from the University of Notre Dame.

- Fifteen students at Discovery Middle School tried RoboMemo during a five-week period in February and March, said lead researcher Brad Gibson
- As a result of that experience, symptoms of inattention and hyperactivity were both reduced, according to reports by teachers and parents, Gibson said.
- Other tests found significant improvement in "working memory", a short-term memory function that's considered key to focusing attention and controlling impulses.
- RoboMemo's effectiveness is not as well established as medications, and it's a lot more work than popping a pill.
- Gibson said Notre Dame's study is considered preliminary because it involved a small number of students. Another limitation is that the study did not have a control group of students receiving a placebo treatment."

We feel fortunate to interview Dr. Gibson today.

Alvaro Fernandez (AF): Dr. Gibson, thanks for being with us. Could you first tell us about your overall research interests?

Dr. Bradley Gibson (BG): Thanks for giving me this opportunity. My primary research interest is Attention and Attentional control: how we prioritize information in order to process it without being overwhelmed by it. This is an executive function that helps each of us manage the tension between the outside environment and our self-directed preferences and goals. This is more complex than it sounds. For example, we must learn how to be focused on one task but be able to pay attention to the overall picture at the same time-you may be aware of Chandler's experiment on inattention blindness.

AF: Yes, we posted about that experiment recently. Let's not talk too much about it, so readers can try it themselves here if they want. Now, tell us about the Attention Lab, we understand it is nicely multi-disciplinary.

BG: It is. We have 5 graduate students, and work together with Prof. Dawn Gondoli, who studies development psychology and socioemotional development. We want to bridge a number of domains to better explain the transition from childhood to adolescence. We are interested in how kids develop cognitive and executive functions. ADD/ ADHD is an extreme case where the normal development trajectory does not apply.

AF: Tell us about ADD/ ADHD and development trajectories.

BG: There is a very insightful study by Walter Mischel on pre-schoolers aged 4 and 5. Some of them had a better ability to control their attention and delay gratification (measured as the capacity not to immediately eat a marshmallow but to wait for a larger posterior reward), and those kids were shown, 14 years later, to be happier, have better overall school grades, score around 200 points higher in the SAT, and, when tested, display better executive functioning overall.

The study showed that there are individual differences at very young ages-and the important implications from this fact. Now, the part that I consider more exciting is that these differences are not fixed. Training is very important: attentional control is one of the last cognitive abilities to develop in normal brain development and, as Prof. Daniel Gopher's research has shown, can be trained at any age. What we are studying is how to help kids that for one

Westerberg et al. (2004)

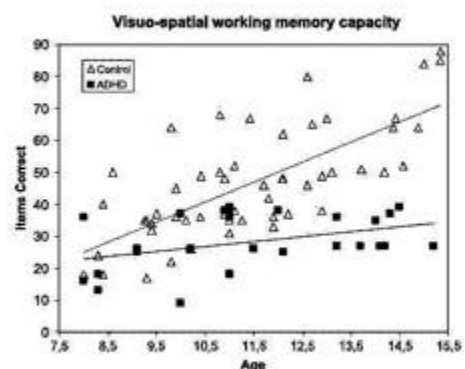


Fig. 1. Working memory scores for all participants in the main study (N = 80). Linear regression lines for ADHD and control group, respectively.

reason or another start from a bad development trajectory get into a more positive one as quickly as possible. This is why we contacted Cogmed to conduct a small replication study of their Working Memory Training program. We wanted to see if we can enhance, accelerate, the development of working memory and executive functioning.

AF: we could see this as a "snowball" effect. If kids are well-equipped to engage in a number of demanding activities, they will, and will only get better at them. If they struggle with them, they will not participate, and not "exercise those muscles" so the gap will only grow. What did the replication study show?

BG: The "snowball" metaphor is a good one. The study we conducted was a small one and we did not have a control group, so it was not as rigorous as the original research conducted by Dr. Klingberg and the Karolinska Institute. However, the results were very positive. Even better than the original results. We saw that Cogmed working memory training led to cognitive improvements-increased verbal working memory and abstract reasoning (measured by Ravens)- and, more importantly, to the reduction in ADHD symptoms as measured both by parent and teacher ratings. The study has been accepted for presentation by the Society for Research in Child Development. I will present the results at their conference in Boston in March.

AF: Please send us the paper when ready. Now, working memory is a very important cognitive ability for all of us. What other applications can you envision for well-designed and structured working memory programs?

BG: I can easily see the relevance in 2 fields. One, professional sports. Two, military training. The Army's Build Better Soldier initiative is very interested in developing resistance and in cognitive enhancements. This would be a natural enhancement, free of secondary and unexpected side-effects of other interventions such as drugs and brain implants. We are right now conducting another study, this one focused on working memory training for healthy college students, to see if the intervention can also be relevant to non-ADD/ ADHD populations and could then be of interest for the Army.

AF: Professor Gibson, many thanks for being with us. You are doing a lot of interesting work, please keep up in the loop.

BG: the pleasure has been mine. I hope to talk to you soon.

David Rabiner, Ph.D., Duke University

Working Memory Training Improves Math & Listening Skills

Disclosure - Attention Research Update receives financial support from Cogmed, the company whose working memory training program was tested in the study summarized below. Although I believe the article reflects an objective account of the findings, you should be aware that this financial relationship has the potential to bias my review of the study.

Working memory (WM) is the capacity to store and manipulate information for brief periods of time. According to researchers at the University of York, "It provides a mental workspace that is used in many important activities in learning...and is a pure measure of a child's learning potential." WM deficits contribute to difficulties with attention and learning for many children with ADHD and individuals with poor WM typically make poor academic progress during the school years. In fact, "...of those children whose WM abilities fall in the bottom 10%, over 80% have substantial problems in either reading or mathematics or, most commonly, in both (Gathercole & Allow, 2008). You can find additional information on Working Memory and its role in learning and attention at

<http://www.york.ac.uk/res/wml/FAQ.htm>

Until recently, WM capacity has been believed to be fixed and it seemed unlikely that the adverse effects of poor WM on learning could be overcome. However, several recent reports indicate that intensive training of WM can enhance WM capacity in many individuals and that this leads to better attention and improvements in daily cognitive functioning. This research has included randomized-controlled trials of WM training for children with ADHD, normally developing preschoolers, adult stroke victims, and healthy younger and older adults. (The study of WM training for children with ADHD is reviewed at www.helpforadd.com/2005/march.htm). In an especially intriguing study, WM training was found to improve fluid intelligence in normal adults - the text of this study can be viewed online at www.pnas.org/content/105/19/6829.full.pdf+html?sid=820a43a6-71cf-4563-b0e2-cd208b1de8ee

The authors of the current study reviewed note that "while these early findings look promising, the educational significance of WM training is as yet untested." In addition, prior studies of school-age children were conducted with children diagnosed with ADHD and did not include youth with poor WM who did not also have ADHD. Thus, the goals of their study [Holmes, J., Gathercole, S.E., & Dunning, D.L. (2009). Adaptive training leads to sustained enhancement of poor working memory in children. *Developmental Science*] was to test whether WM training helps children with documented WM deficits and whether the benefits are sufficient to overcome learning difficulties associated with poor WM.

Participants were 42 eight- to eleven-year-old children attending six schools in the North-East of England who were selected based on scoring in the bottom 15% on a validated test of WM. Children were randomly assigned to one of two conditions - a high intensity (HI) WM training condition and a low intensity (LI) WM training condition that served as the control condition. (Note - Children attending the same school all received the same type of training.)

The HI treatment consisted of performing WM tasks via a computer program developed called Cogmed Working Memory Training. The WM tasks included visuospatial tasks - remembering the position of objects on the screen - as well as verbal tasks - remembering sequences of letters, sounds, and digits. In all cases, children responded to the WM task by clicking on various choices with the computer mouse.

Each training session provided exposure to 115 WM trials and required about 35 minutes to complete; training occurred at school during the regular school day. In the HI condition, the difficulty level of the WM trials was adjusted to match the WM ability of the child on a trial-by-trial basis. For example, if a child successfully recalled three digits in reverse order, on the next trial he had to recall four. When a trial was failed, the next trial was made easier by reducing the number of items to be recalled. By this method of 'adaptive training', children were challenged to work at a level that closely matched their ability and to stretch their WM capacity by presenting more difficult tasks after easier ones were successfully passed.

The LI condition was identical to that described above except that the difficulty of the WM trials remained at a low level throughout, i.e., the number of items children were required to recall never increased beyond two. Thus, these children had the same experience as children in the HI group, i.e., they spent the same amount of time engaging in computerized WM tasks, but they were not challenged to improve. As a result, they were not expected to show the same improvement in WM as children who received HI treatment.

Both groups of children completed a minimum of 20 training sessions spread over five to

seven weeks.

- Measuring the impact of training -

The impact of WM training was assessed in several ways. First, children completed a computerized assessment of WM immediately before and immediately after training was completed using tasks that differed from those on which they trained. Prior research has demonstrated that performance on this WM assessment does not improve the second time it is taken. Therefore, any gains associated with HI training would reflect actual gains in WM rather than mere practice effects.

Standardized measures of IQ and of reading and math were also completed pre- and post training. The reading test was a measure of single word reading which does not place demands on WM in the same way that reading comprehension does. The math test was an assessment of mathematical reasoning, a task for which WM is more important. For students who received HI training, a six-month follow-up was also conducted so that the maintenance of any training related gains could be determined.

Finally, the researchers devised a following directions task that represents a practical assessment of WM that is closely linked to what happens in the classroom. On this task, children listened to an increasingly long set of directions, e.g., "touch the yellow pencil and then put the blue ruler in the red folder..." and then had to perform that designated actions. When they passed a trial, the number of directions to be followed increased on the next trial. The test continued until the child was unable to produce the behaviors in the correct sequence with the number of trials passed to that point serving as each child's score.

- Results -

*** Impact on WM ***

Children completing the HI training showed significant improvements in all aspects of WM - both verbal WM and visuo-spatial WM. The magnitude of their improvement would be considered large by conventional standards, as the effect sizes were greater than 1.0. In contrast, control subjects who received LI training did not make significant gains in either area. Furthermore, 68% of children receiving HI training had WM scores at post-test that fell in the normative range compared to only 25% of children in the LI group.

WM gains for the HI group remained significant at the six-month follow-up. Although the magnitude of the improvements had diminished slightly, the effect sizes remained in a range that is considered large by conventional standards.

*** Listening Test ***

Similar results were obtained on the task that measured children's ability to follow spoken directions. Children in the HI group showed significant improvement at post-test on this task, i.e., they were able to correctly remember a longer string of instructions, while those in the control condition were not. The magnitude of the gains made by HI children would be considered large and remained evident at the six-month follow-up.

*** IQ and Academic Achievement ***

No significant improvements in IQ were found. In addition, no significant gains in reading or math were evident at post-test. However, at the six-month follow-up, children who received HI training showed a significant gain in their mathematical reasoning scores

compared with pre-training baseline levels. The magnitude of this effect would be considered moderate, i.e., an effect size of .49.

- Summary and Implications -

The authors begin their discussion by noting that in a classroom of 30 children, there will typically be four to five who have low WM abilities that hamper their academic progress. They go on to note that their study demonstrates that WM deficits and associated learning difficulties can "...be ameliorated, and possibly even overcome, by intensive training over a relatively short period." In fact, the majority of children completing the intensive training improved their WM substantially and these gains were maintained six months out.

It should be noted that not all outcomes showed improvement following training. Thus, there were no gains in IQ and gains in word reading and mathematics reasoning were not evident immediately after training. The authors suggest the absence of IQ gains indicates that although IQ and WM are related, the contribution of WM to learning is not directly linked to IQ. They note that gains in academic achievement were not anticipated immediately post-training because achievement gains associated with better WM would be expected to take time to develop. Indeed, this was found for children's mathematics reasoning as their achievement scores showed significant improvement six months after training ended. The absence of benefits on the reading measure may reflect the fact that the test used - a basic word reading test - does not depend heavily on WM skills. Had a reading measure that is more WM dependent been used, i.e., a comprehension task, perhaps such gains would have emerged. Of course, this is only speculation and would need to be documented in subsequent work.

Although these are encouraging results, there are limitations of the study that should be noted. First, the sample size - 42 children - is relatively small and replicating these results with a larger sample would be important. Second, six month follow-up data was not collected on children in the control condition, and one cannot be certain that achievement gains would not have also emerged for this group. This seems unlikely given that no improvement in WM was found for control children at the conclusion of training, but cannot be ruled out entirely.

The study would have also been strengthened by the inclusion of teacher ratings of children's behavior and academic performance. In a prior trial of Cogmed WM training in children with ADHD, although significant improvement in parents' ratings of children's inattentive behavior was found, similar gains were not reported by teachers. Thus, it would have been helpful to document whether teachers of children in this study observed them to show better attention and academic performance in the classroom.

Despite these limitations, results from this study add to the research indicating that intensive training of WM can yield important benefits for children and adults who struggle because of WM deficits. A number of additional studies of this new cognitive training approach are currently underway, and will be summarized in future issues of Attention Research Update as they are published.

Dr. Barbara Ingersoll - West Virginia University School of Medicine

Author of:

Attention Deficit Disorder and Learning Disabilities

Your Hyperactive Child

Daredevils and Daydreamers

Distant Drums, Different Drummers: A Guide for Young People With Adhd
Your Hyperactive Child a Parent's Guide to Coping With Attention Deficit Disorder
Lonely, Sad and Angry: How to Help Your Unhappy Child

Dr. Barbara Ingersoll is the clinical director of Memory Plus Clinic in Bethesda, Md. She has authored several major books and articles on ADHD and speaks frequently at conferences around the nation.

To date, Ingersoll has led more than 40 children through Cogmed Working Memory Training. She has offered the training since 2006 and reports that approximately 80 percent of the children she has led through training have seen significant improvements in ADHD symptoms.

“After 35 years of working with ADHD children, I’m thrilled that, at last, we have a training approach that has substantive data to back it up,” says Ingersoll. “The impact on families has been tremendous. Parents are delighted at how rewarding the program is and the youngsters say they feel smarter, their homework is easier, and they get better grades.”

Ingersoll’s career includes both clinical practice and academic appointments. She has taught at West Virginia University School of Medicine for more than 30 years and is currently a clinical associate professor in the university’s Department of Behavioral Medicine and Psychiatry. Ingersoll is also a member of the CHADD Hall of Fame.

The following article is not about an independent researcher but four major US clinics that chose to provide Cogmed training to their patients

Major U.S. Clinics Partner with Cogmed to Provide Computerized Training to Kids, Adults with...

Publication: Business Wire

Date: Monday, November 5 2007

St. John's Mercy Hospital, Centegra Health System, Affinity Health System and Madison Center turn to proven brain training program to help patients suffering from attention problems ranging from ADHD to stroke and brain injury

NAPERVILLE, Ill. -- Cogmed - www.cogmed.com - a developer of working memory training software for children and adults with attention deficits, today announced partnerships with four major Midwestern clinics--St. John's Mercy Hospital in St. Louis; Centegra Health System in McHenry County, Ill.; Affinity Health System in Menasha, Wis.; and Madison Center in South Bend, Ind.

These partnerships add to a growing network of more than 50 U.S. clinics that are offering Cogmed's program to train and improve working memory--a key cognitive function that allows individuals to hold information "online" for short periods of time. Working memory is necessary for countless daily tasks including problem solving, impulse control and focusing attention.

The new Cogmed partners represent significant healthcare providers in the Midwest:

* St. John's Mercy Children's Hospital operates as a "hospital-within-a-hospital" and is located within St. John's Mercy Medical Center, a member of the Sisters of Mercy Health System. It serves the St. Louis, Missouri metropolitan community and provides specialized, child-centered services, including the Child Development Center, a multidisciplinary assessment and treatment center for children and adolescents with neurodevelopmental disorders.

* Centegra Health System serves the greater McHenry County region of northern Illinois with three hospitals, more than 30 locations and 450 Physicians. Centegra is recognized for behavioral health services as well as cardiac care, cancer care, rehabilitation services and occupational health.

* Affinity Health System serves the healthcare needs of the Menasha, Appleton, Oshkosh and Chilton communities in eastern Wisconsin. Affinity boasts more than 200 physicians at its three hospitals and 23 clinics.

* Madison Center in South Bend, Ind. provides a full continuum of behavioral healthcare services to the communities surrounding St. Joseph, Elkhart, LaPorte, Marshall, and Porter Counties in northern Indiana.

"Healthcare clinicians are increasingly turning to working memory training to improve attention and executive function," said Jonas Jendi, CEO of Cogmed. "Having seen such strong results with our specialist partners, Cogmed is proud to be partnering with major clinics and hospitals in the Midwest to allow greater numbers of children and adults with attention problems to overcome these debilitating issues."

Cogmed Working Memory Training is a home-based computerized program backed by peer-reviewed studies published in leading neuroscience journals, including more than 10 studies conducted to date or in progress in Europe and the United States.

About Cogmed

Cogmed has made a breakthrough discovery that individuals can train and improve their working memory, a key function of the brain that allows individuals to store information for brief periods of time. Cogmed Working Memory Training helps people with attention deficits improve focus, impulse control and complex problem solving. Through a combination of software-based working memory exercises and personal coaching, participants engage in a challenging five-week program using an Internet-connected computer at home. More than 80 percent of those who have completed Cogmed's rigorous and rewarding training have demonstrated tangible and lasting improvements. Cogmed's program has been validated by high-impact research in controlled scientific studies at the Karolinska Institute, a world-renowned medical university based in Stockholm, Sweden. A leader in the emerging field of neurotechnology, Cogmed was founded in 2001 and is headquartered in Naperville, Ill. Cogmed's services are provided by a growing network of more than 50 practices around the U.S.

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