Component analysis of verbal versus spatial working memory training in adolescents with ADHD: A randomized, controlled trial

**Institution:** Notre Dame

**Title:** Component analysis of verbal versus spatial working memory training in adolescents with ADHD: A randomized, controlled trial

**Researcher(s):** Gibson BS, Gondoli DM, Johnson AC, Steeger CM, Dobrzenski BA, Morrissey RA

**Program:** Cogmed RM

**Published:** Child Neuropsychology, March 2011

In a 2010 study, Gibson et al. investigated the utility of Unsworth and Engle’s dual-component model (2007) as a theoretical basis for the WM capacity differences in individuals with and without ADHD. Results from Gibson et al. (2010) suggested that maintenance of information in primary memory (PM) was largely intact in ADHD individuals and that secondary memory (SM) was the deficient WM structure in ADHD. Stemming from this 2010 study, Gibson et al. (2011)
questioned whether Cogmed Working Memory Training was effectively training PM or SM or both in ADHD individuals. These researchers proposed that the Cogmed RM program, consisting of simple span tasks, was training only the PM component of working memory. Instead, complex tasks would be necessary to train the SM structure because these exercises force all but the last item of a span to be shifted from PM to SM and thus, the participant would be attempting to extract information from SM during training. Gibson et al. (2011) further reasoned that spatial simple span tasks may function like complex span tasks and may be more appropriate for training the SM component than verbal simple span tasks. Thus, one group of ADHD individuals trained with a spatial task-only version of Cogmed RM and another group of ADHD individuals with a verbal task-only version of Cogmed RM. Gibson et al. (2011) found that when tested with immediate-free-recall tasks after training that there was no significant difference between the verbal and visuospatial Cogmed training groups. Participants in both groups recalled a greater number of items from PM post-intervention but, there was no improvement post-intervention in number of items recalled from SM. Based on these findings, Gibson et al., (2011) concluded that the spatial and verbal exercises in Cogmed are equally effective and that these simple span exercises primarily train the PM component of WM rather than the SM component. These researchers suggested that Cogmed should incorporate complex span tasks so to increase the likeliness that items to-be-remembered are lost from PM and thus, the user must try and extract these items from SM during training.

Published: Child Neuropsychology, March 2011

Working memory training for patients with acquired brain injury: effects in daily life

Institution: Habilitering & Halsa, Stockholm, Sweden

Title: Working memory training for patients with acquired brain injury: effects in daily life

Researcher(s): Johansson, B., & Tornmalm, M.

Program: Cogmed QM

Published: Scandinavian Journal of Occupational Therapy

Overview: Individuals with acquired brain injury struggle with working memory deficits that are commonly experienced as difficulties with multitasking, forgetfulness and distractibility. The aim of this Cogmed training study was to examine whether working memory training, coaching, peer support and education would impact the perceived daily functioning of patients with acquired brain injury.

A sample of 18 adults, mean age 47.5 years, with acquired brain injury (TBI, tumor, and stroke) trained with Cogmed QM in groups of 4 to 6 people for 30 -45 minutes a day, 3 times a week for 7
to 8 weeks. In addition to training, participants also exchanged experiences of working memory deficits for 30 minutes on each training day as well as, learned about the function of working memory in everyday life for 30 minutes on each training day. Researchers collected self-report ratings of cognitive failures (CFQ; Cognitive Failures Questionnaire) and self-report ratings of occupational performance (COPM; Canadian Occupational Performance Measure) pre-, post- and 6 months after training. Participants also kept records of their progress and problems with working memory training in a diary and reported subjective changes in daily functioning in an interview at 6 month follow-up.

**Results:** Following training, all participants improved on the trained working memory tasks. Participants with the lowest baseline training performance showed the greatest improvement during training. Patients self-reported reduced cognitive failures on the CFQ at post-training that were maintained at 6 month follow-up as well as, significant improvements in occupational performance and satisfaction with job performance. Qualitative content analysis of interview data revealed that patients generally had an increased understanding of how working memory deficits impaired their daily life and had increased confidence in their ability to remember where they were and how to return.

**Summary and Implications:** Although this study included a small sample size and lacked a control group, acquired brain injury patients successfully completed training with Cogmed QM and reported improved occupational performance and decreased cognitive failures. Patient’s also described feeling positively about group training and being afforded the opportunity to commune with others struggling with acquired brain injury. Participant revealed that adaptive training more than 3 times per week would not have been feasible, implying that different training schedules for Cogmed should be evaluated in the future. Despite the intense and difficult nature of Cogmed QM, all participants in this study reported that they would recommend the program to others in the same situation.

**Published:** Scandinavian Journal of Occupational Therapy

**Gains in fluid intelligence after training non-verbal reasoning in 4-year-old children: A controlled randomized study**

**Institution:** Karolinska Institute  
**Title:** Gains in fluid intelligence after training non-verbal reasoning in 4-year-old children: A controlled randomized study  
**Researcher(s):** Sissela Bergman Nutley, Stina Söderqvist, Sara Bryde, Lisa B. Thorell, Keith Humphreys, Torkel Klingberg  
**Program:** Cogmed RM
In a double-blind, randomized, controlled study, Bergman-Nutley et al. investigated whether fluid intelligence could be improved by computerized non-verbal reasoning (NVR) training or working memory training. Preschool children were assigned to either: a) visuo-spatial working memory training, b) non-verbal reasoning training, c) combination working memory-NVR training or d) non-adaptive (placebo) combination training. Although only NVR training led to gains in fluid intelligence, working memory training still led to increased working memory capacity in preschoolers.

**Published:** Developmental Science, April 2011

Interventions shown to aid executive function development in children 4 to 12 years old

**Institution:** The University of British Columbia

**Title:** Interventions shown to aid executive function development in children 4 to 12 years old

**Researcher(s):** Diamond, A. Lee, K.

**Program:** Cogmed RM

**Published:** Science, August 2011

**Overview:** In the August 2011 Special Section of Science, Cogmed was featured as the “most researched approach” for improving executive functions in school children 4 to 12 years of age. In evaluating Cogmed, as well as other approaches such as: combination computerized-non computerized training, aerobic exercise, martial arts/mindfulness practice, classroom curricula and add-ons to classroom curricula, researchers came to some main conclusions specifically related to Cogmed:

a. Cogmed training improves working memory
b. Cogmed training has shown transfer to other executive functions but, this transfer is narrow
c. Children with the poorest executive functions benefit most from training programs
d. Executive function training has the potential to impact academic achievement in children
e. Adaptive training is necessary because executive functions must be continually challenged in order to improve
f. A key element to improving executive functions is the child’s motivation, that is, their willingness to devote time to the activity
g. One benefit of computerized training over other approaches is that it can be done at home

Importantly, this review of computerized training in Science parallels Cogmed’s standpoint that adaptive and supported computerized working memory training benefits individuals with working memory constraints, impacts executive functions and influences academic outcomes.

Further, a review of Cogmed in the journal Science and in the context of improving executive functions in school children represents a growing acceptance of Cogmed Working Memory Training within the scientific community.

**Published:** Science, August 2011

Neural correlates of training-related working-memory gains in old age

**Institution:** Karolinska Institute

**Title:** Neural correlates of training-related work-
ing-memory gains in old age

**Researcher(s):** Brehmer Y, Rieckmann A, Bellander M, Westerberg H, Fischer H, Bäckman L

**Program:** Cogmed QM

**Published:** NeuroImage, July 2011

Brehmer and colleagues investigated the relationship between behavioral performance and neural activity in 23 healthy, older adults (60-70 years) following five weeks of Cogmed training. Participants were randomly assigned to either adaptive Cogmed training or a non-adaptive placebo version of Cogmed. Using fMRI, all participants were measured before and after training doing a low difficulty working memory task and a high difficulty working memory task. Both groups evidenced decreased brain activity on the low and high difficulty working memory tasks. Compared to the placebo group, the adaptive training group had significantly larger decreases in memory and attention-related brains regions (frontal, occipital and temporal areas) as well as, subcortical increases when performing the high difficulty working memory task after training. The benefits of training thus unfolded in the context of more difficult working memory challenges as larger decreases in activation imply that the adaptive group needed to invest less neural energy. The adaptive group also improved over the control in measures of working memory, attention and episodic memory.

**Published:** NeuroImage, July 2011

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**Preliminary evidence that allelic variation in the LMX1A gene influences training related working memory improvement**

**Institution:** Karolinska Institute

**Title:** Preliminary evidence that allelic variation in the LMX1A gene influences training related working memory improvement

**Researcher(s):** Bellander M, Brehmer Y, Westerberg H, Karlsson S, Fürtha D, Bergman O, Eriksson E, Bäckman L

**Program:** Cogmed RM

**Published:** Neuropsychologia, July 2011

The LMX1A gene impacts the proliferation, differentiation and maintenance of dopamine producing neurons in the brain. Bellander et al. investigated how individual differences (ie., allelic variations in single nucleotide polymorphisms (SNPs)) in the LMX1A gene influence one’s ability to benefit from working memory training. Twenty-nine younger adults (ages 20 -31 years) underwent genetic testing followed by Cogmed training. Although all of the participants improved in working memory measures post-training, individuals with the TT genotype for the rs4657412 SNP evidenced significantly greater gains in verbal working memory. This study underscores the importance of dopamine and dopamine-related genes in modulating the impacts of working memory training.

**Published:** Neuropsychologia, July 2011