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Cogmed working memory training: Does the evidence support the claims?☆

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A B S T R A C T

Cogmed working memory training is sold as a tool for improving cognitive abilities, such as attention and reasoning. At present, this program is marketed to schools as a means of improving underperforming students' scholastic performance, and is also available at clinical practices as a treatment for ADHD. We review research conducted with Cogmed software and highlight several concerns regarding methodology and replicability of findings. We conclude that the claims made by Cogmed are largely unsubstantiated, and recommend that future research place greater emphasis on developing theoretically motivated accounts of working memory training.

> Today, hundreds of experts in the fields of medicine and psychology are embracing working memory training. They've brought the breakthrough approach into practices and schools around the world and are helping people of all ages succeed in areas of their lives that were once constrained by poor working memory.
> Cogmed (2011e)

> [Working memory] is central to concentration, problem solving, and impulse control. Working memory is closely correlated to fluid intelligence and is a strong indicator of academic and professional success. Poor working memory is the source of many problems related to attention and is often linked to ADHD, and other learning disabilities.
> Cogmed training improves attention, concentration, focus, impulse control, social skills, and complex reasoning skills by substantially and lastingly improving working memory capacity. The goal is improved performance and attentional stamina. Obviously, the results are what really matter.
> Separate entries from Cogmed (2011f) FAQ

Recent years have seen a rise in the popularity of computerized "working memory (WM) training" programs. These interventions are typically sold via the internet with promises of increased IQ (Mindsparke, 2011) and creativity (Lumosity, 2011), improved grades (Jungle Memory, 2011), and reductions in day-to-day lapses of attention (Cogmed, 2011f). The logic behind WM training is spelled out in the above quotations. It begins with an assumption that WM is the driving force behind various abilities such as reasoning, attention, and impulse control. By extension, proper WM function allows people to successfully complete complex academic and professional endeavors. Thus, it is obvious why people would want to train their WM: An intervention that increases WM capacity should benefit day-to-day cognitive function. But do these programs actually work?

The present article focuses on Pearson's Cogmed WM training, which is at the forefront of this industry. Cogmed is not a simple internet-based training program, but is actively marketed to parents and to school systems as a remedy for underachievement (Cogmed, 2011h; Pearson, 2011). Cogmed is also available in clinical practices as therapy for ADHD (cf. Klingberg et al., 2005; Klingberg, Forssberg, & Westerberg, 2002), stroke-related brain damage (cf. Westerberg et al., 2007), and a host of other maladies (Cogmed, 2011c, 2011g). Cogmed's website is neither shy about proclaiming the "evidence based" nature of their product, nor about touting the numerous studies that have employed their product. Indeed, the latter half of this statement is valid. To our knowledge, the number of studies that have trained people using Cogmed software (Table 1) far exceeds those associated with any other commercial WM training program. Moreover, the vast majority of Cogmed studies have been conducted by researchers who have no ties to the company, and thus no incentive for arriving at a particular conclusion. Thus, Cogmed provides an ideal case study for examining the efficacy of commercial working memory training.

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Table 1
Cogmed training studies.

Population studied	Authors	Type of control group	n	Working memory	Reasoning/IQ	Attn control	Sustained Attn	ADHD
Children (ADHD)	Beck et al. (2010)	No-contact	51					**Parent ratings** Teacher ratings
Children (ADHD)	Gibson et al. (2010)	Visuo-spatial vs. verbal training	37					Free recall SM **Parent ratings** **Teacher ratings**
Children (ADHD)	Holmes et al. (2010)	None	25	**SS digit** **SS dot matrix** **SS digit backward** **CS MR X**	WASI verbal WASI performance			
Children (ADHD)	Klingberg et al. (2002)	Non-adaptive	14	**SS visual forward** **SS span board**	**Raven**	**Stroop**		**Motor activity** CRT[d]
Children (ADHD)	Klingberg et al. (2005)	Non-adaptive	44	**SS digit forward** **SS span board**	**Raven**	**Stroop**		Motor activity **Parent ratings** Teacher ratings
Children (ADHD)	Mezzacappa and Buckner (2010)	None	8	**SS digit backward** **SS spatial forward**				**Teacher ratings**
Children (cochlear implants)	Kronenberger, Pisoni, Henning, Colson, and Hazzard (2011)	None	9	**SS digit forward** SS digit backward **SS spatial**				
Children (low birth weight)	Løhaugen et al. (2011)	Typically developing children	30	**SS verbal**[a] **SS spatial**[a]				
Children (low WMC)	Holmes et al. (2009)	Non-adaptive	42	**SS verbal composite** **SS spatial composite** **CS counting recall** **CS spatial composite**	WASI verbal WASI performance WORD WOND			
Children (SEBT)	Roughan and Hadwin (2011)	No-contact	17	**SS composite**	**Raven**[b]		Go/no go	
Children (special education)	Dahlin (2011)	Control group from Klingberg et al. (2005)	57	**SS digit forward** **SS digit backward** **SS span board forward** **SS span board backward**	Raven	Stroop		
Children (Typically developing)	Bergman Nutley et al. (2011)	Non-adaptive	101	**SS visual forward** **CS odd one out** SS word span	Leiter battery Raven – 3 sets Block design			
Children (typically developing)	Shavelson et al. (2008)	Non-adaptive	37	**SS digit span** **SS span board** CS operation span CS reading span	Raven			
Children (typically developing)	Thorell et al. (2009)	Computer games	62	**SS word span** **SS span board**	Block design	Stroop-like	**CPT** **Go/no go**	
Older adults	Brehmer et al. (2012)	Non-adaptive	45	**SS digit** **SS span board**	Raven	Stroop	**PASAT**	
Young adults	Brehmer et al. (2012)	Non-adaptive	55	**SS digit** **SS span board**	Raven	Stroop	**PASAT**	
Young adults	Klingberg et al. (2002)	Children with/ADHD from Exp. 1	4	**SS visual forward** **SS span board**	**Raven**	**Stroop**		
Young adults	McNab et al. (2009)	None	13	**SS digits backward** **SS syllables forward** **SS visual forward** **SS span board**	Ravens – DNR		PASAT – DNR	
Young adults	Olesen et al. (2004) Exp 1	No-contact	3[c]	**SS span board**	**Raven**	**Stroop**		
Young adults	Olesen et al. (2004) Exp 2	No-contact	8[c]	SS span board SS digit span		**Stroop**		
Stroke patients	Westerberg et al. (2007)	No-contact	18	**SS digit span** **SS span board**	Raven	Stroop	**PASAST**	

Note: Bold indicates that the original paper reports significant transfer of this task. When no mention is made of forward/backward this either indicates composite score, or both forward and backward tests were significant; n, number of participants included in posttest; Attn, attention; SS, simple span; CS, complex span; DNR, did not report; SM, secondary memory; CPT, continuous performance task; CRT, choice reaction time.

[a] Relative to baseline scores.
[b] Control group's performance declined.
[c] Trained group only.
[d] Not reported as a measure of ADHD, but included in this column based on separate research.

As highlighted in the opening quotations, the critical information is not the volume of research, but the findings. Although some studies have produced promising results (in particular, Klingberg et al., 2005, 2002), we contend that the overall picture is bleak. In short, many claims made by Cogmed are based on findings that have not replicated, are not readily attributable to increased WM capacity, or simply have not been thoroughly studied. Moreover, the claim that Cogmed actually increases WM capacity has yet to receive careful examination. However, before these issues can be meaningfully explored, we must first develop