Why Cogmed Matters for Traumatic Brain Injury – TBI.
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Agenda

- Why Working Memory, attention and executive functioning (EF) matter for TBI.
  - WM & TBI: Survival, community integration, Quality of life, reduced depression
  - WM Correlates with EF
  - EF & TBI: Obtaining competitive employment, occupational outcomes, and social integration.

- Cogmed Specific Studies & TBI

- Going back to Work:
  Adults with TBI and vocational outcomes.

- Going back to School:
  Children with TBI and the effects upon learning.
1. Why does Working Memory, attention and executive functioning (EF) matter for TBI.
What is Traumatic Brain Injury [TBI]?

Traumatic brain injury (TBI), also known as intracranial injury, occurs when an external force traumatically injures the brain.

TBI can be classified based on severity, mechanism (closed or penetrating head injury), or other features (e.g., occurring in a specific location or over a widespread area).

**Key feature:** TBI can cause a host of physical, cognitive, social, emotional, and behavioral effects.
What is Working Memory [WM]?

Working memory is the ability to keep information in your mind for a short period of time (seconds) and be able to use this information in your thinking.

Key feature: It has a limited capacity that varies greatly between individuals.
What is Executive Functioning [EF]?

Executive functions (also known as cognitive control and supervisory attentional system) is an umbrella term for the management (regulation, control) of cognitive processes, including:

- Working memory
- Reasoning
- Task flexibility,
- Problem solving
- Planning and execution.

**Key feature:** It is often affected by TBI even mild TBI can impair EF
TBI can result in significant long-term negative effects on multiple aspects of life including employment.

- **Reduced working memory** along with age, injury, and lifestyle factors was associated with reduced long-term survival (Himanen, et al., 2011).
  - Age at injury and vocational outcome also correlated with reduced long-term survival (Himanen, et al., 2011).
  - Vocational outcome was associated with age, TBI severity, cognitive impairment, later TBI’s, and alcohol abuse (Himanen, et al., 2011).

- **Better Working Memory predicted** “increased community integration, greater life satisfaction, and lower levels of depression. "
  - General self-efficacy mediated the predictive value of working memory on life satisfaction and depression.” (Wood & Rutterford 2006). This was more than 10 years post TBI. In This study injury severity predicted only decreased life satisfaction.

  - Demographic and cognitive factors may be more predictive of long-term outcomes than injury severity. **These authors emphasize the importance of early social intervention post TBI.** (Wood & Rutterford, 2006).
Adult TBI, WM and EF correlate with Quality of Life  
(Dissertation, DaVanzo, 2009)

- 60 adult survivors of TBI.
- Administered **Quality of Life** after Brain Injury scale.
- “Results revealed moderate correlations between cognitive/linguistic impairment functions of short-term memory and **working memory/executive function** with QOL.”
- A strong correlation between participation and QOL.
Focal lesions in adults with acute mild TBI & neurocognitive outcome

(Lee, et al., 2008)

- Mild adult TBI patients had significantly worse performance on working memory tasks than matched controls at acute (<2 weeks), at 1 month and 1 year post injury.

- Also, CT and 3TMR imaging findings didn’t account for the cognitive impairment which may suggest that new techniques such as “diffusion tensor imaging” may be needed to provide biomarkers for Neurocognitive and functional outcome in mTBI.
Meta-Analytic Review of Neurocognitive Effects of Pediatric TBI
(Babikian and Asarnow, 2009)

28 publications reviewed from 1988-2007. 3 distinct injury severity levels, 3 time intervals for 14 key neurocognitive domains.

Time intervals:
Time 1: 0-5 months, Time 2: 6-23 months, Time 3: 24+ months.

Severity was based upon the Glasgow Coma Scale (GCS) score and often confirmed by clinical findings (such as loss of consciousness, posttraumatic amnesia, and/or positive neuroimaging findings).

Mild (GCS 13-15) Moderate (GCS 9-12) Severe (GCS 3-8)

We will only look at few items here.

Highlights: Intellectual deficits Pediatric TBI (Time 3=long-term > 24 + months)
• Working Memory deficits Pediatric TBI
  − ES (Effect size) Mild (.092), Moderate (.194), Severe (.453)
• Attention deficits Pediatric TBI (long-term 24 + months)
  − ES Mild (< .347), Moderate (.316), Severe (.710)
• Processing speed deficits Pediatric TBI
  − ES Mild (.336), Moderate (.731), Severe (.925)
Long term effects of *Pediatric TBI* with Intra Cranial Pressure (ICP) related to working memory, attention & executive functioning (Slawik, et al., 2009)

- Study of **Severe pediatric TBI** patients:
  - One group had **ICP - intracranial pressure**
  - The other group did not.
  - Both groups had normal IQ’s.
  - **ICP group only showed long-term deficits on “various measures of attention and executive function such as working memory, decision-making, and impulsivity.”**
  - This suggested **ICP lead to “diffuse brain injury”**
  - **Also, measures of attention and EF are sensitive to raised ICP.**
TBI Severity & Impact on Working Memory (WM)

The more severe the injury the more severe the impact on WM. (Levin, et al., 2002; Roncadin, et al., 2004; Ewing-Cobbs et al., 2004; Conklin, et al., 2008).

TBI results in significantly lower VSWM & VWM (Gorman et al., 2012).

Severity of TBI predicts difficulty in producing speech sounds which is predicted by WM and pragmatic inference. (Dennis, et al., 2000)
Other factors affecting TBI long term outcome

- **General Intellectual functioning/Global Cognitive functioning:**
  
  Post-injury relates to ability to return to work with less services – yet not receiving enough services might interfere with a successful transition for those that are more cognitively intact. (Ownsworth & McKenna, 2004; Perna, et al., 2012)

- **Injury Severity**

  Of TBI has been found to be a strong predictor of early TBI recovery (Wood & Rutherford, 2006).

- **Premorbid functioning.**
Family factors affecting Pediatric outcomes of TBI

- Parent psychological distress, perceived family burden, and coping skills affect outcomes (Yeates et al, 2002: J Ped Psych).
- Injury has long-term effects on academic and behavior outcomes but is moderated by family environment (Taylor et al, 2002: Neuropsychology).
- Parent acceptance of injury report lower stress than denial group, active coping increases when stressing the use of humor to decrease stress (Wade et la, 2001: J Clin Cons Psych).
Factors post TBI impacting return to work.

- **Social perception** abilities relate to interpersonal aspects of job functioning and social integration more generally.
  - May need to train on reading social cues and situations.
  - Some authors suggest an early focus upon **social intervention post TBI** (Wood & Rutherford, 2006).

**Addressing attention, memory, working memory and executive deficits can improve workplace outcomes.**

- A significant proportion of TBI patients, including those who are severely injured, are able to return to productive employment if sufficient and appropriate effort is invested (Shames, Treger, Ring, & Giaquinto, 2007).

- **Web-based family interventions after pediatric TBI have been found effective in helping families and improving outcomes** (Wade et al, 2008: J head Trauma Rehab).
Cognitive Effects of Concussions – *Mild* TBI: Memory Problems

**Memory problems:**

This area has the most research supporting it. Many of these effects would be short-term.

- **Working Memory** (Terry, et al, 2012; Levin et al., 2002; Roncadin, et al., 2004; Levin et al., 2004)
- **Delayed memory** (Killam, et al., 2005)
- **Visual/verbal memory** (Matser, et al, 2001; Covassin, et al., 2010)
- **Immediate memory performance** (Chapman, et al., 2006)
- **Memory** (Clark, 2010; Iverson, et al., 2004; Covassin et al, 2008)
One would expect that “returning to learn” might be a challenge after a concussion.

Distractible, forgetful students will find school difficult.

Struggles getting started or completing tasks.

Easily fatigued.

Students may struggle with response speed and need more time to complete work/tests.
2. Cogmed Specific Studies & TBI
46 Cogmed published studies cover range of ages & profiles

Population

Typical

ADHD/Special needs

Westerberg & Klingberg, 2007
McNab et al., 2009
Brehmer et al., 2009; 2011; * 2012
Bellander et al., 2011
Gibson et al., 2012, 2013
Söderqvist et al., 2013
* * Dunning & Holmes, 2014

Brain Injury/Stroke

Westerberg et al., 2007
Lundqvist et al., 2010
Johansson & Tornmalm, 2011
Åkerlund et al., 2013
Björkdahl et al., 2013

Cancer

Developmental/Psychiatric Problems

Low WM and/or Academic Achievement

Adults

* Holmes & Gathercole, 2013 (Trial 1)

Children/Adolescents

* Klingberg et al., 2002,2005
* Holmes et al., 2010
* Gibson et al., 2010, 2013
* Mezzacappa et al., 2010
* Beck et al., 2010
Dahlin, 2011, 2013
* * Green et al., 2012
* Gray et al., 2012
* Egeland et al., 2013
* * Chacko et al., 2013
* Hovik et al.2013
* Gropper et al., 2014
* * van Dongen-Boomsma et al., 2014

Preschoolers

* Kronenberger et al.,2010
* Løhauge et al., 2011
* Roughan & Hadwin, 2011
* Bennett et al., 2013

* Söderqvist et al., 2012
* Grunewaldt et al., 2013
Summary: Why Cogmed matters for Pediatric TBI & concussions (mild TBI)

- Pediatric TBI is often associated with academic difficulties
  - Decline in math skills and then recovery of math skills for children from less stressed families was found (Taylor, et al., 2002).
  - Working Memory (WM) predicts Academic achievement. Cogmed improves WM.

- Outcomes often linked to family functioning – (Taylor, et al., 2002).
  - Cogmed’s coaching structure supports efficient and effective functioning around improving working memory

- Low SES associated with worse outcomes (Taylor et al., 2002).
  - Cogmed’s impact is generally independent of SES

- Cognitive effects of pediatric TBI & Cogmed’s role:
  - **Working memory:** Directly addressed by Cogmed
  - **Executive functioning:** Arguably directly addressed by improving WM with Cogmed given the strong correlation between the two.
  - **Attention/concentration:** Indirectly addressed by Cogmed
  - **Memory:** Indirectly addressed by Cogmed. Some data on episodic memory here.
  - **Processing speed:** Impact unclear by Cogmed
  - **Social Cognition:** Impact unclear by Cogmed, some anecdotal data.
  - **Inhibition** Insufficient data for Cogmed
Summary: Why Cogmed matters for Adult TBI & concussions (mild TBI)

For Adults with TBI reduced WM has been associated with reduced survival.

WM has been associated with community integration, better Quality of life & reduced depression.

WM Correlates with EF. Cogmed improves WM.

Better Executive Functioning in survivors of TBI has been found to be associated with obtaining competitive employment, better occupational outcomes, and social integration.
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.
Cogmed with stroke survivors  
(Westerberg et al., 2007)

Population: Stroke survivors (1-3 years), ages 34 -65 years N = 18 (n = 9 in each treatment and waitlist control groups)

Design: Randomized, Controlled, Test-retest

Inclusion criteria: stroke between 1-3 years ago, stroke documented by PET, MR or CT, age 30-65, daily PC access with internet at home, self-reported deficits in attention.

Exclusion criteria: IQ below 70, motor or perceptual handicap that prevents use of the program, changing Rx during study, Fulfilling criteria for Major depression, known history of abuse of alcohol or illicit drugs.

Treatment group showed statistically significant improvement over control on outcome measures:

1) Non trained visuo-spatial & verbal WM task (Span Board (ES = .83) & Digit Span; WAIS-RNI)
2) WM and Attention (PASAT & RUFF 2&7)
3) Decrease in cognitive symptoms (i.e.. memory problems and attention lapses) (CFQ)

No significant improvements on:
Non verbal reasoning task (Raven's Standard Matrices), response inhibition task (Stroop), learning and declarative memory (Cleason Dahl)

Take Home: More than one year post stroke, Cogmed WM training can improve WM capacity and attention.
Table IV. Mean values and standard deviations (SD) from raw data on the neuropsychological tests and self-rating scale.

<table>
<thead>
<tr>
<th></th>
<th>Pre-training</th>
<th>Post-training</th>
<th>p</th>
<th>ES</th>
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<tbody>
<tr>
<td></td>
<td>Control</td>
<td>Treatment</td>
<td></td>
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<tr>
<td>Self-rating questionnaire</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CFQ total</td>
<td>41.0 (14)</td>
<td>36.9 (10.2)</td>
<td></td>
<td></td>
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<tr>
<td>Neuropsychological tests</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Span board</td>
<td>5.7 (1.4)</td>
<td>5.2 (1.0)</td>
<td></td>
<td></td>
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<tr>
<td>Digit span</td>
<td>5.7 (0.9)</td>
<td>5.8 (1.0)</td>
<td></td>
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<tr>
<td>Stroop time (sec.)</td>
<td>147.0 (54)</td>
<td>108.0 (11)</td>
<td></td>
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<tr>
<td>Stroop raw score</td>
<td>96.5 (3.4)</td>
<td>98.9 (1.6)</td>
<td></td>
<td></td>
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<tr>
<td>Raven (max 18)</td>
<td>15.3 (2.0)</td>
<td>16.0 (1.9)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PASAT</td>
<td>46.4 (9.9)</td>
<td>47.0 (9.9)</td>
<td></td>
<td></td>
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<tr>
<td>Ruff 2&amp;7 (sec.)</td>
<td>115.2 (21.1)</td>
<td>115.4 (21.7)</td>
<td></td>
<td></td>
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<tr>
<td>Word list learning</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>No. of repetitions</td>
<td>6.9 (2.9)</td>
<td>6.3 (2.7)</td>
<td></td>
<td></td>
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<tr>
<td>Delayed recall</td>
<td>5.6 (2.0)</td>
<td>6.0 (1.9)</td>
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</table>

* * *
Cognitive Failures Questionnaire (CFQ)
(Broadbent, Cooper, FitzGerald & Parks, 1982)

The following questions are about minor mistakes which everyone makes from time to time, but some of which happen more often than others. We want to know how often these things have happened to you in the past 6 months. Please circle the appropriate number.

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<table>
<thead>
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<tbody>
<tr>
<td></td>
<td>Very often</td>
<td>Quite often</td>
<td>Occasionally</td>
<td>Very rarely</td>
<td>Never</td>
</tr>
<tr>
<td>1. Do you read something and find you haven’t been thinking about it and must read it again?</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2. Do you find you forget why you went from one part of the house to the other?</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>3. Do you fail to notice signposts on the road?</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>4. Do you find you confuse right and left when giving directions?</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>5. Do you bump into people?</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>6. Do you find you forget whether you’ve turned off a light or a fire or locked the door?</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>7. Do you fail to listen to people’s names when you are meeting them?</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>8. Do you say something and realize afterwards that it might be taken as insulting?</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>9. Do you fail to hear people speaking to you when you are doing something else?</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>
“...The treatment group improved significantly more than the passive control group on the nontrained tests that measured WM and attention...”

Training was found to yield significant improvement on non-trained measure of working memory and on attention.

Participants reported significant improvement in their daily functioning.

The study suggests a potential role of working memory training in the rehabilitation of stroke victims.

Take Home: More than one year post stroke, Cogmed WM training can improve WM capacity and attention.
Cogmed helps heterogeneous group of brain injured adults reduce cognitive failure

(Lundqvist et al., 2010)

Computerized training of working memory in a group of patients suffering from acquired brain injury

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Structured and intense working memory training improves subjects’ cognitive functioning, ratings of occupational performance and ratings of overall health

WM training for acquired brain injury
(Lundqvist et al., 2010)

Population: adults with acquired brain injury, ages 20 -65 years, heterogeneous, ~ 3 years post
N = 21 (n = 10 in treatment group and n = 11 in waitlist control), 10 men, 11 women. Mean age 43.2 years old. Time since injury onset 37 months. Trained with Cogmed QM.

Design: Randomized, Waitlist controlled, Test-retest
T1= baseline, T2 = 4 weeks post training, T3 = 5 month follow up

Treatment group evidenced significant improvements on outcome measures at T2 &T3:
1) WM and attention (PASAT)
2) Complex non-trained visuo-spatial and verbal tasks
   (Block Span Board (ES = .71); WAIS R-NI, Listening Span, Picture Span(T3 only))
3) Verbal inhibition and executive shifting (CWIT; D-KEFS, Stroop)
4) Self reported occupational performance and satisfaction with performance (COPM)
   (WM-related activities)
5) Overall health rating increased 20 weeks after training.
WM training for acquired brain injury  
(Lundqvist et al., 2010)

Table VI. Neuropsychological test results at baseline, 4 and 20 weeks after training.

<table>
<thead>
<tr>
<th>Test</th>
<th>Baseline $M$ (SD) $(n=21)$</th>
<th>Four weeks after training $M$ (SD) $(n=21)$</th>
<th>Wilcoxon signed-rank test, $p$-value</th>
<th>Twenty weeks after training $M$ (SD) $(n=20)$</th>
<th>Wilcoxon signed-rank test, $p$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PASAT (max 60 digits)</td>
<td>37.5 (11.1)</td>
<td>44.5 (11.8)</td>
<td>&lt;0.001</td>
<td>44.55 (12.11)</td>
<td>&lt;0.001 ★</td>
</tr>
<tr>
<td>Listening Span Test (max 54 words)</td>
<td>22 (5.2)</td>
<td>26.1 (5.1)</td>
<td>&lt;0.001</td>
<td>26.85 (5.27)</td>
<td>&lt;0.001 ★</td>
</tr>
<tr>
<td>Picture Span (max 17 spans)</td>
<td>7.8 (2.7)</td>
<td>9.8 (2.5)</td>
<td>0.002</td>
<td>9.7 (2.87)</td>
<td>0.012 (ns)</td>
</tr>
<tr>
<td>Block Span forwards (max 14 spans)</td>
<td>7.1 (1.9)</td>
<td>8.5 (1.4)</td>
<td>0.009 (ns)</td>
<td>8.7 (1.69)</td>
<td>0.002 ★</td>
</tr>
<tr>
<td>Block Span backwards (max 14 spans)</td>
<td>6.8 (1.9)</td>
<td>8.2 (1.6)</td>
<td>0.005</td>
<td>8.75 (1.55)</td>
<td>0.001 ★</td>
</tr>
<tr>
<td>CWIT inhibition/switching (seconds)</td>
<td>76.1 (30.8)</td>
<td>63.7 (25.2)</td>
<td>&lt;0.001</td>
<td>64.55 (26.34)</td>
<td>0.002 ★</td>
</tr>
</tbody>
</table>

Take home: Heterogeneous group of brain injured adults self-report decreased cognitive failures and improved occupational performance and satisfaction. Interviews with and dairy entries of participants support questionnaire outcomes. Users with poorest baseline show most improvement.
Adults with ABI report improved occupational satisfaction after Cogmed training

(Johansson & Tornmalm, 2011)

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

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“Now I dare go for a walk, I think I can find my way back. Now I know why I went from one room to another. I’m less stressed... It’s easier to find things in my bag. It’s a small thing, but important for me...”

WM training for patients with acquired brain injury: Effects in daily life
(Johansson & Tornmalm, 2011)

Population: N = 18 adults with ABI, ages 16-65 years (M=47.5 years), heterogeneous, 1-22 years post-event (M = 7 years)

Design: Test- retest, T1 = baseline, T2 = post-intervention, T3 = 6 month follow up
Those with a lower baseline showed a greater percentage of improvement.
In other words, those more impaired improved the most.

Baseline index correlates positively with percent improvement

Figure 2. Correlation between baseline index and improvement in percentage on training software QM.
Results: Treatment group evidenced improvements at T2 and T3 on:
(T1 = baseline, T2 = post-intervention, T3 = 6 month follow up)

1) **Cognitive Failures Questionnaire (CFQ)** - reduced cognitive problems

2) **Canadian Occupational Performance Measure (COPM) (T2 data)** - improved performance/satisfaction

3) Diary & Semi-structured interview – self awareness - // CQP & COPM

**Take home:** Heterogeneous group of brain injured adults self-report decreased cognitive failures and improved occupational performance and satisfaction. Interviews with and dairy entries of participants support questionnaire outcomes. Users with poorest baseline show most improvement.
Can computerized working memory training improve impaired WM, cognition and psychological health?
(Akerlund, Esbjornsson, Sunerhagen, Bjorkdahl, 2013)

Adults with acquired brain injury in the sub-acute phase after acquired brain injury average age= 47.7 years, n = 47, range= 22-63.

3 stages of treatment for brain injury:
Acute—to stabilize the patient immediately after the injury;
Sub-acute—to rehabilitate and return the patient to the community; and
Chronic—to continue rehabilitation and treat the long-term impairments.

Design: Randomized included all outpatients at the Department of Rehabilitation Medicine, Sahlgrenska University Hospital, Goteborg, Sweden, during March 2008 to December 2010. BOTH GROUPS RECEIVED “rehabilitation in accordance with the normal routines at the clinic, based on their rehabilitation needs.”

Patients included if below normal range on digits forward, digits reversed on WAIS-III; digit span and/or blocks forward and/or blocks reversed on the WAIS-III NI Span board. Exclusion criteria aphasia/non-Swedish communicable or if contra-indicated by MD (i.e. pronounced fatigue, pain or depression). Both groups were well-educated. IG: 3, 1-9 years ed., 8, 9-12 years ed, 14, 12+ years ed., CG 2, 1-9 years ed., 11, 9-12 years ed, 7, 12+ years ed.

No significant differences were found between the Intervention group (IG) and Control Group (CG) regarding gender, age, time since injury, RLS (reaction level scale), educational level, diagnosis...
Can computerized working memory training improve impaired WM, cognition and psychological health? (Akerlund, et al., 2013)

NOTE: For ethical reasons at the conclusion of the 18 weeks those in the CG who wanted to do Cogmed, did. Also, note similarly high levels of education among subjects.
For this purpose the CG was divided into C1 and C2.
C1 were those that did Cogmed. (n=11)
C2 were those that refused to do Cogmed. (n=10)
3. Returning to Work or School post Moderate to Severe TBI
Returning to Work after Moderate to Severe TBI

• Only 29.9% working full-time at time of interview compared to 64% pre-injury (Colantonio, Ratcliff, Chase et al., 2004). Longitudinal study 7-24 years post TBI.
• Return to competitive employment after severe brain injury is related to intellectual functioning both on initial exam (inpatient) and post-acute exam (discharged).

• Return to work:
  • Avg. VIQ (initial) 95-108 (discharge)
  • PIQ (initial) 87-103 (discharge)

Not Return to work:
  • Avg. VIQ (initial) 78-88 (discharge)
  • PIQ initial 68-83 (discharge)

• Significant relationship between activity limits & Residual cognitive impairment at follow up.

• Biggest problem areas – shopping, managing money, and transportation – all correlate with EF:
Children with TBI were disproportionately compromised in **selective learning (SL) efficiency** in contrast to memory span when compared to normally developing children.

Also, the **effect of TBI on performance was demonstrated to take place at the time of encoding**, rather than at retrieval (SL to learn items selected from among others) (Hanten, et al., 2002).

**Encoding** is known to be the time of skill acquisition and to place a larger load upon working memory (Huang-Pollock & Karalunas, 2010).

Language comprehension tasks with **high working memory demands** generally posed the most difficulty for adolescents with traumatic brain injury. (Moran & Gillon, 2004)
Pediatric TBI Impact upon Learning

Post TBI adolescents placed in High WM demand conditions performed poorly on understanding inferences, but not when WM demands were low. (Moran & Gillon, 2005).

Moderate to severe TBI resulted in deficits in phonological loop (PL) and central executive tasks vs. controls in school-aged children. On new learning tasks the TBI group consistently produced fewer words.

Results revealed impaired Phonological Loop function related to poor encoding and acquisition on a new verbal learning task in the TBI group. (Mandalis, et al., 2007)
Pediatric TBI’s Impact upon Learning

Emerging evidence suggests that a traumatic brain injury (TBI) in childhood may disrupt the ability to abstract the central meaning or gist-based memory from connected language (Chapman, et al., 2006).

TBI groups showed decreased performance on a summary production task as well as retrieval of specific content from a long narrative (Chapman, et al., 2006).

WM on n-back tasks was impaired in children with severe TBI, whereas immediate memory performance for recall of a simple word list in both TBI groups was comparable to controls (Chapman, et al., 2006).

Interestingly, working memory, but not simple immediate memory for a word list, was significantly correlated with summarization ability and ability to recall discourse content. (Chapman, et al., 2006)
TBI Impact upon Learning

Adolescents with TBI differed from their non-injured peers in their understanding of proverbs. In addition, working memory capacity influenced performance for all participants. (Moran, et al., 2006) (5,499 in CA system).
Concerned about Learning Trajectories? Working Memory Predicts Achievement

- WM Ages 4-5
  - National Achievement: Spelling, phonological awareness
- WM Ages 11-12
  - National Achievement: Reading, English, Math
- WM Ages 6-7
  - National Achievement: English, Reading, Math
- WM Ages 11-14
  - National Achievement: Math, Science
<table>
<thead>
<tr>
<th>Reading Decoding</th>
<th>Reading Comprehension</th>
<th>Written Language</th>
<th>Math</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phonological STM</td>
<td>Executive WM</td>
<td>Executive WM</td>
<td>Visuospatial WM</td>
</tr>
<tr>
<td>Verbal WM</td>
<td>Verbal WM</td>
<td>Verbal WM</td>
<td>Executive WM</td>
</tr>
<tr>
<td><strong>Executive WM</strong></td>
<td></td>
<td>Phonological STM</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:**

STM = Short-Term Memory
WM = Working Memory
What is Cogmed Working Memory Training™?

1. **Scientific**
   - designed by leading neuroscientists

2. **Adaptive**
   - in real time

3. **Intensive**
   - hard work

4. **Sustained**
   - 25 sessions

5. **Supported**
   - your coach will be there

6. **Targeted**
   - wm only
Cogmed Coaching is Critical.

Coaching Broadly Defined:

- Coaching: Future-oriented toward behavioral change.
- Behavioral.
- Specific.
- Emphases skill development.
- Removing of obstacles that prevent success (e.g. scheduling) Manages motivation...
Working memory training acts on underlying levels

**Skill/behavior**
- Reading comprehension
- Math skills
- Language development
- On-task behavior

**Influences**
- Rate of learning
- Manipulating information
- Remembering Instructions
- Concentration

**Executive function**
- Working memory
- Planning
- Attention
- Task monitoring
- Organizing
Cogmed: Now on IPad.
Cogmed Improvements Salient to TBI: The Cogmed Progress Indicator (CPI)

80% of end-users improve on working memory

78% of end-users improve on following instructions

64% of end-users improve on Math challenge
Results on CPI from 4 countries

n = 1226  n = 346  n = 352  n = 223
Total N = 2147
Improvements on the CPI

Number of CPI tasks improved on:

0 tasks – 3%
1 task – 17%
2 tasks – 35%
3 tasks – 45%
How to interpret CPI data

- The majority of Cogmed users show improvements on at least one CPI task, but it is common that improvements are not seen on all three tasks.

- We recommend that Cogmed coaches explain to the end-user that it is normal to not improve on all tasks and that this does not necessarily reflect poor training performance.
Cogmed Plus: Pediatric & Teen EF Interventions

- A colleague of mine suggested some Executive Functioning training programs.
- Peg Dawson & Richard Guare: Amazon:
  - One is book called **Smart but not Scattered**, by Peg Dawson and Richard Guare. There is a child and teen version on Amazon.
  - **Executive Skills in Children and Adolescents, Second Edition: A Practical Guide to Assessment and Intervention.** Peg Dawson and Richard Guare. Also, **Coaching Students with Executive Skills Deficits**.

- Another such program/book is: **Late, Lost, and Unprepared: A Parents' Guide to Helping Children with Executive Functioning.** By Joyce Cooper-Kahn & Laurie Dietzel. On Amazon.

- Finally, there is a book by George McCloskey: **Assessment and Intervention for Executive Function Difficulties (School-Based Practice in Action)**

- I have not used any of these programs, but both George McCloskey and Peg Dawson/Richard Guare were suggested by my colleague
Apps for Executive Function

- Lauren S. Enders, MA, CCC-S...
Cogmed Plus: Adult EF Interventions

Cognitive-Behavioral Therapy for Adult ADHD: Targeting Executive Dysfunction
Hardcover – March 7, 2011 by Mary V. Solanto (Author) Amazon.

“It describes effective cognitive-behavioral strategies for helping clients improve key time-management, organizational, and planning abilities that are typically impaired in ADHD. Each of the 12 group sessions—which can also be adapted for individual therapy—is reviewed in step-by-step detail. Handy features include quick-reference Leader Notes for therapists, engaging in-session exercises, and reproducible take-home notes and homework assignments. The book also provides essential guidance for conducting clinical evaluations and overcoming treatment roadblocks. The treatment program presented in this book received the Innovative Program of the Year Award from CHADD (Children and Adults with ADHD).”

Mastering Your Adult ADHD: A Cognitive-Behavioral Treatment Program Therapist Guide (Treatments That Work). by Steven A. Safren (Author), Carol A. Perlman (Author), Susan Sprich (Author), Michael W. Otto Used in conjunction with the corresponding client workbook, this therapist guide offers effective treatment strategies that follow an empirically-supported treatment approach. It provides clinicians with effective means of teaching clients skills that have been scientifically tested and shown to help adults cope with ADHD. The step-by-step, session-by-session descriptions are a practical resource for therapists who deliver the treatment to clients with ADHD. Together, the therapist guide and client workbook contain all of the information and materials necessary to delivery this treatment in the context of individual outpatient cognitive behavioral therapy.
Thank you, Any questions?
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