Title: Improving the working memory capacity of children: A comparison of two intervention programmes

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Improving the Working Memory Capacity of Children: A Comparison of two Intervention Programmes

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Baddeley’s model of WM (2001)
Role of WM in Mathematics

- **Storage systems**
  - contribute indirectly to mathematics problem solving (Lee et al., 2004)
  - Less associated with scholastic achievement in 11 and 12 year old children than central executive

- **Central Executive**
  - Longitudinal study (Clark et al., 2010)
  - Functioning at age 4 accounted for substantial variability in mathematical achievement age 6, controlled for IQ and reading ability
  - Of those with poor executive functioning at age 4, 63% were later considered below average in mathematics age 6
  - 1-unit advantage in executive functioning at age 4 was associated with an 8-point advantage on a standardised test of mathematics fluency
• Central Executive
  ▫ Inhibition – implicated in
    • word problems (Marzocchi et al., 2002; Passolunghi et al., 2005) and
    • overall mathematics performance (St Clair-Thompson & Gathercole, 2006),
    • but not computation (Censabella & Noel, 2008)
  ▫ Updating – implicated in
    • computation (van der Sluis et al., 2007),
    • word-problem solving (Passolunghi & Pazzaglia, 2004),
    • overall mathematics performance (St Clair-Thompson & Gathercole, 2006)
  ▫ Shifting – mixed findings
In P5 pupils,

- WM explained 21% of variance in P5 pupils’ performance on algebraic tasks (Lee, Ng, Ng & Lim, 2004)
- WM and Updating accounted for about 25% of variance on performance in algebraic tasks (Lee, Ng & Ng, 2009)
Questions

Can we improve academic performance by improving working memory?

▪ How do Cogmed and Updating-based intervention programmes compare in improving working memory?

▪ Do improvements in working memory result in better mathematical performance?
Design

- 4 Conditions: Cogmed, Updating, Active control, Passive control
- 3 Times: Pre-test, Post-test, Follow-up test (6 months)
Participants

P1 children
- $N = 117$
- Mean age = 83.6 months; $SD = 3.2$ months; Range = 75 – 90 months
- 73 boys & 44 girls
- Identified for Learning Support for Mathematics (LSM)
- With WM deficits (as measured by Animal Updating and Corsi Blocks tasks)
Measures

- Short-term and Working Memory
  - Letter Recall
  - Corsi Blocks
  - Backward Letter Recall
  - Letter Rotation
  - Animal Updating

- Mathematics performance
  - WIAT Math Fluency - Addition and Subtraction
  - WIAT Numerical Operations

- Fluid intelligence
  - Raven’s Coloured Progressive Matrices

- Covariates
  - Language: Bilingual Language Assessment Battery (BLAB)
  - Literacy: Schonell Reading Test
Intervention

• Dosage
  ▫ 25 sessions
  ▫ Length of session
    • Updating/ Active control – 30 minutes
    • Cogmed – 45 minutes
  ▫ Average number of sessions attended
    • Cogmed – 24
    • Updating – 23
    • Active Control – 22
Cogmed
Updating & Active control

Monster Smash Game
Key Findings

• Working memory:
  ▫ 4 conditions comparable at pre-test
  ▫ Significant interaction effects for Corsi Blocks and Backward Letter Recall

• Mathematics performance & fluid intelligence:
  ▫ No significant differences at post-test
Estimated Marginal Means of Backward Letter Recall

- Condition Assigned
- Cogmed
- Updating
- Active Control
- Passive Control

Estimated Marginal Means

- Time
  - 1
  - 2
Preliminary Conclusions

- Cogmed training results in improvement on Corsi Blocks task performance
- Both Cogmed and Updating training result in improvement on Backward Letter Recall task performance
- Updating training results in improvement on Letter Rotation task performance
- Working memory training leads to improvement in working memory capacity
Preliminary Conclusions

However...

- Improvements not translated into gains in mathematical performance in the short term
Further Analysis

- Effects of working memory gains on mathematical performance in the longer term (6 months after intervention)
What’s Next?

• Findings of the follow-up test
• Scaling up of the Updating intervention programme
Thank you

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Letter Rotation

Letters used: F, J, L, P, R
Animal Updating
Raven’s Coloured Progressive Matrices