Computerised cognitive training in older adults: What Works?

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Cognition-oriented treatments

Cognitive Remediaion
- Intervention strategies to mediate deterioration in memory and other cognitive domains
  - Cognitive Stimulation
    - Participation in activities which generally enhance cognitive and social functioning, using non-specific techniques such as discussions or reminiscence
  - Cognitive Training
    - Provides theoretically driven strategies and skills and involves "guided practice" on various tasks reflecting specific cognitive functions
  - Cognitive Rehabilitation
    - Relies on identifying and targeting individual areas of weakness in daily functioning, and implementing strategies to improve or compensate for these difficulties

- Strategy-based:
  - Teach and facilitate practice of techniques to enhance strengths and/or adapt to weaknesses; includes both internal and external strategies
- Computerized:
  - Games and exercises targeting various cognitive functions; usually individually-tailored and incorporates graded difficulty and independent learning
- Internal:
  - Incorporate mental techniques to facilitate cognitive processes; e.g., "chunking" pieces of information to assist encoding
- External:
  - Use practical aides to compensate for weaker cognitive processes; e.g., writing information down to reduce the burden on memory processes

What is cognitive training?

One of the key cognition-oriented treatments, based on:

1. Repeated and well controlled exercises, on
2. Standardised tasks, with an
3. Inherent problem or challenge, that
4. Address specific cognitive domains

Aim is to restore, maintain and optimise general cognitive function

Therapeutic Targets

Cognition
Overall (global) measures
Memory (encoding/retrieval)
Attention
Cognitive control
Social cognition

Community function
Work
Independent living
Driving
Social life

Neural systems
Brain structure
Functional connectivity
Neural system function

CCT: Efficacy Across Populations

- Healthy older adults (k=52)
- Mild cognitive impairment (k=17)
- Parkinson’s disease (k=7)
- Traumatic brain injury (k=14)
- Multiple sclerosis (k=17)
- Schizophrenia (k=38)

Hedges’ g (overall cognition) (k = no. of RCTs)

1. Lampit et al, PLoS Medicine, 2014;11(11), e1001756
5. Lampit et al (under review)
Mild Cognitive Impairment: Within-group effects

Clinical guidelines

Practice guideline update summary: Mild cognitive impairment


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Major recommendations
Clinicians should assess for MCI with validated tools in appropriate scenarios (Level B). Clinicians should evaluate patients with MCI for modifiable risk factors, assess for functional impairment, and assess for and treat behavioral/neuropsychiatric symptoms (Level B). Clinicians should monitor cognitive status of patients with MCI over time (Level B). Cognitively impairing medications should be discontinued where possible and behavioral symptoms treated (Level B). Clinicians may choose not to offer cholinesterase inhibitors (Level B); if offering, they must first discuss lack of evidence (Level A). Clinicians should recommend regular exercise (Level B). Clinicians may recommend cognitive training (Level C). Clinicians should discuss diagnosis, prognosis, long-term planning, and the lack of effective medicine options (Level B), and may discuss biomarker research with patients with MCI and families (Level C).
What determines CCT effects?

1. Training content
2. Supervision
3. Dose
4. Combination with other approaches
1. Training Content

- Computerised cognitive training (CCT)
  - Multidomain
  - Single-domain
    - Working memory
    - Processing speed
    - Reasoning
  - Virtual reality CCT
  - Most clinical work
    - Simultaneous physical and cognitive training ('exergaming')
    - Social cognitive training
  - Videogames
Multidomain CCT

Ideally, training should:
1. Target multiple domains
2. Consider initial abilities
3. Adapt regularly:
   • Difficulty
   • Content
2. Supervision

Adherence to cognitive training in the FINGER trial

Group sessions: ~70% adherence

Individual sessions: ~30% adherence

Based on supplementary data from Ngandu et al. *The Lancet*. 2015;385(9984):2255-2263

Commentary:
2. Supervision

Based on data from Lampit et al *PLoS Medicine*, 2014;11(11), e1001756.

51 RCTs, 4885 participants

![Diagram showing effect on cognition (g) for group-based and home-based supervision. The group-based supervision has a higher effect size (0.3) compared to home-based supervision (0.1), with p<0.01 significance.](image-url)
Computerised training improves cognitive performance in chronic pain: a participant-blinded randomised active-controlled trial with remote supervision

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3. Dose

Effect sizes across 51 RCTs

Based on data from Lampit et al *PLoS Medicine, 2014;11(11), e1001756.*
3. Dosing: The Timecourse of CCT effects

- **Loading Dose**: Peak-finding Dose through Titration
- **Maintenance Dose**: during slow decay phase

- **Therapeutic Effect (Cohen's net d)**
  - **Peak Response after unknown number of sessions**
  - **Rapid gains**
  - **Diminishing returns with further training**
  - **Rapid decay of portion of gains after training ceases**
  - **Slow decay of residual gains**
  - **Some gains may be durable over the long term**

- **Sessions/Time**
  - Training ON
  - Training OFF

4. Combinatory Approaches

Effective combinations of CCT

1. Physical exercise
   Simultaneously but **not** sequentially/serially\(^1\)

2. Neuropsychological and Educational Approach to Remediation (NEAR)\(^2\)

3. Multifaceted cognitive interventions\(^3\)

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