

Seminar Presentation

Long-term Effects of Cognitive Training on Everyday Functional Outcomes in Older Adults

Willis, Sherry L., et al. *Jama* 296.23 (2006) 2805-2814

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Group 7: A Cognitive Training Quiz Application

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Project: A Cognitive Training Quiz Application

- Web application for visuospatial cognitive training and testing
- Based upon an existing pen-and-paper set of exercises and exams.
 - Paper exam designed to be taken with assistance from clinician
- Electronic format allows for accessibility, data collection & interactivity
 - Measure per-question response latency
 - Instant feedback

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Paper Selection

“Long-term Effects of Cognitive Training on Everyday Functional Outcomes in Older Adults”

- First multicenter, randomized controlled trial with an interest in long-term outcomes
 - Also aimed to include much more ethnic diversity than previous studies
- Relevance: background & motivation
 - No previous studies had investigated the effects of cognitive training on everyday function
 - Wanted to see if *preventative* vs. reactionary training had benefits

Background

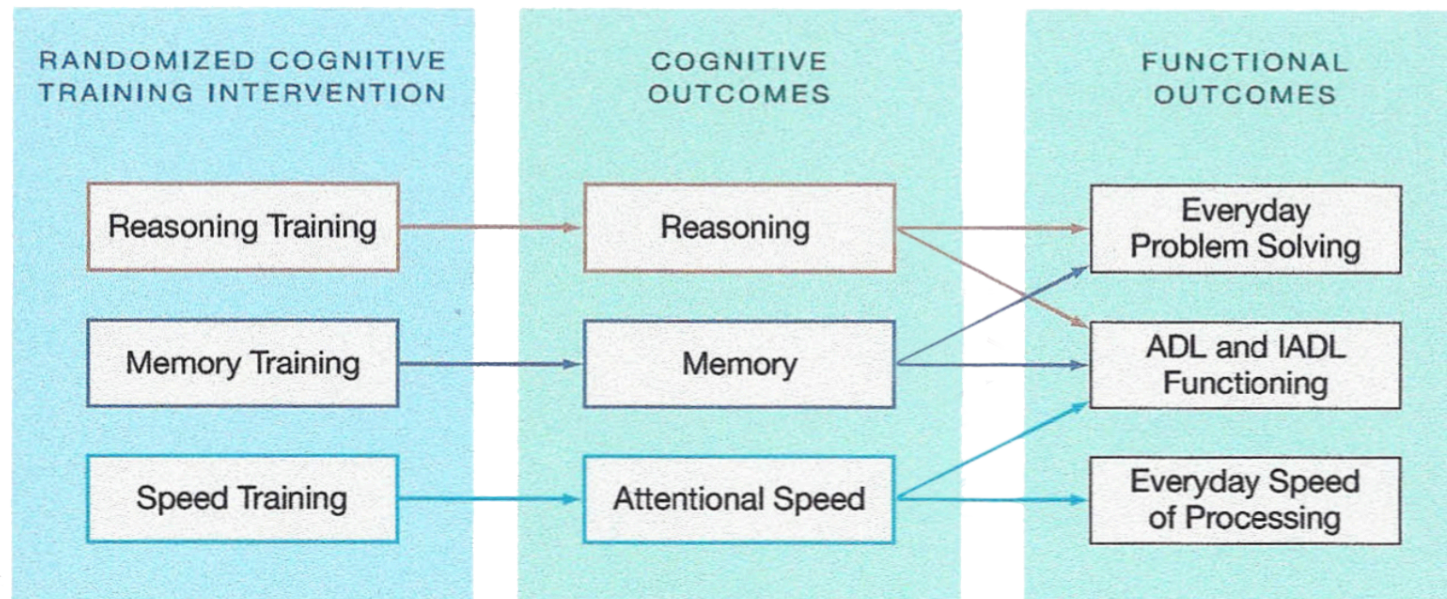
Cognitive Training: “a hypothesis that cognitive abilities can be maintained or improved by exercising the brain, in analogy to the way physical fitness is improved by exercising the body.”¹

- Cognitive training has been shown to improve cognitive abilities in older adults
- Can be training for multiple different cognitive functions: memory, reasoning, speed of processing, etc.

¹ https://en.wikipedia.org/wiki/Cognitive_training

The Approach

- Previous studies focused on reactionary treatment or if cognitive training affected cognitive function.
- Willis et al. wanted to expand this: is there a link between cognitive training and *everyday* function?
- Tested using Instrumental Activities of Daily Living (IADLs)



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INSTRUMENTAL ACTIVITIES OF DAILY LIVING SCALE (IADL)

M.P. Lawton & E.M. Brody

A. Ability to use telephone

1. Operates telephone on own initiative; looks up and dials numbers, etc.
2. Dials a few well-known numbers
3. Answers telephone but does not dial
4. Does not use telephone at all.

B. Shopping

1. Takes care of all shopping needs independently
2. Shops independently for small purchases
3. Needs to be accompanied on any shopping trip.
4. Completely unable to shop.

C. Food Preparation

1. Plans, prepares and serves adequate meals independently
2. Prepares adequate meals if supplied with ingredients
3. Heats, serves and prepares meals or prepares meals but does not maintain adequate diet.
4. Needs to have meals prepared and served.

D. Housekeeping

1. Maintains house alone or with occasional assistance (e.g. "heavy work domestic help")
2. Performs light daily tasks such as dish-washing, bed making
3. Performs light daily tasks but cannot maintain acceptable level of cleanliness.
4. Needs help with all home maintenance tasks.
5. Does not participate in any housekeeping tasks.

E. Laundry

1. Does personal laundry completely
2. Launders small items; rinses stockings, etc.
3. All laundry must be done by others.

F. Mode of Transportation

1. Travels independently on public transportation or drives own car.
2. Arranges own travel via taxi, but does not otherwise use public transportation.
3. Travels on public transportation when accompanied by another.
4. Travel limited to taxi or automobile with assistance of another.
5. Does not travel at all.

G. Responsibility for own medications

1. Is responsible for taking medication in correct dosages at correct time.
2. Takes responsibility if medication is prepared in advance in separate dosage.
3. Is not capable of dispensing own medication.

H. Ability to Handle Finances

1. Manages financial matters independently (budgets, writes checks, pays rent, bills goes to bank), collects and keeps track of income.
2. Manages day-to-day purchases, but needs help with banking, major purchases, etc.
3. Incapable if handling money.

Source:

Lawton, M.P., and Brody, E.M. "Assessment of older people: Self-maintaining and instrumental activities of daily living." *Gerontologist* 9:179-186, (1969).

Participant Selection

- Sample consisted of older adults living independently with good functional and cognitive status
 - Recruited from senior housing, community centers, and hospitals and clinics
 - Birmingham, AL; Detroit, MI; Boston, MA; Baltimore, MD; Indianapolis, IN; State College, PA
- Patients excluded if they were younger than 65, had substantial functional impairment or cognitive decline, or cognitive ailments
- Recruitment of other race and ethnic groups was emphasized
 - Races self-reported as white, black, Asian, Native Hawaiian/Pacific Islander, American Indian/Alaskan Native, or biracial

Study Design

- Participants randomly placed into one of four groups: 3 treatment groups and a control group
 - Treatment groups aligned with the three cognitive functions to be trained
- Assessments conducted at baseline, following the interventions, and annually at 1, 2, 3, and 5 years
- Control group received no training and no placebo social contact

Training Interventions

- Designed to narrowly target a specific cognitive ability
- Memory
 - Teaching mnemonic strategies (organization, visualization, association) for remembering verbal material
- Reasoning
 - Teaching strategies for finding the pattern in a letter or word series and identifying the next item in the series
- Speed of Processing
 - Involved visual search and divided attention

Training Interventions

- Each training intervention was 10 sessions.
 - 10% of the 60- to 75-minute training sessions focused on applying these strategies to solving everyday problems.
 - Eg, mnemonic strategies to remember a grocery list, reasoning strategies to understand the pattern in a bus schedule
- 4-session booster training conducted at 11 and 35 months after the initial training sessions
 - Involved four 75-minute sessions

Outcome Measures

- 2 types: cognitive and functional
- Cognitive outcomes used to assess cognitive training effects
 - Assessed the effects of each intervention on the cognitive ability trained.
 - Memory: Hopkins Verbal Learning Test, Rey Auditory-Verbal Learning Test, and the Rivermead Behavioral Paragraph Recall test.
 - Reasoning: letter series, letter sets, and word series.
 - Speed of Processing: 3 useful field of view subscales.

Outcome Measures: Functional Outcomes

- Moved past cognitive outcomes and assessed whether the cognitive interventions had an effect on daily function
- Mostly comprised of participants' self-ratings of difficulty
 - Difficulty of IADL tasks from the Minimum Data Set – Home Care
 - Ranged from “independent” to “total dependence” on a 6-point scale
- Two performance-based categories of daily function also assessed
 - Everyday problem solving assessed ability to reason and comprehend information in common everyday tasks
 - Hypothesized to be most closely related to reasoning and memory abilities
 - Everyday speed of processing assessed participants' speed in interacting with real-world stimuli and ability to react quickly to 1 of 4 road signs

Outcome Measures: Composite Scores

- Most outcomes assessed by multiple measures
- Each measure was standardized to its baseline values, from which an average of equally weighted standardized scores was calculated
- Net effect of training at year 5:
 - Defined as

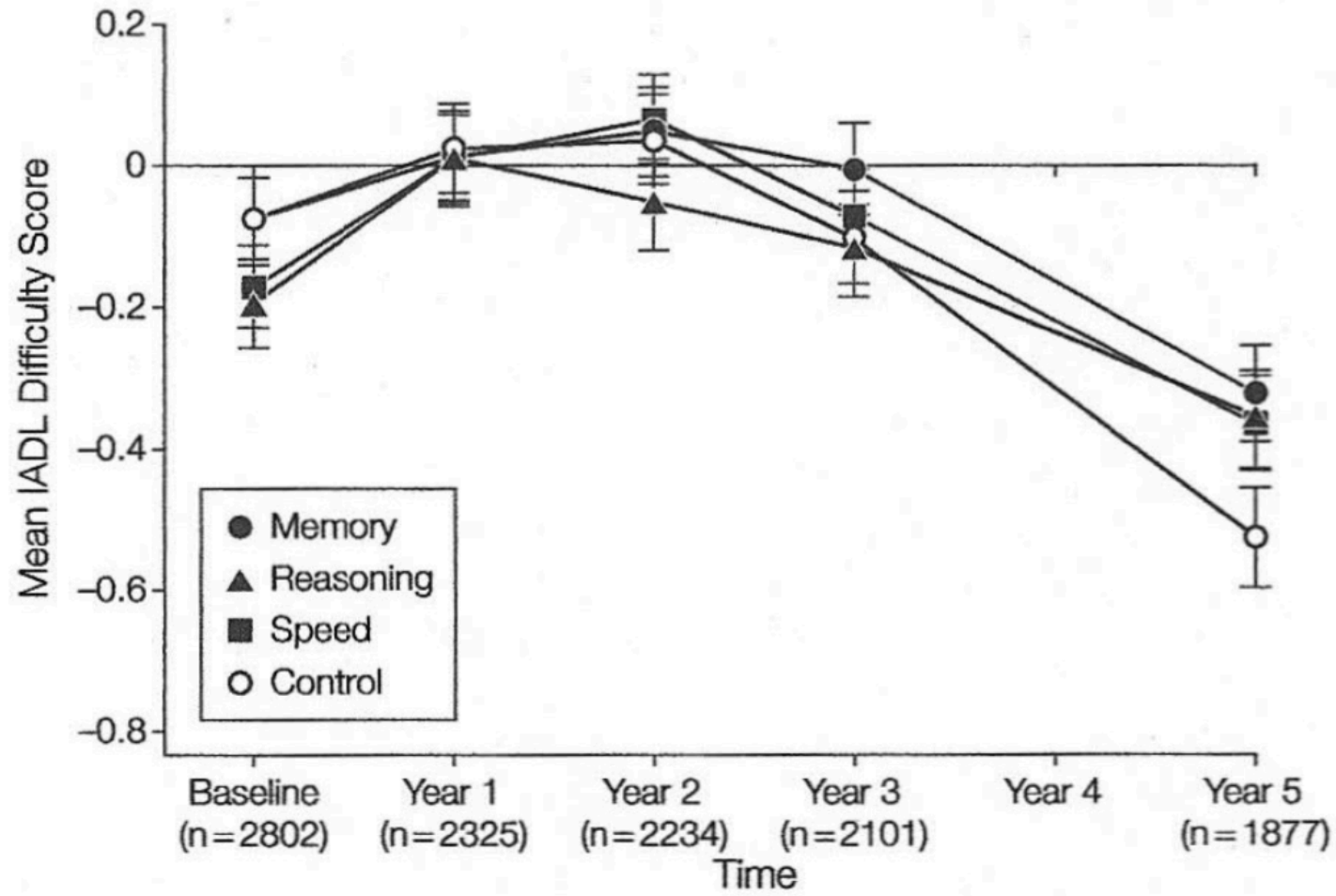
$$\frac{(\text{mean improvement from baseline to year 5})_{\text{intervention}} - (\text{mean improvement from baseline to year 5})_{\text{control}}}{(\text{intrasubject SD of the Blom - transformed score})}$$

- When reporting statistically significant training effects, used 99% confidence intervals (CI's; $p=0.008$) to adjust for multiple comparisons

Summary of Results

- Reasoning training resulted in significantly less difficulty in the IADL than the control group, while neither of the other groups had a significant effect.
 - Reasoning: effect size 0.29, 99% confidence interval, 0.03-0.55
 - Speed of Processing: effect size 0.26, 99% CI, -0.002 to 0.51
 - Memory: effect size 0.20, 99% CI, -0.06 to 0.46
- Booster training only helped for speed of processing
- Each intervention maintained positive effects on its targeted cognitive ability through the 5-year study period
 - Effect sizes: 0.26 (Reasoning), 0.76 (Speed of Processing), 0.23 (Memory)

Summary of Results



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Significance

- Reasoning training resulted in less functional decline in self-reported IADL
- Compared to control, cognitive training resulted in improved cognitive abilities specific to the abilities trained
- Improvements continued 5 years after initial intervention training
- First large-scale, randomized trial that shows that cognitive training improves cognitive function in well-functioning older adults
 - This improvement lasts up to 5 years from the beginning of the intervention

Assessment

Pros

- Very clear about the study's aims, procedures, selection process, and assessment tools
- Statistics were well performed and documented
- Had an obtainable aim that was easily verifiable

Cons

- Using self-reported performances is prone to error and hard to standardize
- Unknown why effects of cognitive training on function was modest and not observed until 5-year follow-up

But How Does This Relate?

- Our application provides cognitive training to patients
 - Can be expanded to all patients, not just those with cognitive deficits
- Cognitive training can have a preventative effect in addition to reactionary
- Next steps: can cognitive training prevent or delay functional disability in an aging population?