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Can executive functions be trained in late adulthood and Mild Cognitive Impairment?

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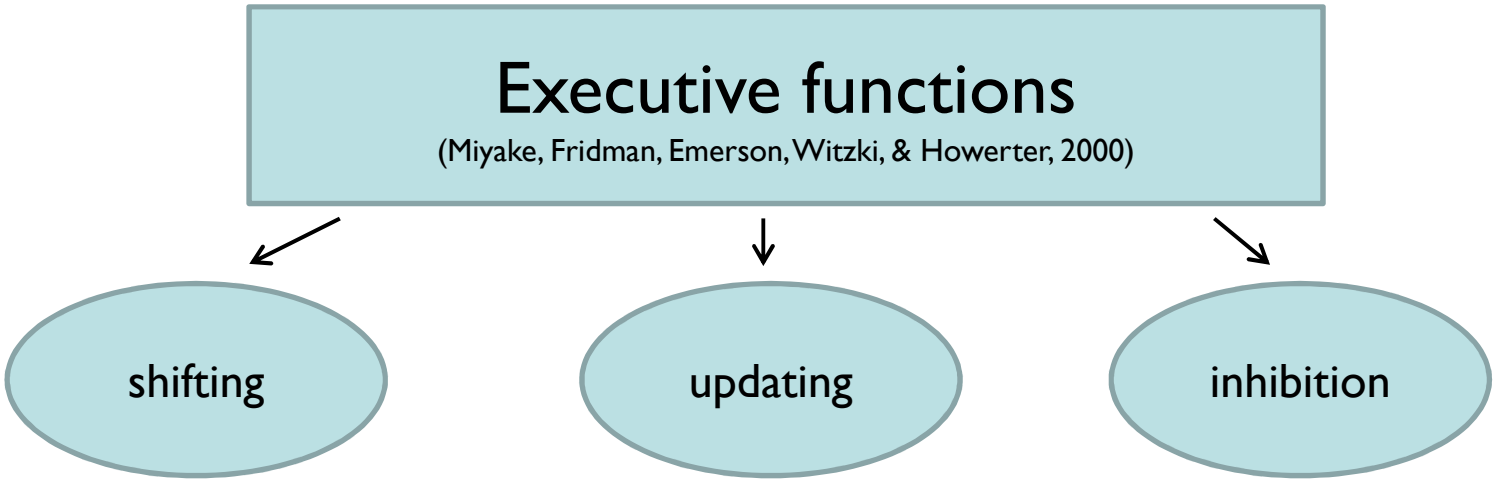
Executive functions

- crucial for learning new information and skills
- refer to goal-directed, flexible use of cognitive abilities, e.g., sustaining, dividing and shifting attention according to task demands, inhibiting inappropriate responses, and solving problems



Executive functions and age

- Substantial age-related changes in executive abilities, with increase during childhood and subsequent decrease in older age, have been observed in previous studies employing various experimental paradigms (Bedard et al., 2002; Cepeda, Kramer, & de Sather, 2001; Kray, Eber, & Karbach, 2008; Kray, Eber, & Lindenberger, 2004; Verhaegen, Marcoen, & Goossens, 1993; Williams, Ponesse, Schachar, Logan, & Tannock, 1999).

Training of executive functions

- There is some evidence showing that both children, young adults and older adults can benefit from executive training and even show transfer to untrained tasks (e.g. Bherer et al., 2005; Dowsett, & Livesey, 2000; Klingberg et al., 2005).
- The effects of executive training and the generalization of these effects are far from clear

Mild Cognitive Impairment

- Persons who do not fulfil the criteria for Alzheimer's disease or dementia, but who show some form of cognitive decline (for review, see Palmer, Fratiglioni, & Winblad, 2003)
- Of particular interest is *amnestic MCI* that refers to subjects with isolated episodic memory impairment (Collie & Maruff, 2000; Petersen et al., 1999; Petersen et al., 2001; Petersen, 2004)→amnestic MCI is the form that most often leads to AD

Episodic and semantic memory

- *Episodic memory* refers to memory for personally experienced and temporally specific events or episodes
- *Semantic memory* refers to a store of knowledge including facts, concepts and word meanings

Research methods and materials

- ***Training of set shifting in late adulthood (Experiment 1)***
- ***Working memory updating in MCI (Experiment 2)***
- ***Strategies as a learning aid in MCI (Experiment 3)***

Training of set shifting

- *Set shifting* refers to the ability to swiftly change between mental representations or response sets
- Recent results have indicated that set shifting training can transfer to other executive domains (Karbach & Kray, 2009).
- **40 older adults** (20 training group/20 control group), training 3 times a week for 2 weeks (each session 30 min)

Training of set shifting

- **3 training tasks**: 1) computerized version similar to the Wisconsin Card Sorting Test (WCST), 2) verbal version of a number-letter task, 3) non-verbal version of the number-letter task
- **Pre/post tests, near transfer:** Trail Making Task B, the Brixton task, CANTAB IDED set-shifting subtest
- **Pre/post tests, far transfer**: Simon task, the N-back task, the spatial N-back task, and neuropsychological tests, as well as a self-report measure on executive functioning
- **"Placebo training"** for control group: matching and categorization tasks with similar stimuli but without the set shifting component
- → depending on results, training of 15 MCI patients with the same paradigm

Working memory updating in MCI

- Working memory updating is a basic executive function that updates and monitors working memory representations (needed in a large number of everyday activities, such as learning)
- Recent research by our Scandinavian research partners has indicated clear cut training gains in this domain in young and elderly adults (Dahlin, Stigsdotter Neely, Larsson, Bäckman, & Nyberg, 2008)→ Therefore, we will employ the training paradigm of Dahlin et al. (2008) on MCI patients.

Working memory updating in MCI

- **30 MCI patients** (15 training group/15 control group), training 3 times a week for 5 weeks
- **"Placebo training"** for control group: computerized vigilance tasks
- **Pre/post tests, near transfer:** the N-back task, the spatial N-back task, and neuropsychological tests
- **Pre/post tests, far transfer:** computerized versions of the the Trail Making Task B, the Brixton task, the CANTAB IDED set-shifting subtest, the number-letter task, and the Simon task. A self-report measure on executive functioning will also be used before and after training

Strategies as learning aid in MCI

- Regarding the effects of executive functions on word learning in MCI patients, we have previously found that the patients' use of self-generated strategies in learning new object names was poorer than that of healthy elderly controls (Grönholm-Nyman et al, 2010), however, semantic support showed a beneficial effect on retrieval of newly learned object names in the MCI group 8 weeks after training, suggesting that the MCI patients' semantic memory can partly compensate for their compromised episodic memory.

Strategies as learning aid in MCI

- Also, in a previous brain imaging study (Grönholm, Rinne, Vorobyev, & Laine, 2007), we found increased activation in the frontal lobe (anterior cingulate) in MCI patients compared with controls when they named newly learned objects, suggesting that the task posed additional executive demands on the patients.

Strategies as learning aid in MCI

- **30 MCI patients** (2 experimental groups, i.e. 15 patients per group), 4-day training period, follow-up 1 week, 4 weeks and 8 weeks after training
- **Similar paradigm as in Grönholm-Nyman et al. (2010)**, i.e. names of 40 unfamiliar objects will be trained with (20 objects) or without (20 objects) semantic support (=object definition). Additionally, one of the patient groups will be aided in actively creating semantic strategies in order to learn the new object names that are presented without semantic support (20 out of 40 object names), and the other group will be aided in actively creating phonological strategies during the training period in order to learn the new object names that are presented without semantic support

Strategies as learning aid in MCI

AARRA

JUNKI

knife used by women

20 object names without definition
→ one patient group will be aided in actively creating *semantic strategies*, the other patient group will be aided in actively creating *phonological strategies*

20 object names + definition (semantic support)

Research partners

- Professor Matti Laine, PhD, Department of Psychology and Logopedics, Åbo Akademi University, Turku, Finland
- Senior Lecturer Mira Karrasch, PhD, Department of Psychology and Logopedics, Åbo Akademi University, Turku, Finland
- Professor Juha Rinne, MD, Turku PET Centre, Turku, Finland
- Professor Heikki Hämäläinen, PhD, University of Turku, Turku, Finland
- Professor Lars Nyberg, PhD, Department of Integrative Medical Biology, Umeå University, Umeå, Sweden
- Senior Lecturer Anna Stigsdotter-Neely, Department of Psychology, Umeå University, Umeå, Sweden
- Professor Lars Bäckman, PhD, Aging Research Center, Karolinska Institute, Stockholm, Sweden

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