Aging and Memory: How to Foster Successful Functioning in Old Age

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Patterns of Cognitive Aging

• Functions that decline: mental tempo, attention, episodic memory

Episodic memory

 Memory for temporally and spatially bound information (e.g., What you had for lunch yesterday; Details from your last vacation)

Recall and Recognition

• Two ways of testing your episodic memory

Free Recall of Words



Laukka et al, Psychol Aging, 2013

Recognition of Words



Laukka et al, Psychol Aging, 2013

Conclusion

Support at episodic memory retrieval is very important in aging

Patterns of Cognitive Aging

- Functions that decline: mental tempo, attention, episodic memory
- Well preserved functions: short-term memory, semantic memory

Short-Term Memory Digit Span 80-89 90+ Age

Laukka et al, Psychol Aging, 2013

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Semantic Memory



Laukka et al, Psychol Aging, 2013

Cognitive Changes in Aging: Biological Origins

1. Grey-matter losses in critical brain regions: frontal cortex, hippocampus

Age-Related Grey-Matter Losses



Raz et al, Cerebr Cortex, 2008

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Cognitive Changes in Aging: Biological Origins

- 1. Grey-matter losses in critical brain regions: frontal cortex, hippocampus
- 2. Age-related changes in white-matter structure

Age-Related White-Matter Losses



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Cognitive Changes in Aging: Biological Origins

- 1. Grey-matter losses in critical brain regions: frontal cortex, hippocampus
- 1. Age-related changes in white-matter structure
- 2. Losses of neurotransmitters: Focus on dopamine

Age-Related DA Losses in Striatum



Bäckman et al, Am J Psychiatr, 2001

Age-Related DA Losses in Frontal Cortex



Suhara et al, *Psychopharmacology*, 1991

Kaasinen et al, Neurobiol Aging, 2001

Individual Differences



Nyberg et al, Trends Cogn Sci, 2012

Individual Differences in Normal Cognitive Aging

- **Demographic factors** (sex, education)
- Life-style factors (physical, mental, and social activities)
- **Biological factors** (vitamin B12, folic acid, blood pressure, depressive symptoms)
- Genetic factors (specific genes: APOE, COMT, BDNF)

The Landscape of Adult Memory Development



Lövdén et al, Psychol Bull, 2010

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Successful Cognitive Aging

Compensation: Origins in lesion studies; used in behavioral research on cognitive aging (e.g., Bäckman, 1984, 1985); very often applied in neuroimaging work on aging and cognition (e.g., Cabeza, 2002; Reuter-Lorenz & Cappell, 2008). A likable concept!

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Brain maintenance: Individual differences in the manifestation of age-related brain changes and pathology allow some people to show little or no age-related cognitive decline (Nyberg et al, 2012)

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- 3. Low amyloid burden in aging is linked to high memory performance (Rentz et al, *Ann Neurol* 2009; Rodrigue et al, *Neurology* 2012)

Training of Cognitive Functions in Aging

 Systematic training of episodic memory and executive functions

Episodic memory training



Training of Cognitive Functions in Aging

• Systematic training of episodic memory and executive functions

• Are improvements maintained over time?

Memory training: 8-month follow-up



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Age differences in degree of improvement after training?

Cognitive and Brain Plasticity



Dahlin et al, *Science*, 2008 Bäckman et al, *Science*, 2011

Cognitive and Brain Plasticity

Striatum



Training gains in scanner



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Dopamine Release After Training



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- 1. Multiple alterations in brain structure and function underlie age-related cognitive deficits
- 1. There are huge individual differences in memory among older adults
- 2. Aging is characterized by a substantial cognitive reserve capacity

Optimally Healthy Older Adults

