



# Cognitive Decline in old age

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# Cognitive Decline in old age



The definition of "normal cognitive aging" includes people who would not meet the criteria for dementia or any of the varieties of "mild cognitive impairment".

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People differ greatly in the degree to which their brains decline with age. Identifying the risk factors for cognitive decline and the mechanisms of individual differences in age-associated cognitive decline is among the greatest challenges to improve the well-being of older people.

# Heritability studies

Using data from twins and families with adopted children - have estimated that the heritability of general cognitive ability is 50%, increasing from childhood to adulthood into old age.



Some studies have shown that heritability decreases in very old age though the contribution of genes to cognitive ability remains above 50%.



It is likely that there are genetic influences on both the lifelong trait of intelligence and specifically on age-associated cognitive decline.

# Cognitive Decline

Biological changes can lead to damage from...

- oxidative stress
- diminished ability to detoxify free radicals
- decline in mitochondrial function
- accumulation of amyloid- $\beta$  peptide and tau protein
- decrease integrity of neuronal membranes
- loss of neurons and synapses
- altered metabolic functions to cell death.

Imaging studies - changes with healthy aging occurs in frontal regions. But – correlated with poor cognitive performance are....

- whole brain- white matter volume,
- prefrontal cortex
- hippocampus
- sub cortical regions (thalamus, putamen, caudate, nucleus accumbens)
- parietal and temporal lobe volume
- ventricular expansion



# Cognitive Decline



These changes may be related to gender.

In men, the frontal and temporal lobes are the most affected.

Whereas in women is the hippocampus and parietal lobes.

The reduction in dopamine and acetylcholine seems to be related with difficulties in planning and small declines in memory, respectively.

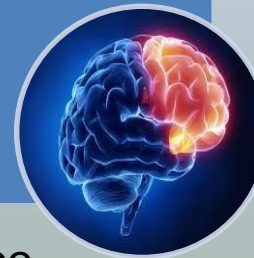
Over time, some cognitive abilities stabilize and other may even increase. The fluid abilities are the most affected cognitive abilities by advancing of age.



# Cognitive Decline

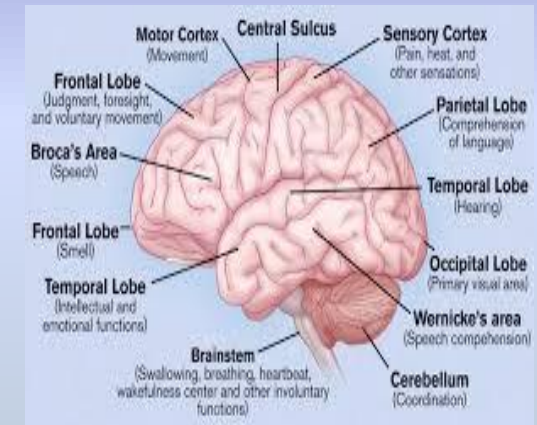
- episodic memory
- attention
- verbal fluency
- processing speed
- explicit memory
- executive functions
- working memory
- Language

Significant changes in cognition can occur in multiple domains



- crystallized intelligence
- emotion regulation
- semantic memory can remain stable throughout the life trajectory or, in some cases, develop with age.

Relatively spared until late in life are knowledge-based verbal abilities and verbal production, implicit memory and autobiographical memory



Another important consideration is that some aspects of cognition remains stable, or even improves, across lifetime

# Cognitive Decline

Education and brain volume are measures of cognitive reserve and predict slower progression to cognitive decline.

In terms of life-course perspective there is a continuum between cognitive deficits, childhood IQ and brain cortical thickness], which may be a predictor of a successful cognitive aging and also reduce the chance of developing vascular dementia.

Education may influence the cognitive trajectory by promoting health consciousness, more physical exercise, better stress management, meaningful social network and mentally-stimulating activities .



# Cognitive Decline



The complexity of brain, neural and cognitive function makes the exact mapping of this cognitive decline extraordinarily difficult.

The etiology of the change, the chronological point when this becomes evident, its magnitude and rate of progression varies with cognitive function and among individuals.

Accordingly, some older adults experience cognitive decline, others perform as well or better than younger adults and the same individual may perform differently in different domains.

Owing to the normal processes of aging, the older adults exhibit more activity in the right hemispheres, the ventral or dorsal prefrontal cortex during memory tasks and the frontal and parietal throughout attention tasks.



# Concerns about memory and ageing

Memory is not as good as it used to be



Difficulty finding, remembering words, names

Senior  
moment

Losing things – not remembering where you put something



# The Aging Brain



As individuals age, their brains shrink.

They gradually lose nerve cells that they had from birth and process information more slowly.

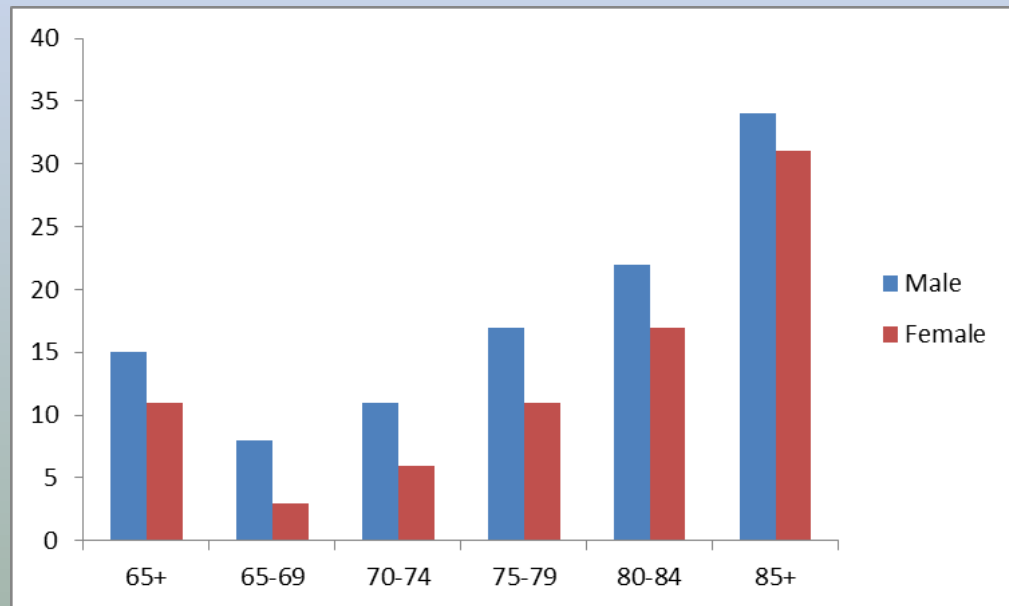
As a consequence, learning new concepts and patterns becomes more difficult.

Memory also begins to fail.

# Memory

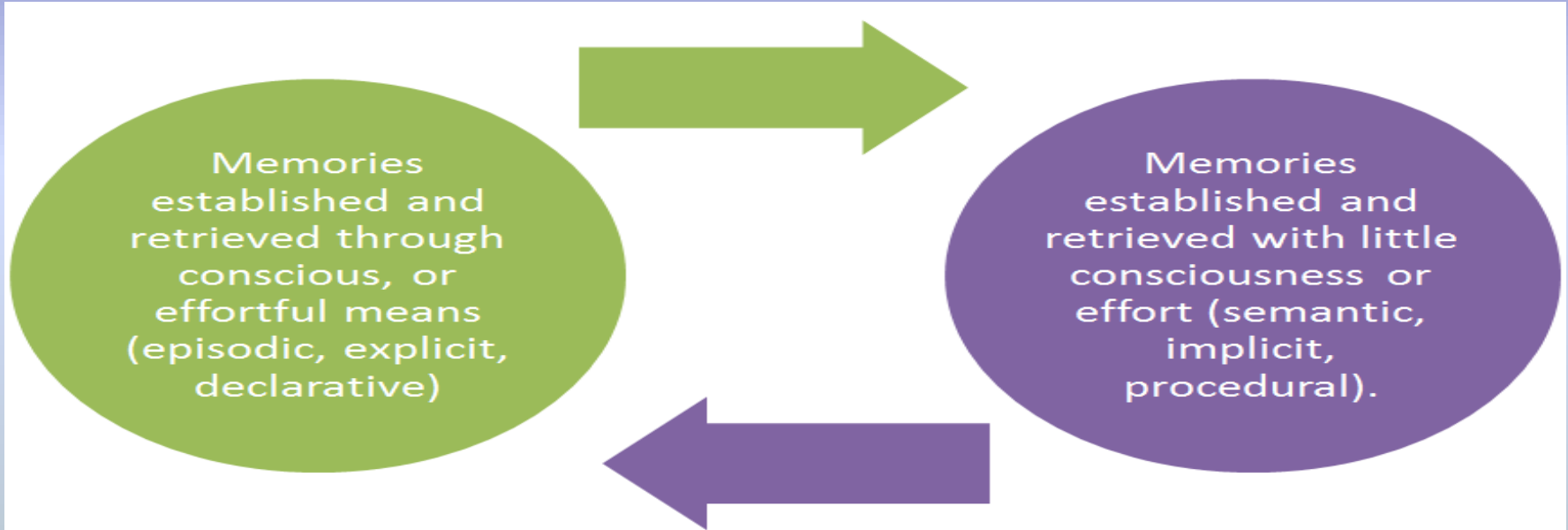
Fewer than 1 in 5 adults over age 65 experiences moderate to severe memory impairment.

Percent with moderate to severe memory impairment



Source: Federal Interagency Forum on Aging-Related Statistics, Older Americans Update 2006: Key Indicators of Well-Being (Washington, DC: Federal Interagency Forum on Aging-Related Statistics, 2006).

# Memory Decline



## Craik (1983) – environmental support hypothesis

- tasks requiring less effortful processing are well preserved with age because performance is supported by elements in the test environment
- e.g., recognition tests provide memory items themselves – no need to generate the item from memory – only assess its familiarity = less work

Effortful memories are more likely to decline than those requiring less effort

# Effortful vs. Effortless Processing



- Myerson and Hale (1990)
  - Decline due to speed of cognitive operations slows with age

Laborious tasks  
have many  
processing  
steps



The more steps the more information is lost

# Memory

## Sensory memory

More fleeting in older adults –but because this store holds information so briefly it is hard to compare younger with older adults (Botwinick, 1984).

## STM

*Working memory* is reduced in older adulthood. The more complex the mental manipulations, the more difficulty older adults will experience.

## LTM

*Procedural memory* – older adults may be slower than younger adults in recovering these memories but, given a little more time, they are just as capable as younger adults.

## LTM

*Semantic memory* – older adults do not differ from younger adults in the content or organisation of linguistic knowledge in their semantic store (Wingfield, 1995).

Although word-finding differs = tip of the tongue experiences (Kemper, 2004).

*Episodic memory* – actions and activities - where we put the keys etc. differs between older and younger adults. Better for motor activities than cognitive activities (Kausler, 1994).

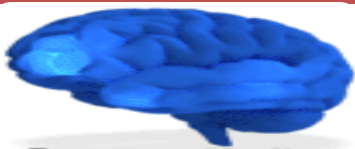


## More recently...

Cognitive tasks heavily dependent on the frontal cortex (matching faces and recalling words) neuroimaging showed distinct age differences in which area of the brain is accessed.

Older adults sometimes used an entirely different part of the brain than younger adults use for the same task

Older adults sometimes used additional areas in the same region of the brain. E.g., young adults performed a cognitive task by activating the left hemisphere of the prefrontal cortex, older adults activated both the right and left hemispheres.

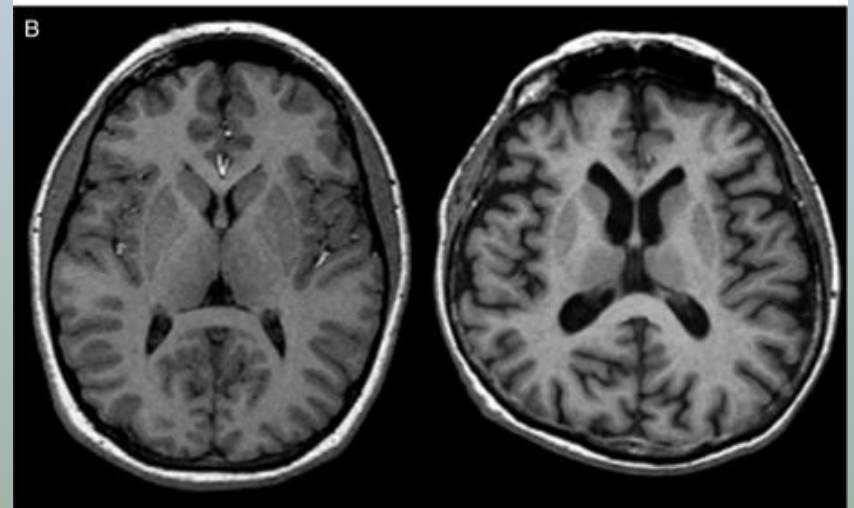
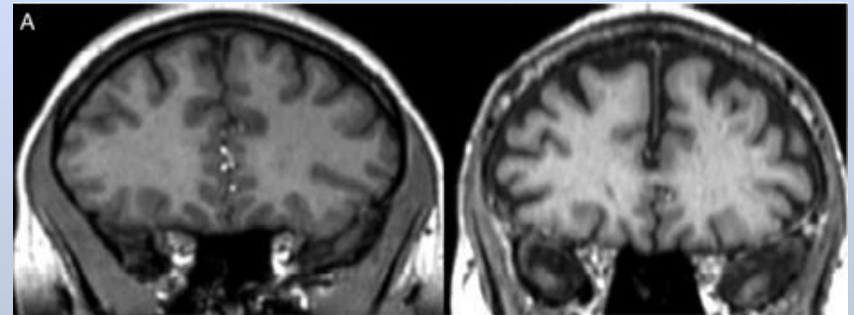
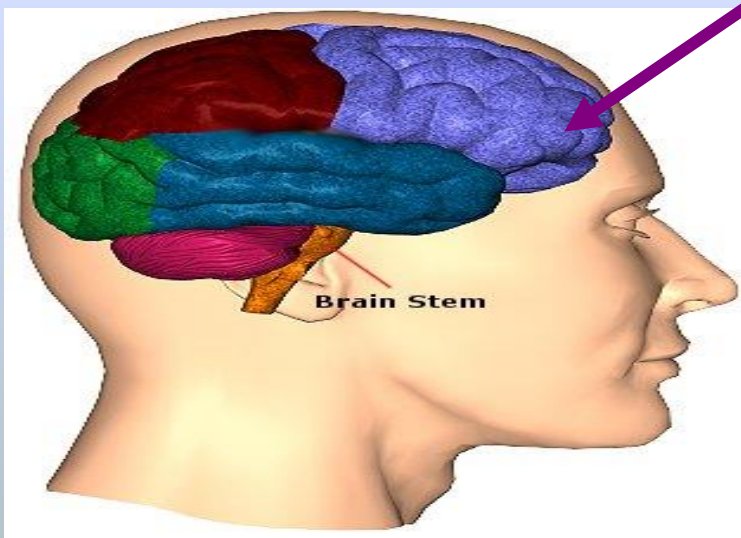


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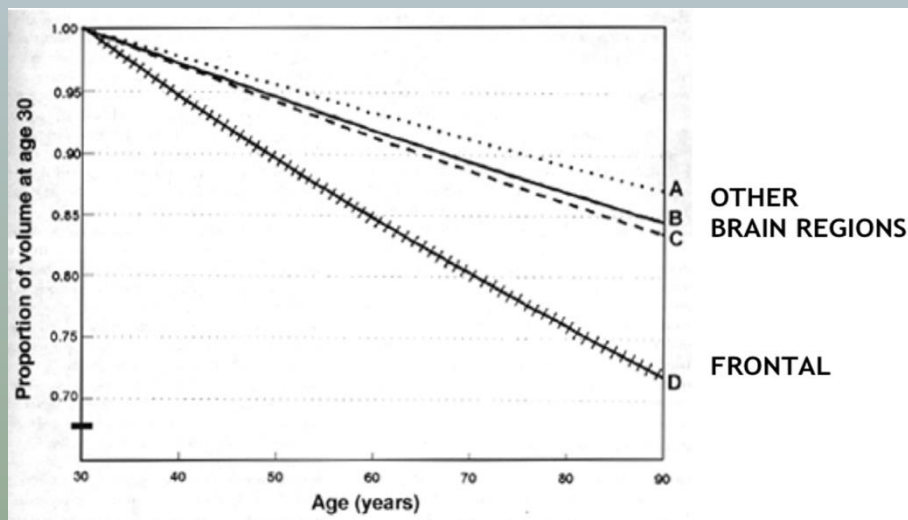
When older adults were asked to perform the same cognitive tasks as young adults, brain scans showed that different or more parts of the brain lit up (Cabeza 2002)

# Working Memory

Reliant on prefrontal cortex...a region that undergoes cell shrinkage & cell loss with age



Young adult      Older adult



# Working Memory & Processing Speed

Working memory declines with aging because of reductions in processing speed

Aging results in slowing of reaction time (the time it takes to respond to an event)

Somewhat slower on “simple associative” tasks (e.g., hitting brakes in response to red light)

Even more pronounced slowing on “complex choice” tasks (e.g., deciding whether to accelerate or brake at a yellow light)



# Working Memory & Processing Speed

Processing speed can affect the ability to hold information in mind, because by the time one part of a problem has been completed, other aspects of the problem may have been forgotten.

- Fred walks up to a store counter with 3 packs of sweets, each costing 50p.
- He gives the sales clerk £5.
- Because the clerk is out of pound coins, she gives Fred his change in 50p coins.
- How many 50p coins does Fred receive from the sales clerk?

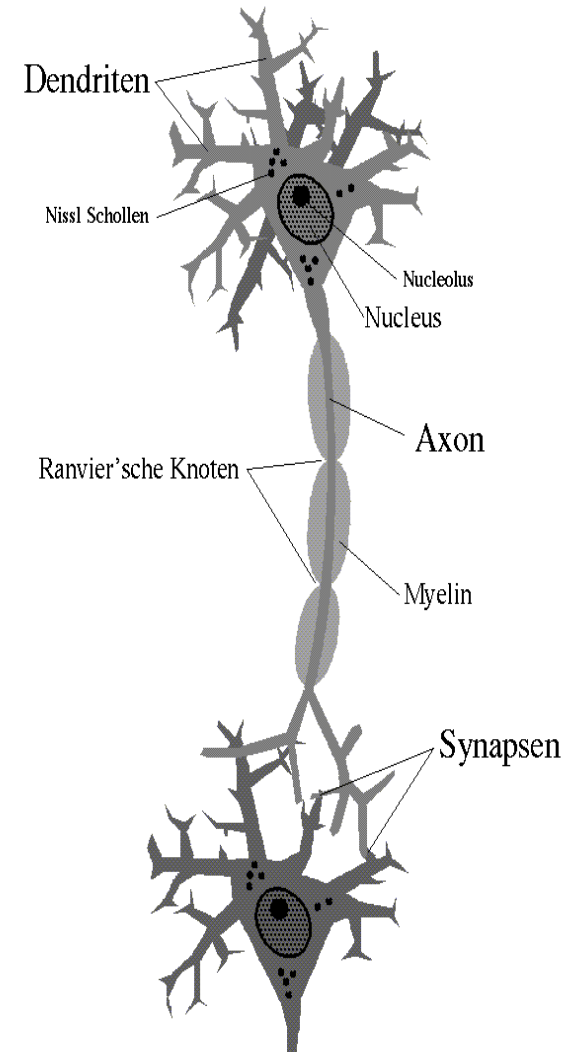
If it takes you longer to process “Fred walks up to a store counter with 3 packs of sweets”, you may miss that they each cost 50p.

If it takes you longer to multiply 3 by 50, you may have already forgotten that he gave the clerk £5.

# The Aging Brain: Slowing Down

Changes in the speed of neurotransmission (the passing of chemical and electrical signals from one brain cell to another) likely underlie these age-related changes in processing speed

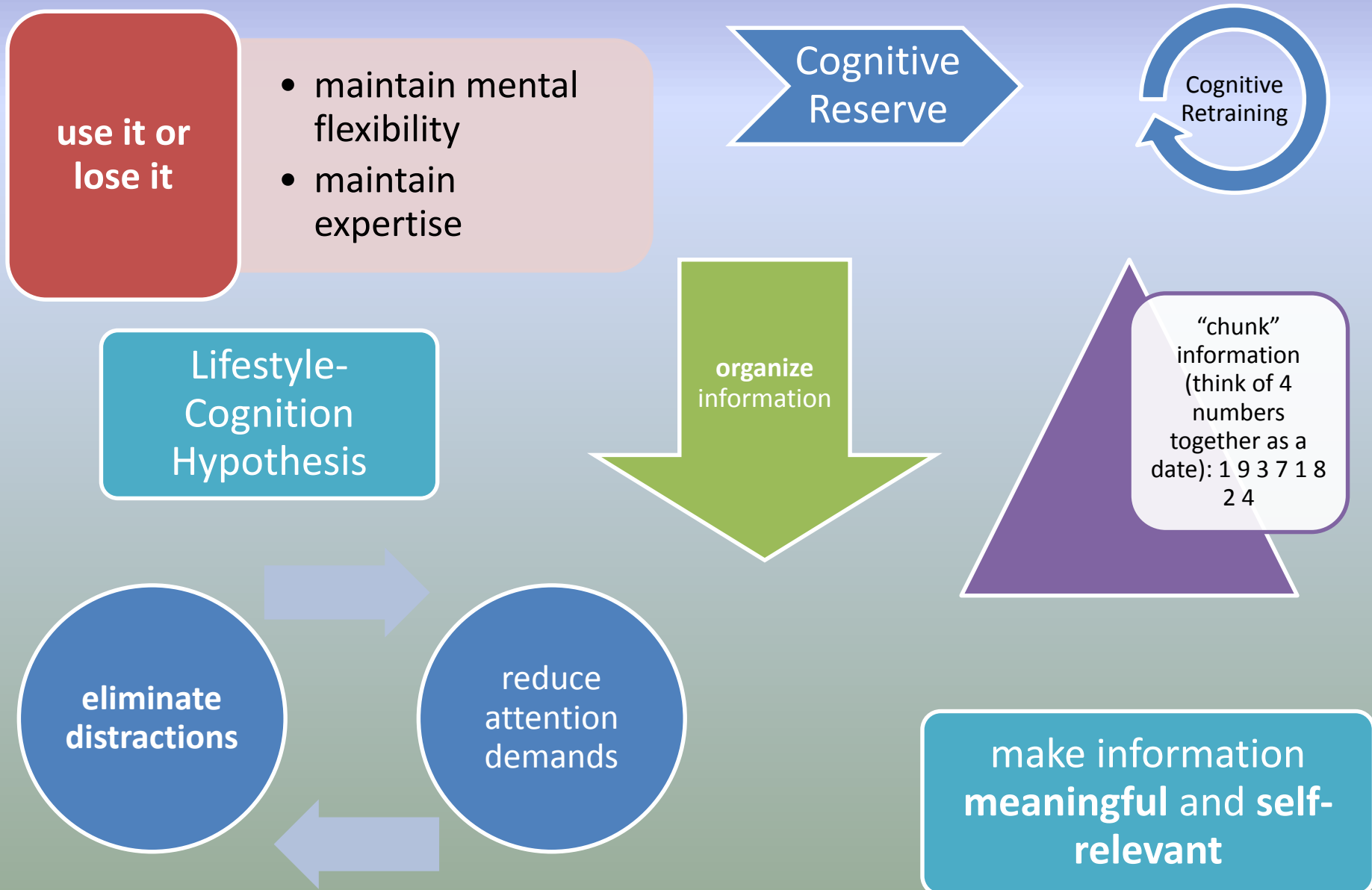
These neurotransmission changes are particularly pronounced in the prefrontal cortex



Although aging can lead to a slower reasoning through decisions, it can facilitate making a “gut decision”. These “gut decisions” are often the optimal ones.

(T. Hess, F. Blanchard-Fields, A. Damasio)

# Successful aging & working memory



# Wilson, Boyle, Segawa, Yu, Begeny, Anagnos, and Bennett (2013)



The authors used data from a longitudinal cohort study of >1,000 community dwelling older persons to examine the relation of cognitive aging to psychological well being. Rates of change in cognition and well being were correlated and cognitive level predicted subsequent level of purpose. The results support the hypothesis that cognitive decline in old age leads to decline in well being.

# Johansson, Wressle and Marcusson (2012)

<https://pdfs.semanticscholar.org/b26a/045d25435a1956f18cbcbbe601369e7bc6fb.pdf>

This study investigates how cognition influences activities of daily living and health-related quality of life in 85-year-olds in Sweden (n=373).



Postal questionnaire comprising demographics and health-related quality of life measured by the EQ-5D. The ability to perform personal activities of daily living was assessed during a home visit that included administering the Mini Mental State Examination (MMSE).



Cognitive impairment was shown in 108 individuals (29%). The majority were independent with respect to personal activities of daily living (PADL).



A larger number of participants with cognitive impairment reported that they needed assistance in instrumental activities of daily living (IADL) compared to the group without cognitive impairment. Impaired cognition was significantly related to problems with IADL.



Significant but low correlations were found between cognition and health-related quality of life – higher ratings on perceived quality of life correlated with higher results on the MMSE.

# Johansson, Wressle and Marcusson (2015)

<https://pdfs.semanticscholar.org/7072/ff98ea9dc63f6bcdade187ffc4d8390f868a6.pdf>

## BACKGROUND:

- The aim of this study was to explore experiences of cognitive impairment, its consequences in everyday life and need for support in people with mild cognitive impairment (MCI) or mild dementia and their relatives.

## METHODS:

- A qualitative approach with an explorative design with interviews. The participants included five people with MCI and eight people with mild dementia and their relatives. All participants were recruited at a geriatric memory clinic in Sweden.

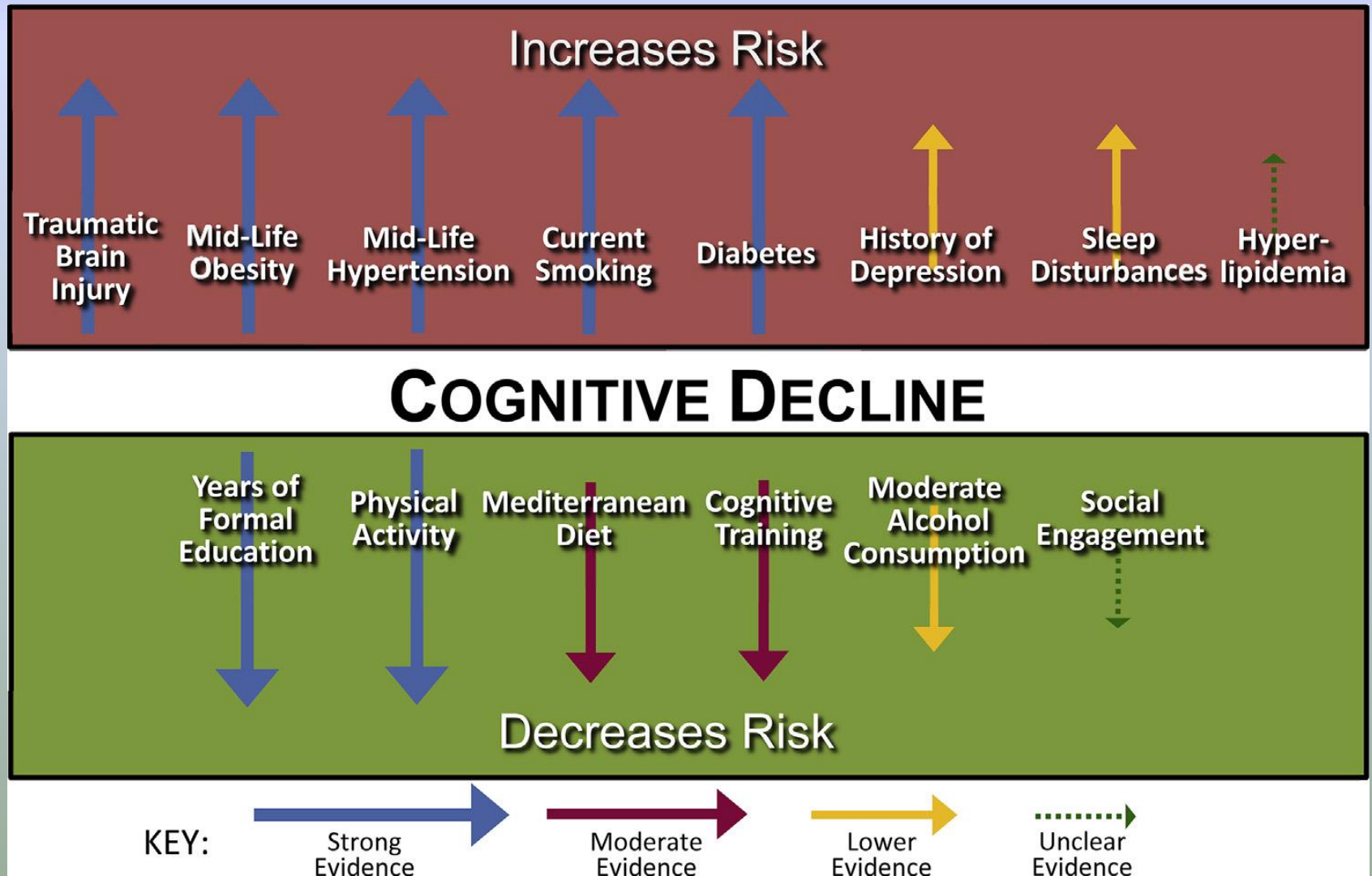
## RESULTS:

- Themes: noticing cognitive changes; changed activity patterns; coping strategies; uncertainty about own ability and environmental reactions; support in everyday life; support from the healthcare system; consequences in everyday life for relatives; and support for relatives. The main findings were that people with MCI and dementia experienced cognitive changes that could be burdensome and changed activity patterns. Most of them, however, considered themselves capable of coping on their own. The relatives noticed cognitive changes and activity disruptions to a greater extent and tried to be supportive in everyday life. Degree of awareness varied and lack of awareness could lead to many problems in everyday life.

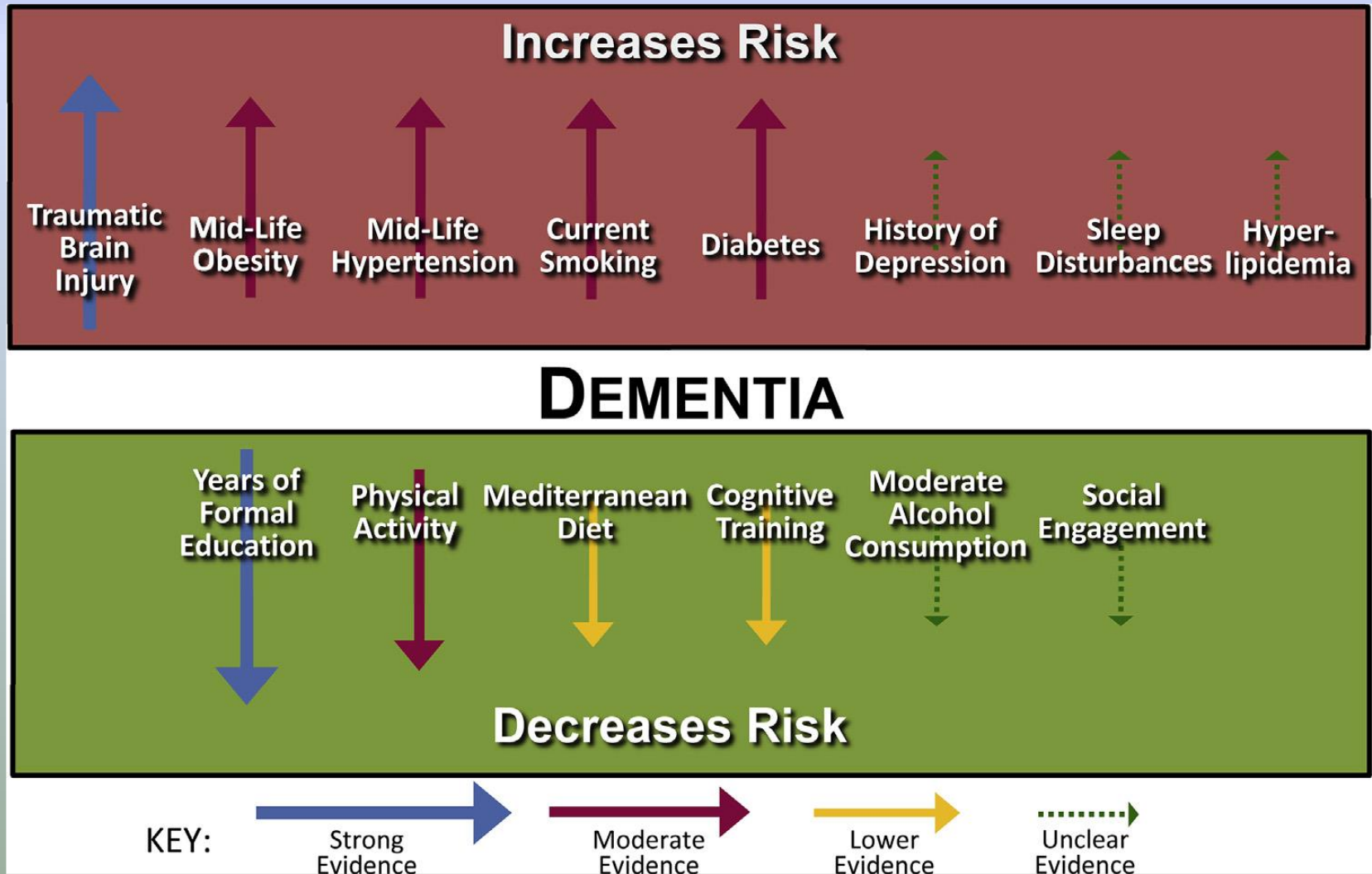
## CONCLUSIONS:

- Perceived cognitive impairment and its consequences in everyday life were individual and differed among people with MCI or dementia and their relatives. Thus, healthcare professionals must listen to both people with cognitive impairment and their relatives for optimal individual care planning. Support such as education groups and day care could be more tailored towards the early stages of dementia.

# Risk factors: cog decline



# Risk factors: dementia



# Cognitive Decline

Not all cognitive function decline in old age

Not all memories decline in old age

Use it or lose it

There are clear links  
between cognitive decline,  
MCI and dementia



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