DEPARTMENT of EXPERIMENTAL PSYCHOLOGY
Human Neuropsychology Laboratory
Center for Brain Injury Rehabilitation (CRECER)

AGING of Cerebral Functions

Advances in the prevention and treatment of organic memory disorders associated with aging

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THE BRAIN

- The human brain is unique, individual and non-transferable.
- Research on the functional brain is the search for transcendence and being in contact with the final reality, whatever that reality may be.

INTRODUCTION

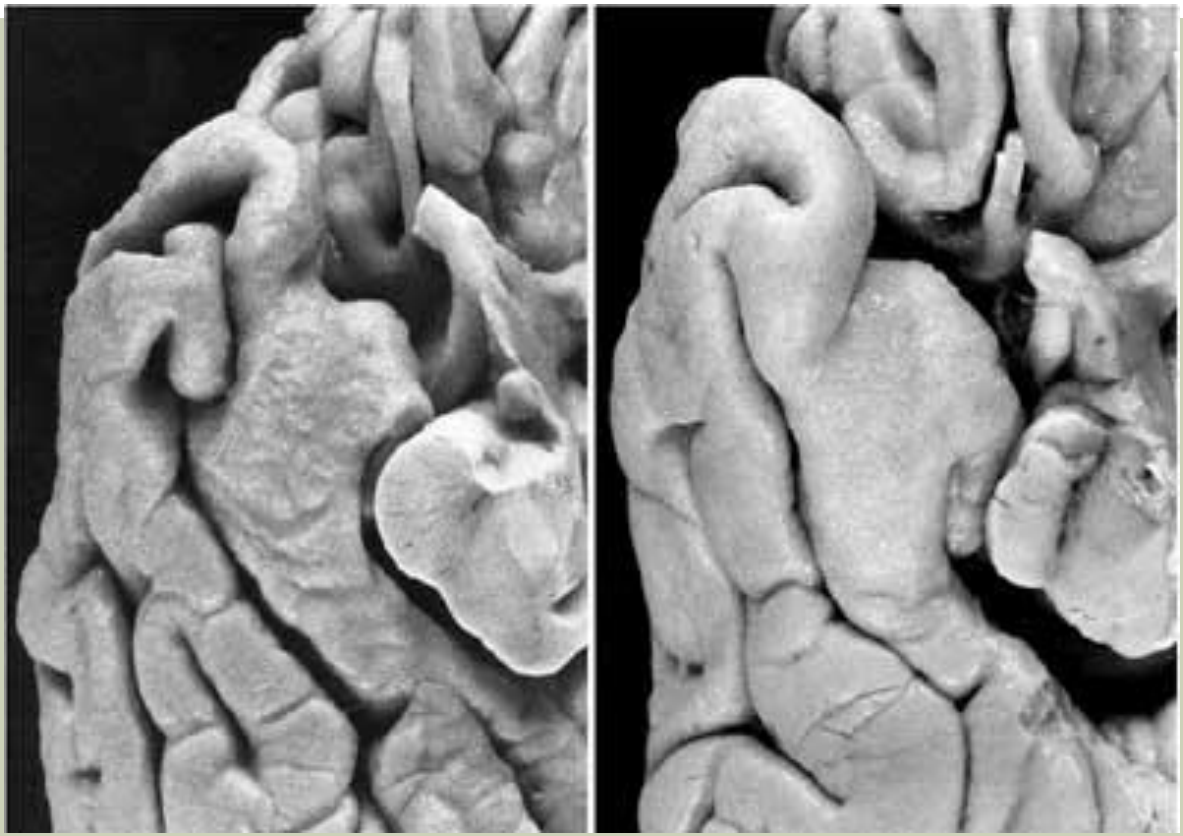
- The brain ages and human genetics and genomes are involved in cellular aging.
- Aging genetic expression is conditioned by the interaction with the environment.
- Some genes have less expression after the age of 40: those with a major role in synaptic plasticity, vesicular transportation and mitochondrial function.
- Genes that have damaged DNA resemble aging brains.
- DNA damage can reduce gene expression in vulnerable genes which are involved in learning, memory, and neural survival—initiating an aging process in the brain early on in life.

THE EFFECT OF AGING ON CEREBRAL CORTEX NEURONS: UNBALANCED LOSS OF GREY AND WHITE MATTER

- Loss of white matter increases after the sixth decade
  - areas of fronto-polar, premotor and temporal association--12 and 15%
  - hippocampus and parts of the amygdala—20 -25%
  - locus cerelus—20-40%
  - black matter—50%

ALL OF THESE CHANGES REDUCE SYNAPTIC DENSITY

MEMORY AND THE BRAIN



Mesial temporal lobe which is essential to anterograde memory. Left: In Alzheimer's Disease; Right: In a healthy elderly person.

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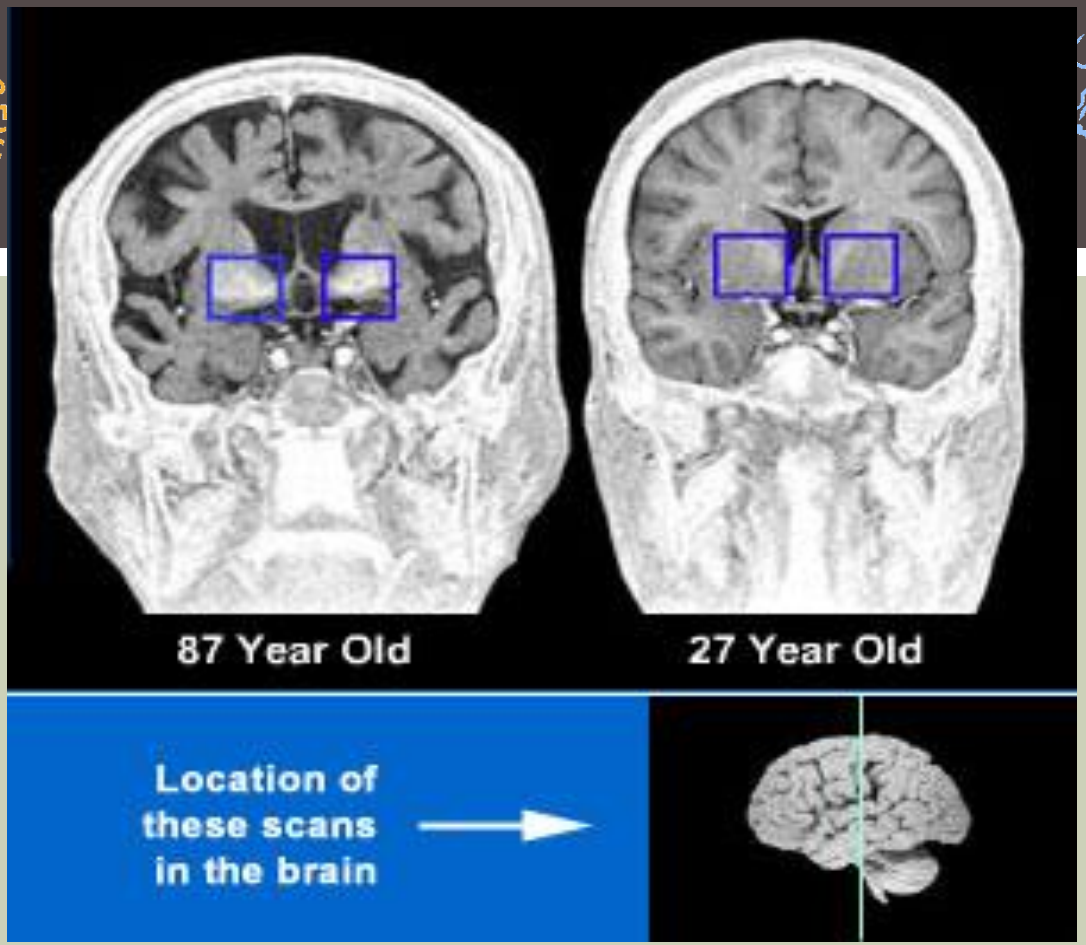
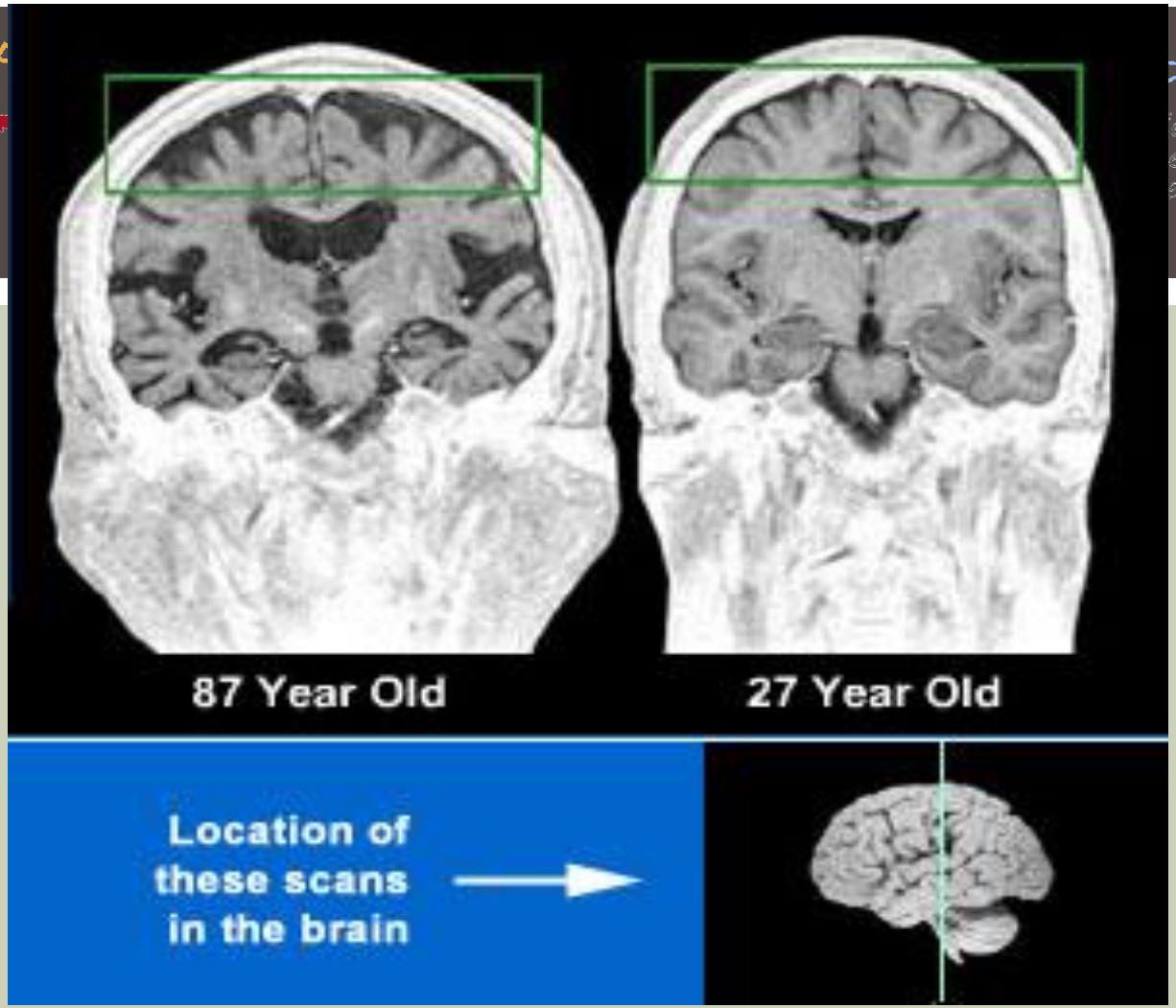


Basal Ganglia are groups of neurons responsible for the initiation and integration of movement. With age, they begin to shine, due to an accumulation of iron. However, these changes do not appear to affect one's health.

OTHER EFFECTS OF AGING

- Ratio between cerebral/cranial volume drops 20% (b/t sixth and seventh decade)
- Progressive neural loss in HIPPOCAMPUS
- Reduction in neural population in PUTAMEN and THALAMUS
- Gradual loss of CEREBRAL BLOOD FLOW



Subarachnoid area is the region surrounding the brain. As the brain gets smaller, due to the gradual loss of neurons, this area increases in size to fill in the empty space.

STUDIES ON CEREBRAL SELF-REGULATION

Experience produces functional changes that can improve nervous system functioning.

However, cerebral self-regulation can deteriorate with age.

As we get older, we get wiser

- Other factors have adverse effects in the long-run:
  - uncontrolled hypertension
  - heart failure
  - smoking

STUDIES ON CEREBRAL SELF-REGULATION

- According to different studies, the aforementioned conditions and aging can have a dual impact on the cerebral-vascular system.

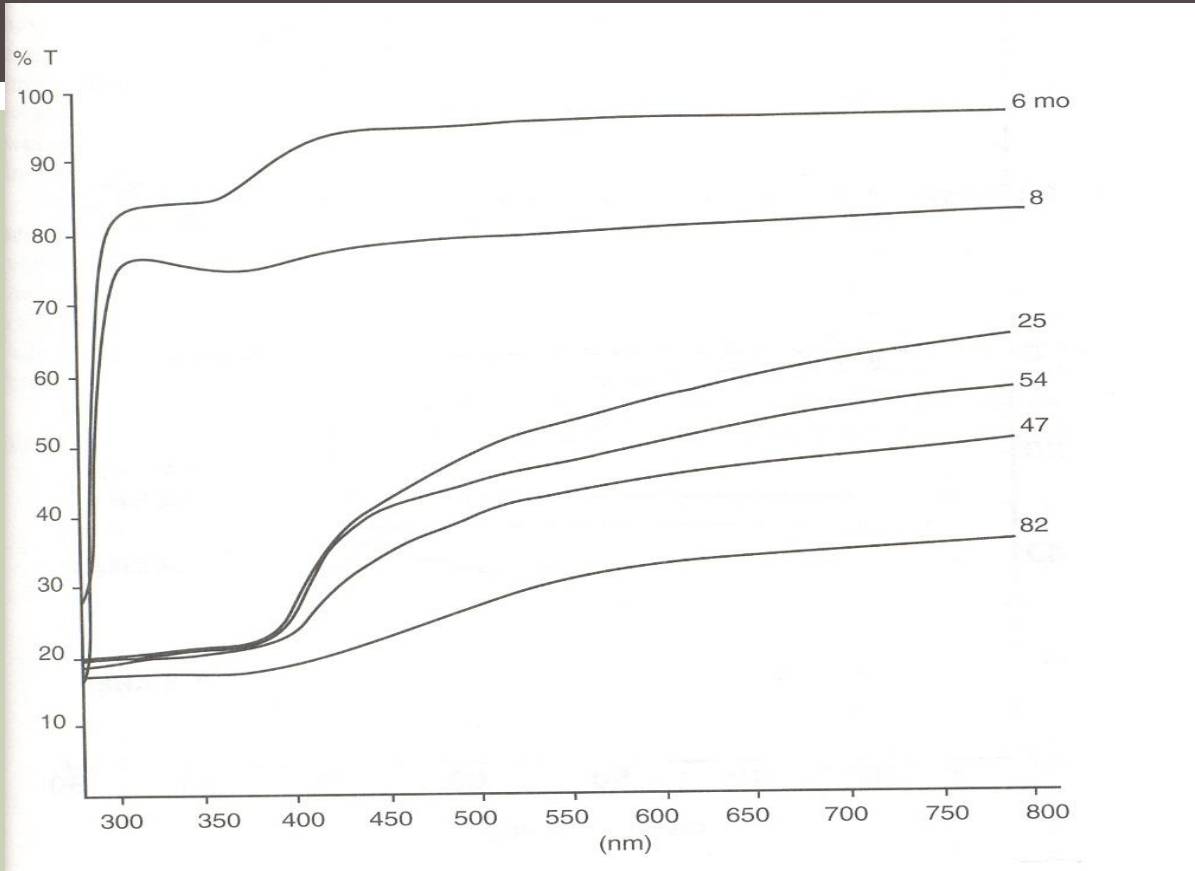
- Three of the most common neurological diagnoses in the elderly are Alzheimer's, Parkinson's and stroke.

DEMENTIAS

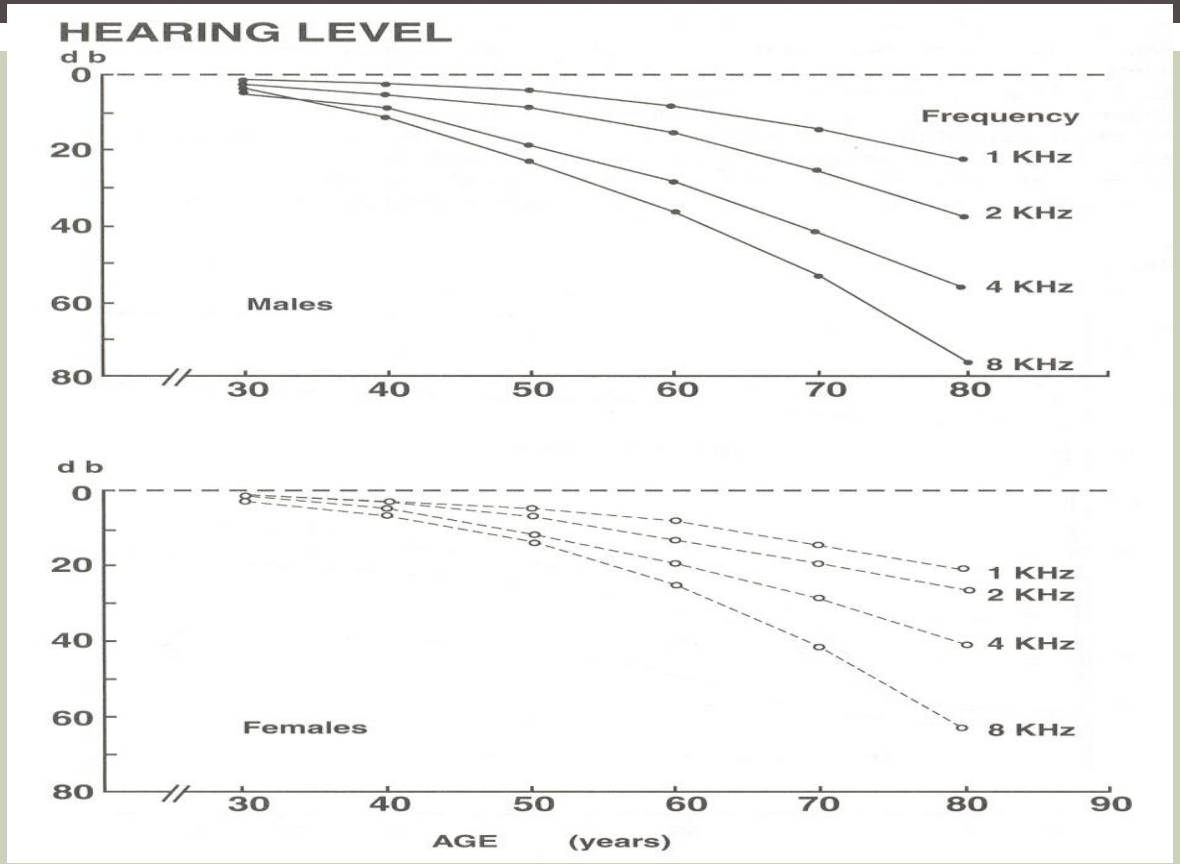
- *5%* of the *over 65 population* will be diagnosed as having a ***dementing disorder***.
- This percentage will increase to *10%* in the *over 80 population.*
- The most common diagnosis within the dementias is *Alzheimer's ,* affecting between *35% -- 50%* of dementia cases; next is *vascular dementia, which will be detected in 18% --13% of these cases.*

FUNCTIONAL DETERIORATION

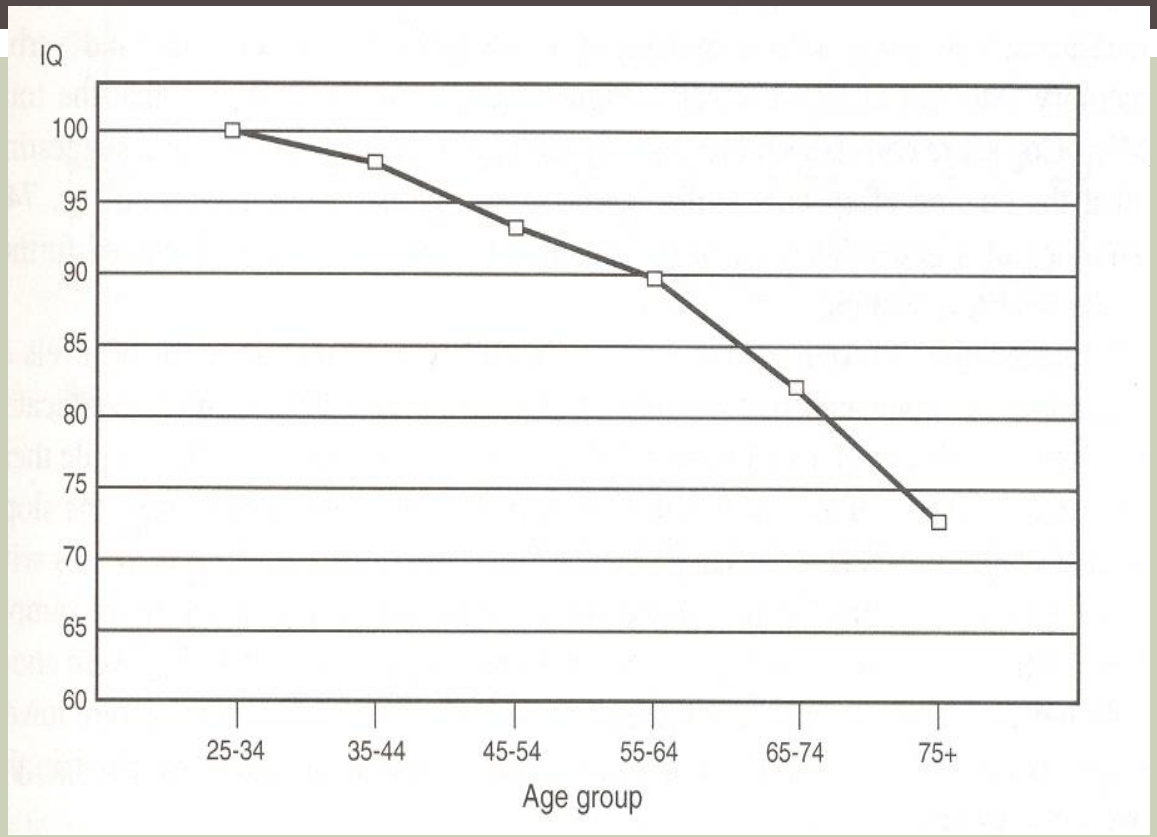
- LINK BETWEEN AGING AND WEAKENING OF FUNCTIONAL ABILITY DUE TO NEUROLOGICAL CONDITIONS
  - COMPLEX OR INSTRUMENTAL ACTIVITIES ARE LIMITED
  - BETWEEN AGES OF 65-69, 10% REQUIRE ASSISTANCE
  - IN THOSE AGED 85+, 50% REQUIRE ASSISTANCE
- SOME SIMPLE ACTIVITIES OFTEN REMAIN INTACT
  - DAILY LIFE ACTIVITIES, LIKE BATHING, EATING, WALKING, ETC.
  - INTACT IN 89% OF PERSONS OVER 85
- THE BRAIN'S WEIGHT CHANGES WITH AGE
  - DECREASES AS OF FIFTH DECADE
  - LOSS OF 2-3% OF BRAIN VOLUME IN FOLLOWING DECADES
  - 3 ZONES MOST AFFECTED BY GYRAL ATROPHY



PERCENTAGE OF TRANSMISSION (T) OF DIFFERENT LIGHT WAVES BY HUMAN LENS AT DIFFERENT AGES, FROM 6 MONTHS TO AGE 82.
(DE LERMAN, S., J. GERONTOL., 38.295, 1983.)

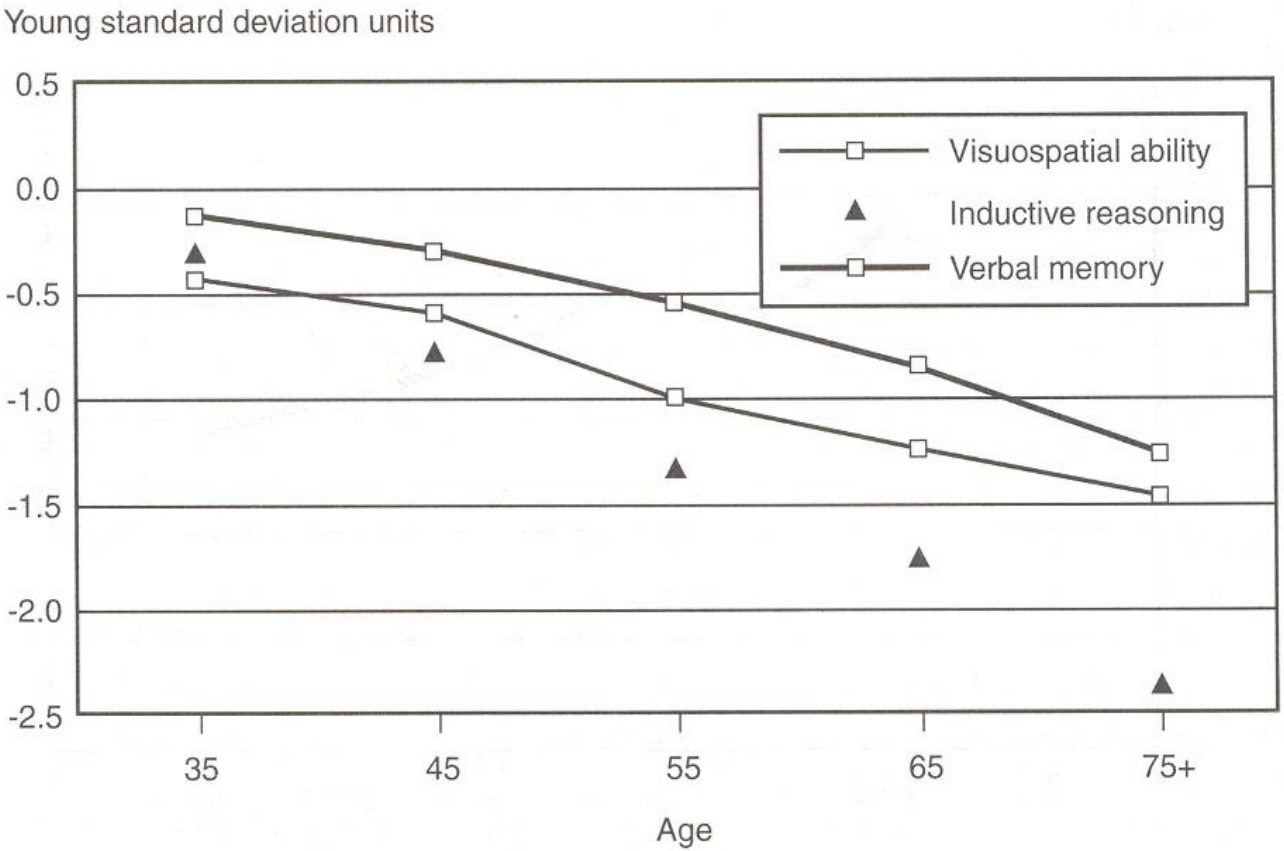


HEARING LOSS AT DIFFERENT AGES AT THE HIGHEST FREQUENCY –1 A 8 kHz. DATA FROM EIGHT SURVEYS PUBLISHED BY SPOOR AND CONVERTED TO ANSI 1969 BY LEBO AND REDDELL.(DE ORDY, J. M. AND BRISSEE, K.R., EDS., *AGING, VOL 10, SENSORY SYSTEMS AND COMMUNICATIONS INTHE ELDERLY*, RAVEN PRESS, NY, 1979, 156.)



WAIS FULL SCALE IQ MEAN SCORES FOR AGES 25-34 AND >75.

(DEKAUFMAN, A.S., *ASSESSING ADOLESSCENT AND ADULT INTELLIGENCE*, ALLYN &BACON, BOSTON, 1990, 185.)



DIFFERENCES IN MEMORY ASSOCIATED WITH AGE: REASONING, VISUAL-SPATIAL ABILITY OF SUBJECTS BETWEEN 35 – 75 YEARS OF AGE; DECREASE IN THE YOUNG ADULT (22—28) SD. (DE POWELL, D.H., *PROFILES IN COGNITIVE AGING*, HARVARD UNIV. PRESS, CAMBRIDGE, MA, 1997, 87)

SENSORY MEMORY AND AGING

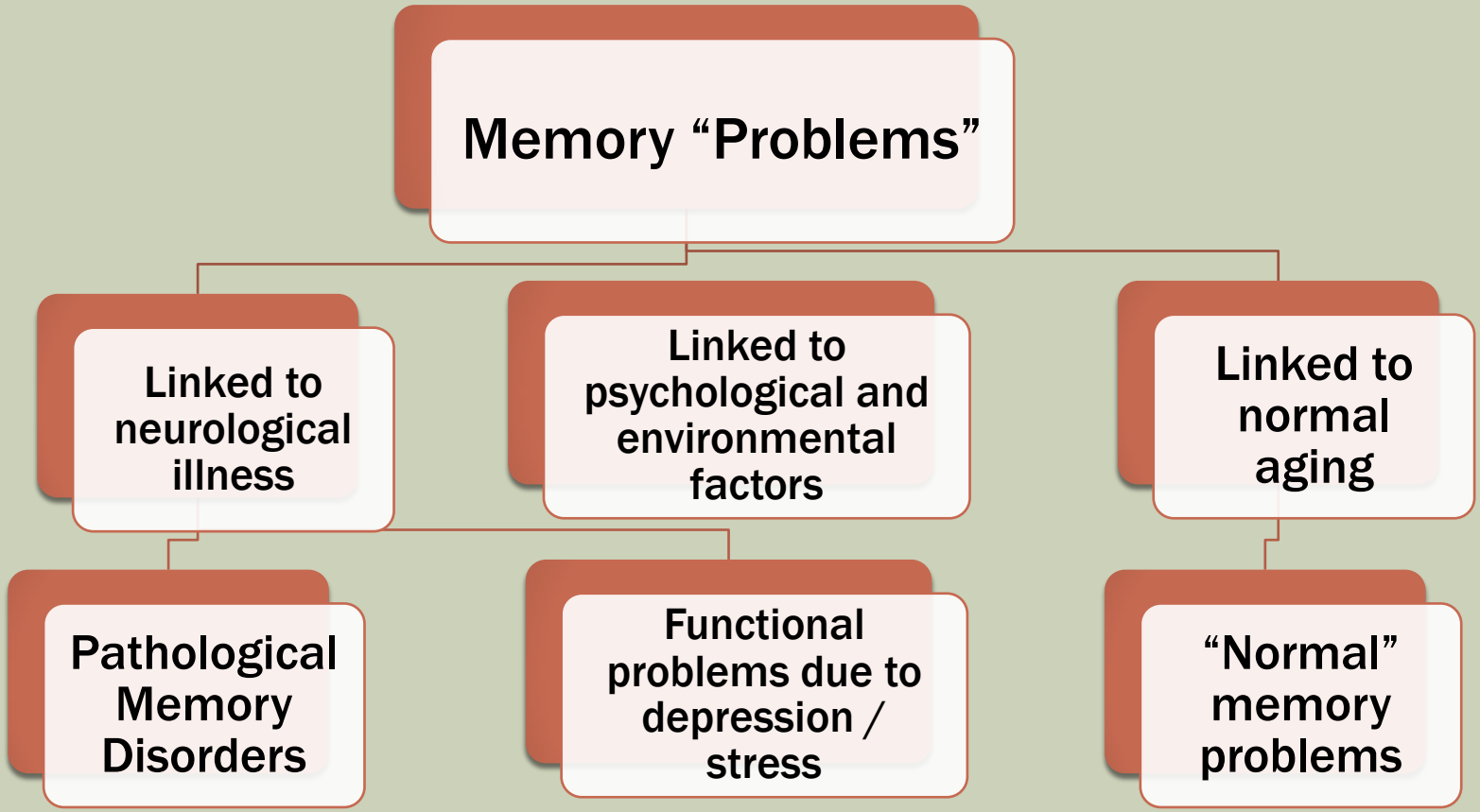
CHANGES IN VISION

- As we age, our vision deteriorates
- More time is needed to identify complex visual stimuli
- This decline could be due to the usual loss of visual discrimination

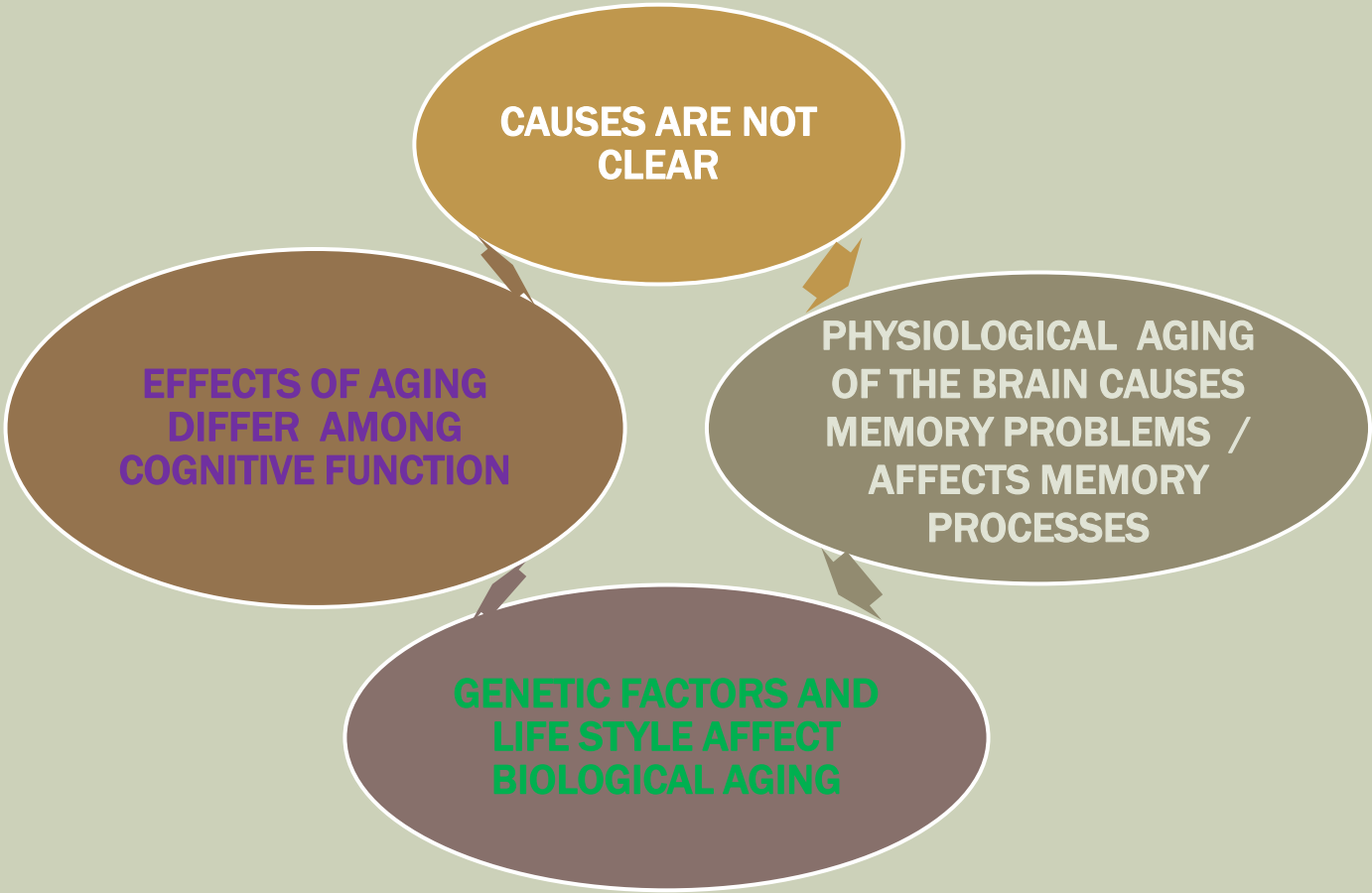
CHANGES IN SMELL

- The elderly suffer a gradual deterioration of their sense of smell
- The most significant decline is in identifying and remembering smells
- Deterioration may be due to a decrease in the speed of cognitive processes

OTHER FACTORS AFFECTING MEMORY PROCESSES



CHANGES IN MEMORY ASSOCIATED WITH AGING



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WORKING OR FUNCTIONAL MEMORY

OUR VOLUME OF MEMORY

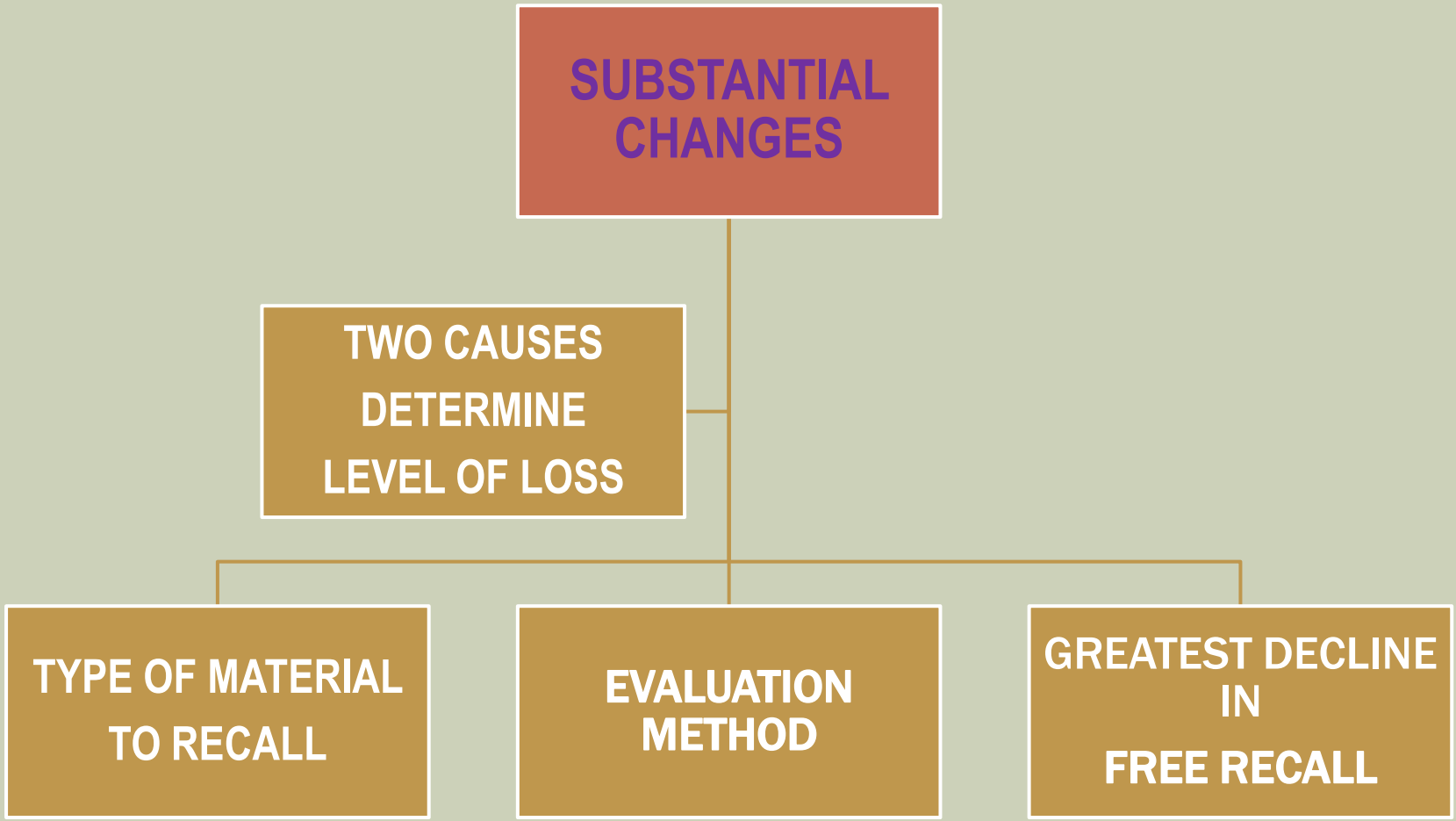
WM is the volume of information available on the mental screen for information processing which reaches the senses simultaneously

- temporary activation of long-term memory network for a specific purpose
- if volume of available information is low, all other cognitive functions could be affected or delayed
- simultaneous storage, recovery and manipulation of processed information
- functional and long-term memory are part of the same system of cortical neural networks

PRIMARY MEMORY AND AGING

- IN THE ELDERLY, **POOR PERFOMANCE** IN DIFFERENT COGNITIVE TASKS HAS BEEN LINKED TO A ***RELATIVE* DECREASE IN FUNCTIONAL MEMORY.**
- IN STUDIES ON **PRIMARY MEMORY** (short-term memory), THE CHANGES ARE **LIMITED**:
  - STUDIES ON DIGIT AND WORD SPAN SHOWED INSIGNIFICANT DIFFERENCES ASSOCIATED WITH AGE
  - ANNUAL STUDIES ON MEMORY AND OTHER COGNITIVE DOMAINS (USING NEUROPSYCHOLOGICA BATTERY) REVEALED DETERIORATION IN MEMORY FUNCTION OVER TIME, BUT NOT IN OTHER TASKS (SPEECH, VISUAL-SPATIAL ABILITY, ABSTRACT REASONING)
  - DETERIORATION ASSOCIATED WITH AGING IS LIMITED TO SPECIFIC ASPECTS, LIKE ACQUISITION AND RECOVERY OF NEW INFORMATION
    - NOT RETENTION

SECONDARY MEMORY STORAGE AND AGING



AGING AND PROSPECTIVE MEMORY

Prospective memory undergoes ***general deterioration*** during the aging process

- Prospective abilities deteriorate with age
- Problems worsen due to an increase in memory load, both in number of tasks and task content
- Prospective memory functions within the context of continuous activities
- The level of commitment required by the activity will determine what is remembered

IMPLICIT MEMORY

STUDIES REPORT THAT
IMPLICIT MEMORY IS ***MORE RESISTENT***
TO DETERIORATION DURING NORMAL AGING

- IMPLICIT LEARNING ABILITIES APPEAR BEFORE EXPLICIT MEMORY
- THESE ABILITIES SHOW LITTLE DETERIORATION IN ADULT LIFE
- FUNCTION IN IMPLICIT PERCEPTION TASKS WAS NORMAL IN OLDER ADULTS
- IMPLICIT MEMORIES OCCUR UNCONSCIOUSLY
- IN ACQUISITION, THIS DEFICIT APPEARS LIMITED WHEN CREATING NEW ASSOCIATIONS, WHICH REQUIRES CAPACITY

INTERVENTION IN AGING OF COGNITIVE FUNCTIONS

- AUTHORS HAVE FOUND ASSOCIATION BETWEEN
  - Physical Activity
  - Age
  - Cognitive/motor Functions
- TO FIND WAYS TO
  - Prevent
  - Postpone
  - Compensate

THE POSSIBLE DECLINE IN COGNITIVE FUNCIONS DUE TO AGING

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- **Thank you very much.**

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