

# COGNITIVE RESERVE & BRAIN RESERVE



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# What is what

# Definition

## ❑ COGNITIVE RESERVE:

- Innate intelligence/aspects of life events/education plays a role in some to cope up with progressive neurological/psychiatric illness

## ❑ CEREBRAL/BRAIN RESERVE:

- Brain size/neuronal count . Particular damage before clinical symptoms occur.

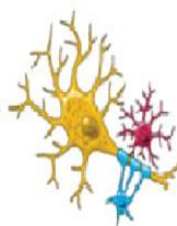
**BRAIN**



Increased Brain Size  
Increased neuronal count  
Increased Synaptic density



Traumatic Brain Injury  
Encephalitis  
Psychiatric Illness  
Developmental disorders



Cognitive Engagement  
Cognitive Remediation  
Education  
Leisure activities  
Nutrition  
Social stimulation



Sedentary mental activities  
Malnutrition  
Lack of education  
Loneliness

**BRAIN RESERVE**

**COGNITIVE RESERVE**

# Brain Reserve-parameters

- ❑ Intra cranial capacity
- ❑ Cross sectional area of brain
- ❑ Head circumference
- ❑ Synaptic count
- ❑ Dendritic branching

# Cognitive Reserve – Parameters

- ❑ Socio-economic status
- ❑ Education
- ❑ Occupation
- ❑ Finance
- ❑ Leisure activities (reading)
- ❑ IQ

## ➤ COGNITIVE PHENOTYPES

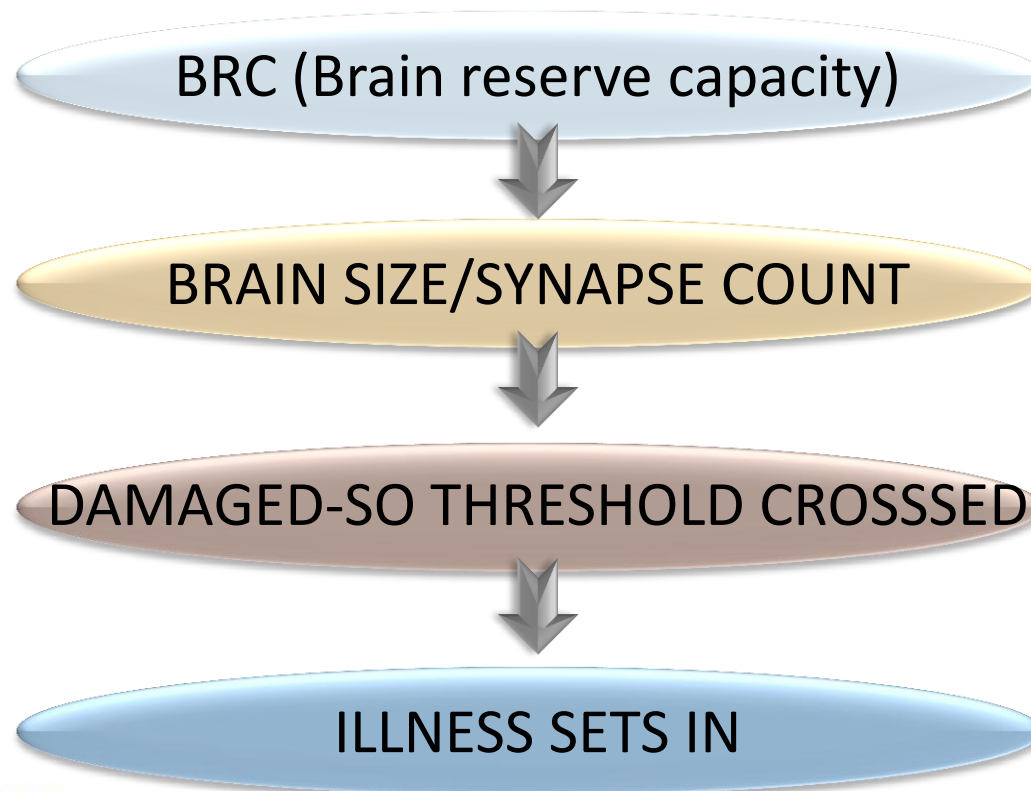
➤ Memory

➤ Language

➤ Processing time

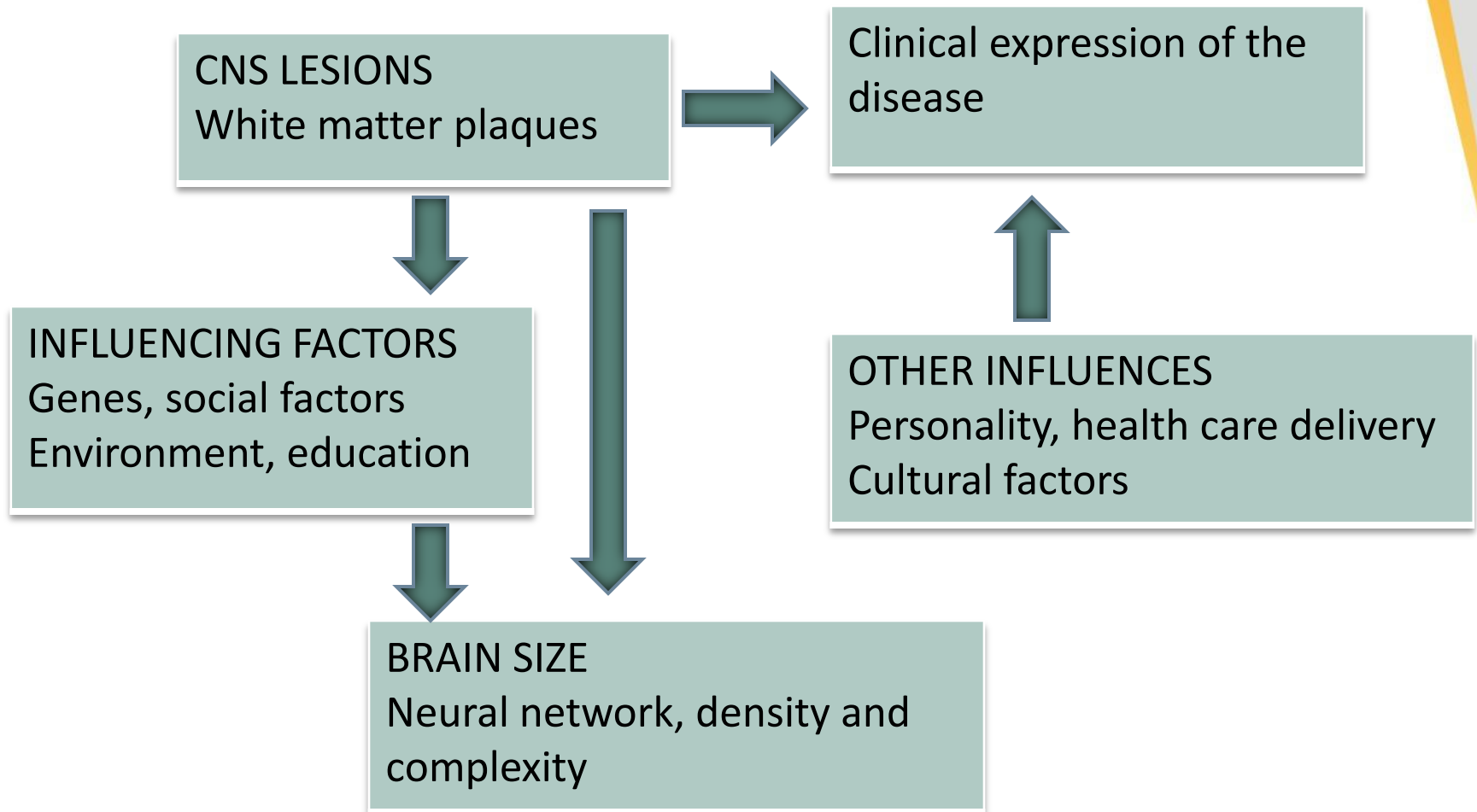
# Models

## □ THRESHOLD MODEL-SATZ-PASSIVE





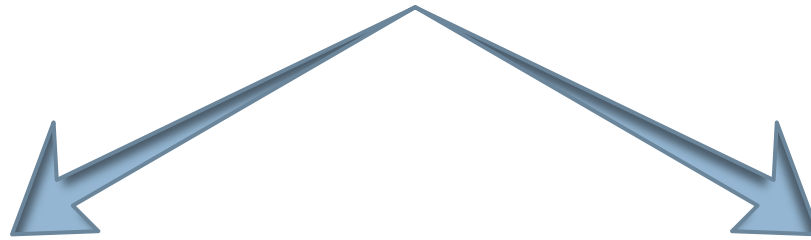
# Life Course Model



# Genetic Factors in Cognitive Reserve

- ❑ Cognitive functions-Heritable
- ❑ Gene expression associated
  - PP1 (Protein phosphatase 1) inhibition- reduced time for learning and slowed AD
  - Nncl-chromosome 11-behaviour and performance
  - APOE4- cognitive decline in AD
  - BDNF-hippocampus-new learning.

# COGNITIVE RESERVE



NEURAL RESERVE

Inter individual variation

NEURAL PROCESSING

Compensatory after damage

# Measures of brain reserve

- ❑ Brain size
- ❑ Head circumference
- ❑ Synaptic count
- ❑ Dendritic branching

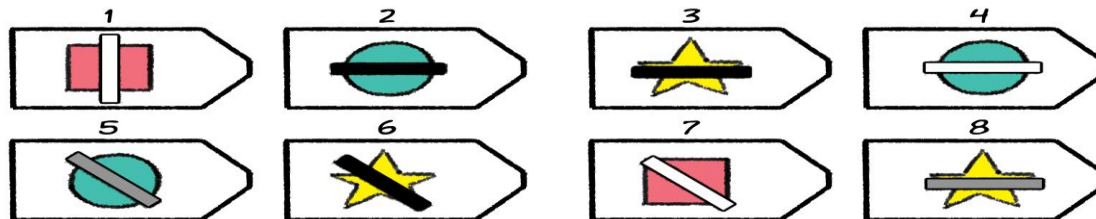
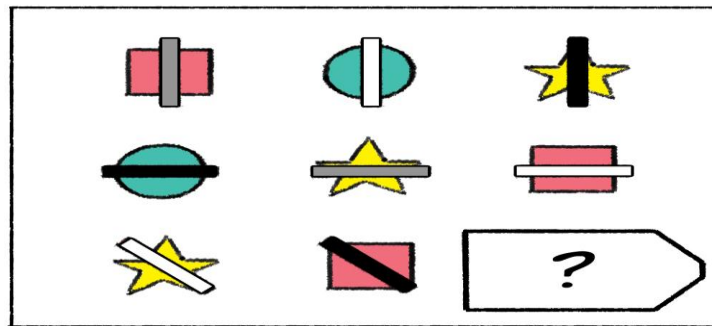
# Measures of cognitive reserve

- ❑ IQ
- ❑ Literacy
- ❑ Specific cognitive function
- ❑ Leisure activity (reading)
- ❑ Occupational attainment

# Tests

- ❑ DUAL TEST
- ❑ RPM TEST

## RAVEN'S PROGRESSIVE MATRICES



# Permanent Attention Test

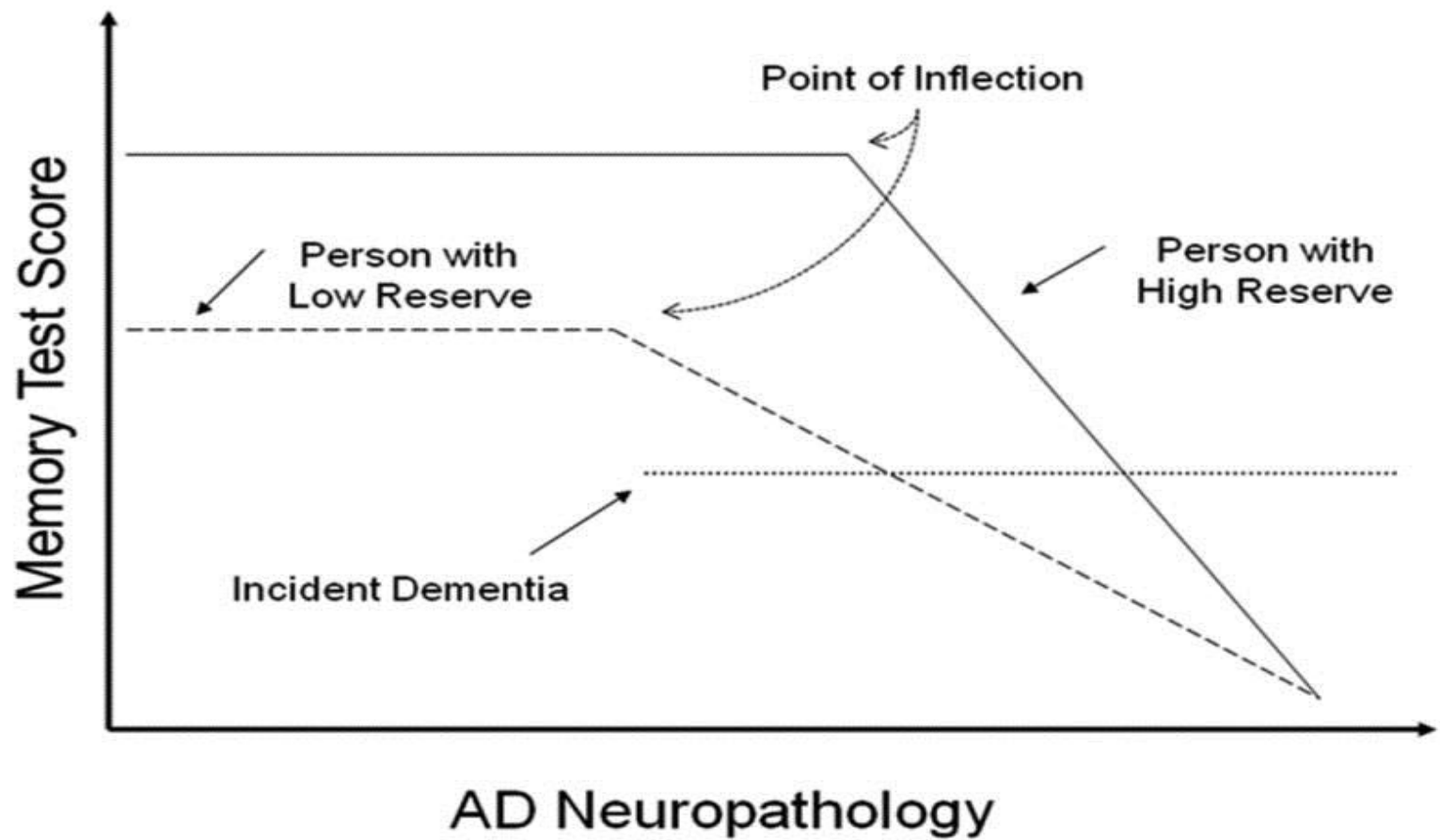
- IMAGING STUDIES:
  - Regional cerebral blood flow
  - PET scans

# IMPLICATIONS IN NEUROLOGY



# Alzheimer's Disease

- ❑ Depletion of synapses.
- ❑ The onset is delayed in patients with good cerebral reserve.
- ❑ In symptomatic patients with higher cognitive reserve respond better to cognitive therapy .



# Amyloid Pet in Assessment of Reserve in Alzheimer's

Assessment of regional cerebral blood flow (rCBF) showed that there is a negative correlation between the resting rCBF in parieto temporal area affected in AD and years of education.

- ❑ Patients with higher education had more depleted flow.
- ❑ This suggests that patients with higher education were tolerating more AD pathology than those with lower education

# Parkinson's Disease

- ❑ PD patients with higher cognitive reserve have less impaired activities of daily living and better quality of life.
- ❑ Rate of global cognitive decline in PD has a shallow initial rate of decline followed by an inflection point when it gains momentum towards dementia.

# Obstructive Sleep Apnea

- In higher intelligence patients - minimal reduction in alertness and better response with CPAP.

# Carotid Artery Stenosis

- Age more than 70 years is associated with poor cerebral reserve in patients with significant stenosis as measured by cerebral blood flow response to acetazolamide.

# Multiple Sclerosis

- ❑ Maximal life time brain growth (MLBG) and intellectual enrichment attenuate the negative relation between MRI estimates of disease burden and cognitive status
- ❑ MLBG protects against cognitive inefficiency and intellectual enrichment protects against memory problems.



# Stroke

- ❑ Anterior circulation stroke produced worse scores in visual abstract reasoning, word finding and processing speed.
- ❑ Posterior circulation stroke patients showed a better performance in almost all cognitive tests.
- ❑ Education, a measure of a cognitive reserve was found to be the only predictor of cognitive decline after stroke – negatively correlated.

# Traumatic Brain Injury

- High pre morbid intelligence – a protective factor against cognitive decline in traumatic brain injury patients.

# Measuring the cognitive reserve

- ❑ CR Proxies
- ❑ Using Various Scales
- ❑ Using Neuro Imaging
- ❑ Using Transcranial Doppler.

# Harnessing the cognitive reserve

- ❑ Cognitive training
- ❑ Domain specific
- ❑ Across the domains
- ❑ Known tasks vs unknown tasks.

# Two types of cognitive training

- ❑ Training which shows transfer of effect.
- ❑ Training which has persistence of effect
- ❑ The purpose has to produce a sustained and long lasting effect beyond the training period .

- ❑ The ACTIVE study is the largest trial in the area and examined the effects of 10 sessions of cognitive training on 2832 healthy older individuals.
- ❑ Participants completed three different intervention groups: memory training, reasoning training, and processing speed training.

# Active trial

Follow up at five-years, however, found that reasoning training specifically protected against functional decline compared to any of the other interventions or the control wait-and-see condition. This is therefore the first large clinical trial to demonstrate transfer of effect since cognitive training produced enduring benefits on a general functional outcome that is highly relevant to dementia onset.

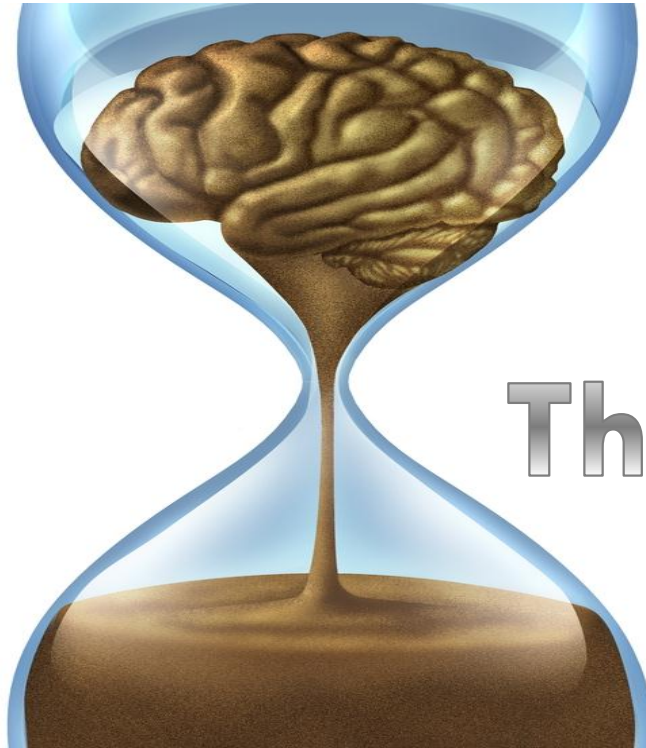
# Mechanisms

- ❑ Molecular- up regulation of AMPA, BDNF AND NGF.
- ❑ Cellular- synaptogenesis, angiogenesis and possible neuro genesis.
- ❑ Network- increased efficiency to adapt.
- ❑ Compensate and reorganise.



# Future

- ❑ Domain specific cognitive training.
- ❑ Create new cognitively demanding hobbies.
- ❑ Changes in the lifestyle and behaviour.
- ❑ Promote positivistic attitude.
- ❑ Computer based cognitive training.
- ❑ Group as well as individual based.



Thank you