

# Gamma Waves and Cognitive Disorders

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# Agenda

1. What are gamma waves?
2. What do gamma waves signify?
3. Research methods.
4. Link to cognitive disorders.
5. Conclusions and Future.
6. Questions and answers.

# What are Gamma Waves?

- Brainwaves are patterns of neural activity
  - Spike trains, local field potential oscillations, etc
- Different types of waves
  - Delta (1 - 4hz)
  - Theta (5 - 8hz)
  - Alpha (9 - 12hz)
  - Beta (13 - 29hz)
  - Slow Gamma (30 - 70hz)
  - Fast Gamma (71 - 125hz)
  - Sharp wave ripples (SWR) (126 - 250hz)

# What do Gamma Waves Signify?

- Often associated with SWR
- Linked to memory activities
  - Slow gamma waves
    - Associative memory
    - Memory Retrieval
  - Fast gamma waves
    - New memory encoding
    - Object - place pairings
    - Navigation

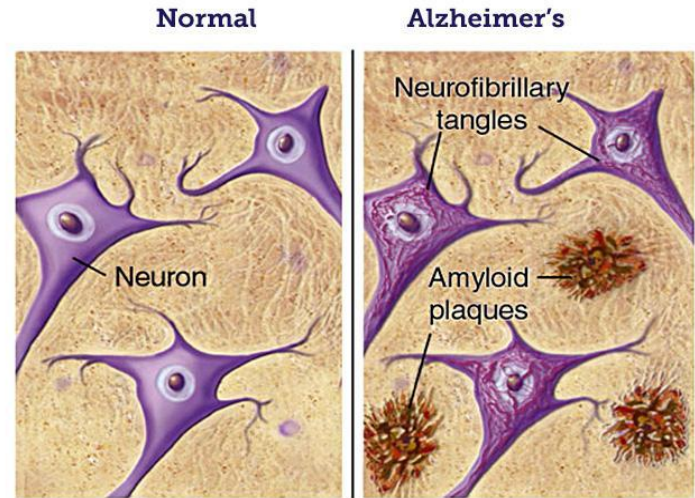
# Research Methods

- Animal models
  - Mostly rodent models
  - Apolipoprotein E (APOE) mouse model
  - Collect data through memory based experiments
- Use the data to build computational models
  - Use models to develop possible treatment methods

# Alzheimer's Disease

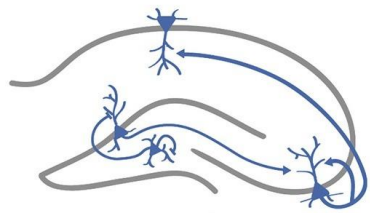
- Neurodegenerative Disease
  - Amyloid- $\beta$  deposits
  - Neurofibrillary tangles
- Affects memory subsections
  - Hippocampus
  - Entorhinal cortex

Normal vs. Alzheimer's Diseased Brain

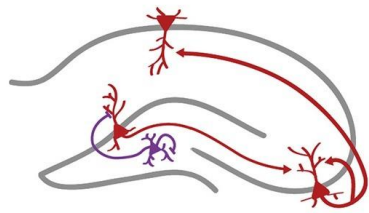


# Alzheimer's Disease

- Current hypothesis
  - Memories can be encoded but not retrieved.
  - Rodent models support this.
    - Decreased frequency, amplitude, SWR.
- Information used in computational models
  - Find methods to decrease slow gamma disruptions.
  - Eliminate APOE4 in GABAergic interneurons.
  - Methods resulted in improvements in rodent memory.

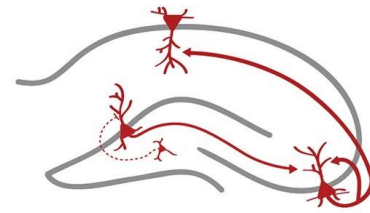


**Aged ApoE3-KI**

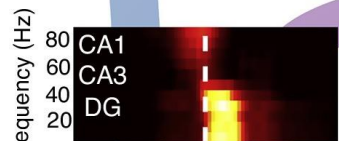


**Aged ApoE4-KI/Dlx-Cre**

ApoE4 Eliminated in  
GABAergic Interneurons



**Aged ApoE4-KI**



**Normal Slow Gamma  
during SWRs**



**Reduced Slow Gamma  
during SWRs**

**Normal  
Learning and Memory**

**Impaired  
Learning and Memory**



# Conclusions and Future

- Gamma disruptions and cognitive disorders seem to be related.
- Are gamma disruptions the cause or are they a byproduct of cellular disturbances?
- More research being done with deep brain stimulation?

Questions?