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
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

Normal SWR Abundance

Reduced SWR Abundance

Normal Slow Gamma during SWRs

Reduced Slow Gamma during SWRs

Normal Learning and Memory

Impaired Learning and Memory

Current Opinion in Neurobiology
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?