

# Eliciting the Neural Basis of Music Medicine in Epilepsy

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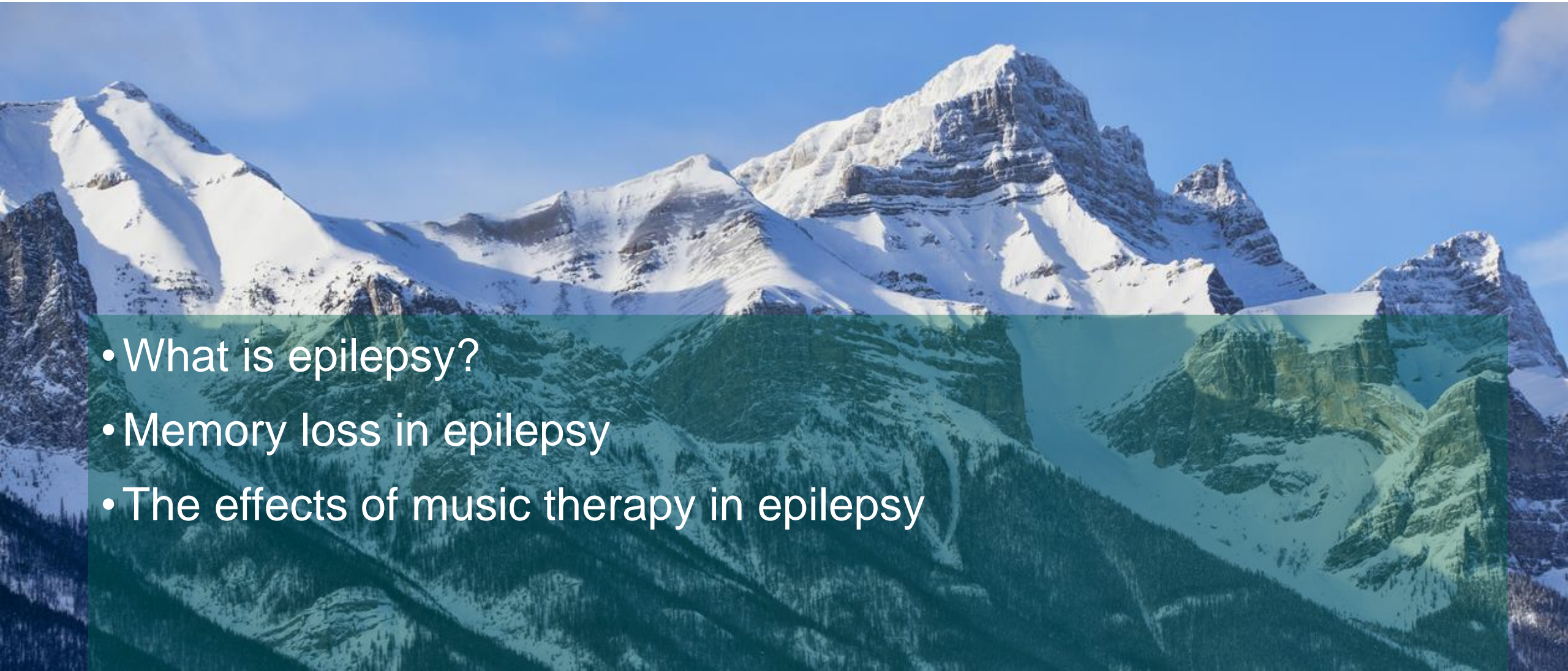
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- Research:
  - Federal
    - CDC
    - NIH
    - Department of Defense
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    - Neuropace, Inc.
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- Associate Editor of *Neurology*
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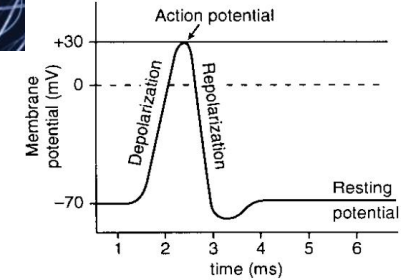
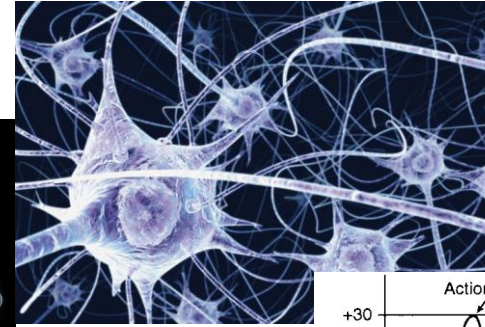
Richard Quon, PhD

# Overview

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- What is epilepsy?
  - Memory loss in epilepsy
  - The effects of music therapy in epilepsy

# What is epilepsy?

- Seizures

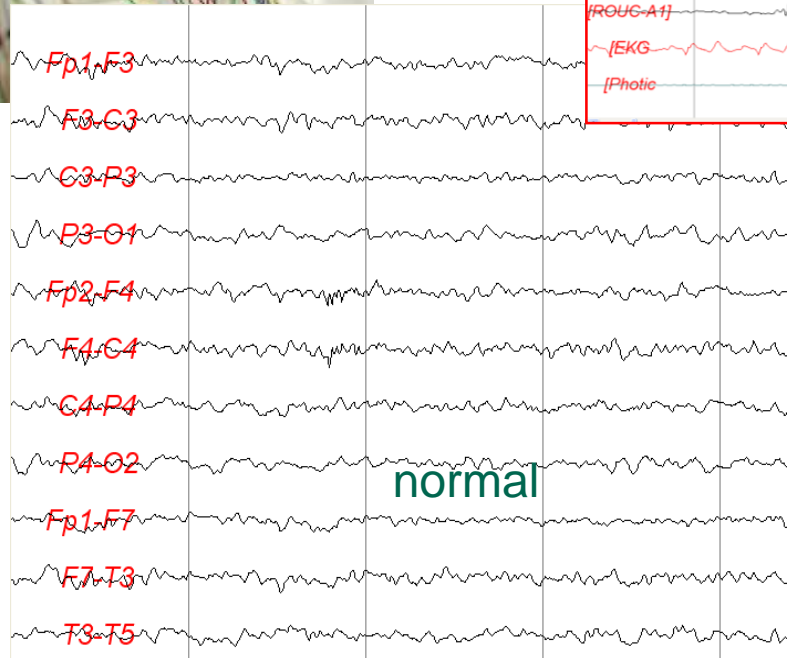
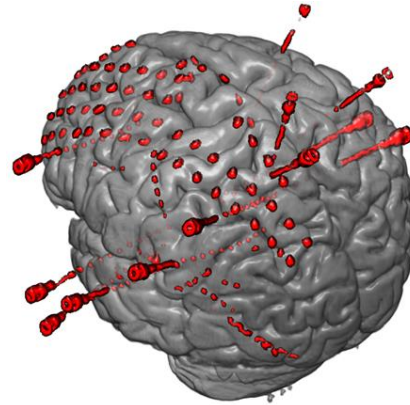
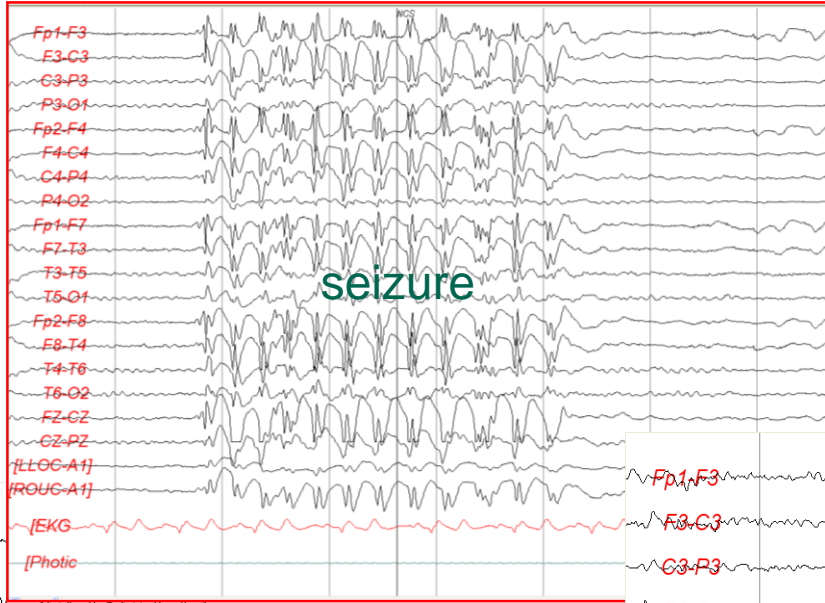
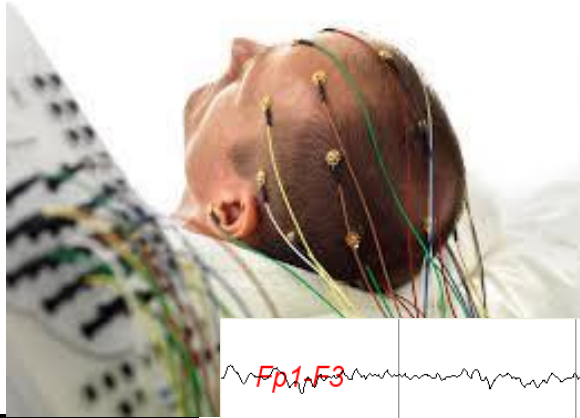


- 3.4 Mio people in the US have epilepsy

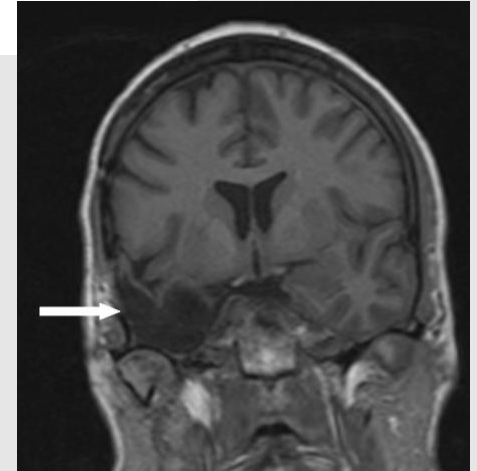
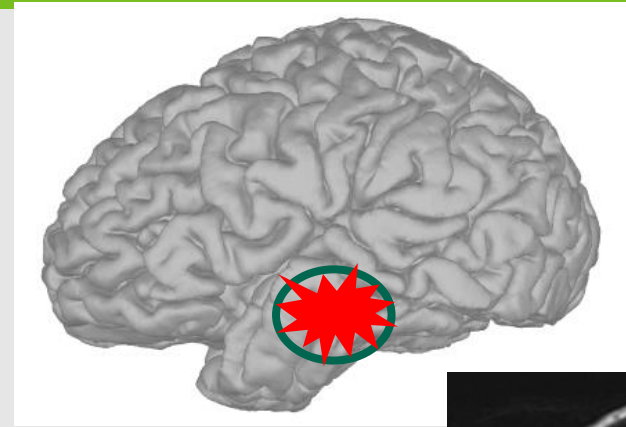


- 1% of the population will have a seizure in their lifetime

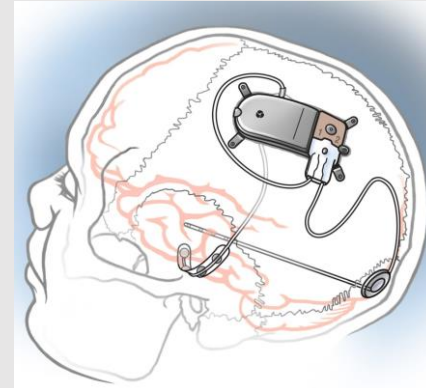
# EEG



# Treatment for epilepsy



70 % have no  
more seizures



If frequent seizures persist there are other problems

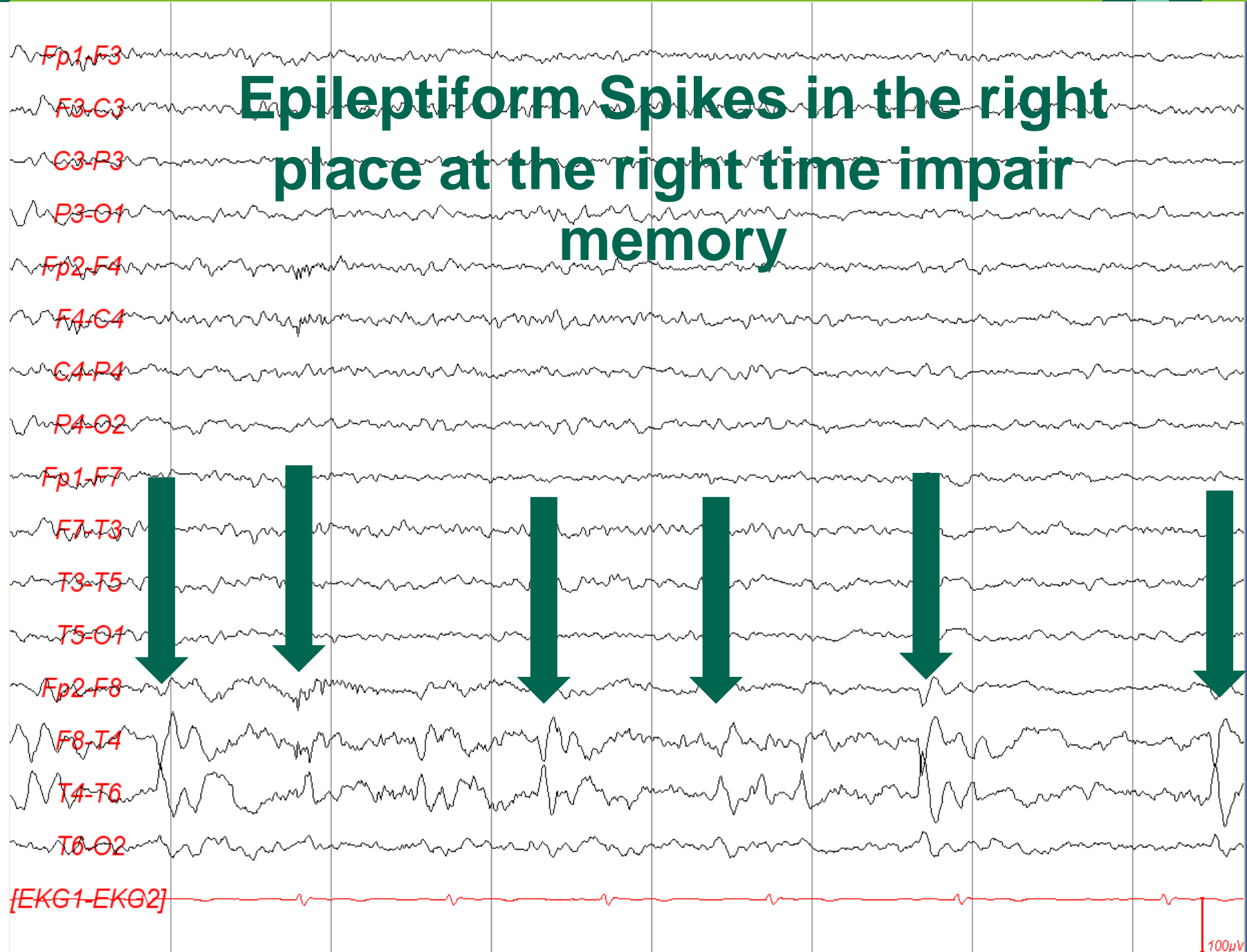
- Memory loss, that is variable but disabling for many



- Problems with mood, anxiety and depression



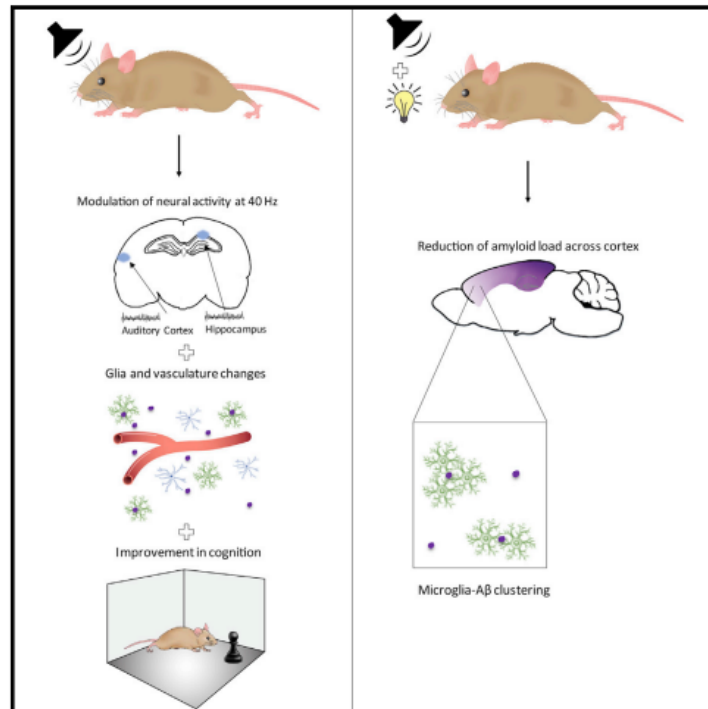
## Epileptiform Spikes in the right place at the right time impair memory



# 40 Hz tones and visual stimuli in mice

## Multi-sensory Gamma Stimulation Ameliorates Alzheimer's-Associated Pathology and Improves Cognition

### Graphical Abstract



### Authors

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Ho-Jun Suk, ..., Edward S. Boyden,  
Annabelle C. Singer, Li-Huei Tsai

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### In Brief

Auditory stimulation combined with light-induced gamma oscillations in the hippocampus CA1 and auditory cortex regions of the brain reduces amyloid levels and improves memory in animal models of Alzheimer's disease.





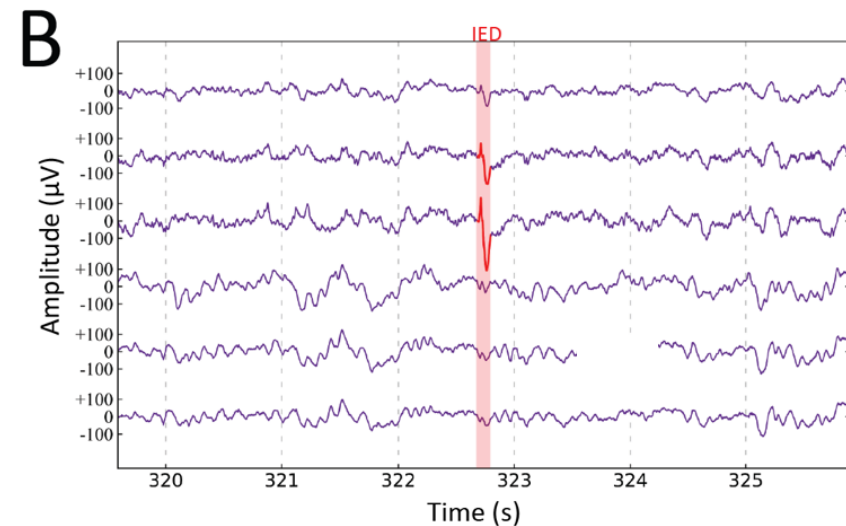
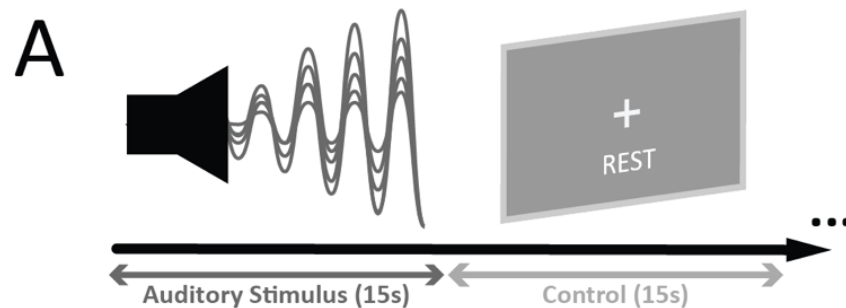
# “The K448 Effect”




- **Mozart’s Sonata for Two Pianos in D Major (K448)** reduces seizures and epileptic spikes
  - Rauscher et al. (1993)
    - “Mozart K448 effect” first described
  - Lin et al. (2011)
    - Randomized Controlled trial with children listening before bedtime correlated with a reduction in seizures



# 40 Hz and KV448



## 40-Hz auditory stimulation for intracranial interictal activity: A pilot study

Robert J. Quon<sup>1</sup>  | Grace A. Leslie<sup>2</sup> | Edward J. Camp<sup>3</sup> | Stephen Meisenhelter<sup>3</sup> | Sarah A. Steimel<sup>1</sup> | Yinchun Song<sup>1,3</sup> | Alan B. Ettinger<sup>4</sup> | Krzysztof A. Bujarski<sup>1,3</sup> | Michael A. Casey<sup>5,6</sup> | Barbara C. Jobst<sup>1,3</sup> 

- 40 Hz and KV448 did reduce epileptic spikes
- White noise and modulated KV448 and a 440 Hz tone did not

# Musical Stimuli



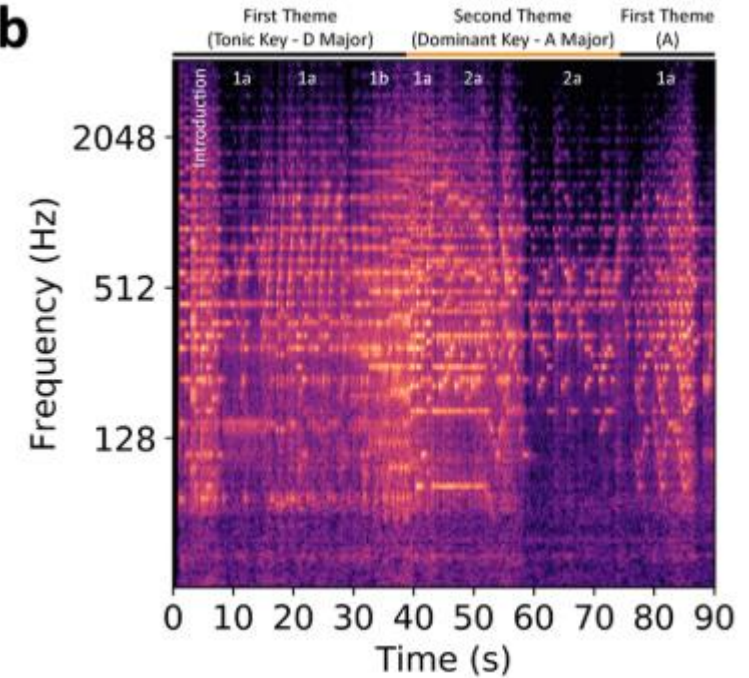
altered



Wagner

- Original version of **K448**
- Altered version of **K448**
- Negative controls: **Wagner** and **Violet Noise**
- Other stimuli:
  - Frederic Chopin's Bolero in C – Op. 19 for piano, performed by Nikita Magaloff (“**Classical T**”)
  - Franz Liszt’s Piano Sonata in B Minor, 1st movement: Lento assai – Allegro energico, performed by Leslie Howard (“**Classical N**”)
  - Three songs from a preferred musical genre (“**Preferred N**”) (“**Preferred T**”)
- “**T**” or “**N**” indicates if the gamma-range auditory modulation spectrum of that song matched (“**T**”) or did not match (“**N**”) that of K448
- “**Altered**” indicates signals with secondary gamma modulations

**b**



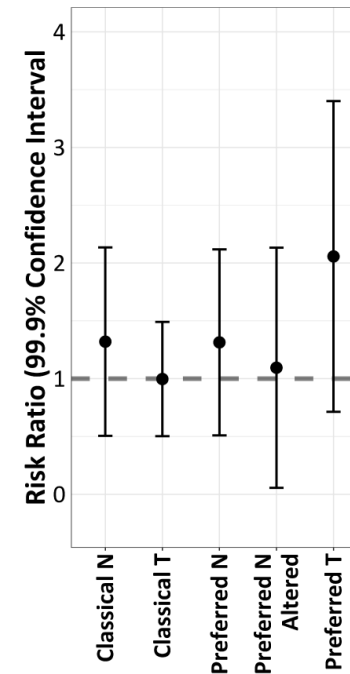
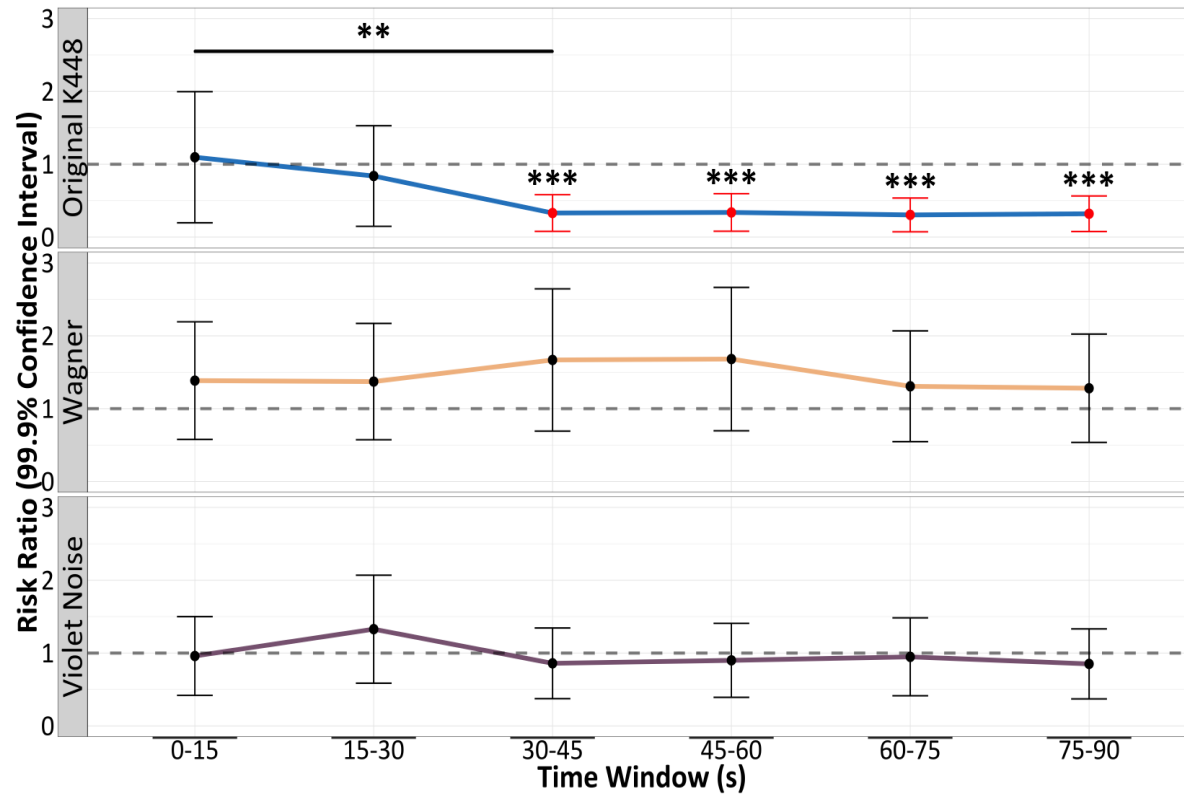


# Music and Spikes

Check for updates

## OPEN Musical components important for the Mozart K448 effect in epilepsy

Robert J. Quon<sup>1,4</sup>, Michael A. Casey<sup>2,3</sup>, Edward J. Camp<sup>4</sup>, Stephen Meisenhelter<sup>4</sup>, Sarah A. Steimel<sup>1</sup>, Yinchun Song<sup>1,4</sup>, Markus E. Testor<sup>4,5</sup>, Grace A. Leslie<sup>6</sup>, Krzysztof A. Bujarski<sup>1,4</sup>, Alan B. Ettinger<sup>7</sup> & Barbara C. Jobst<sup>1,4</sup>

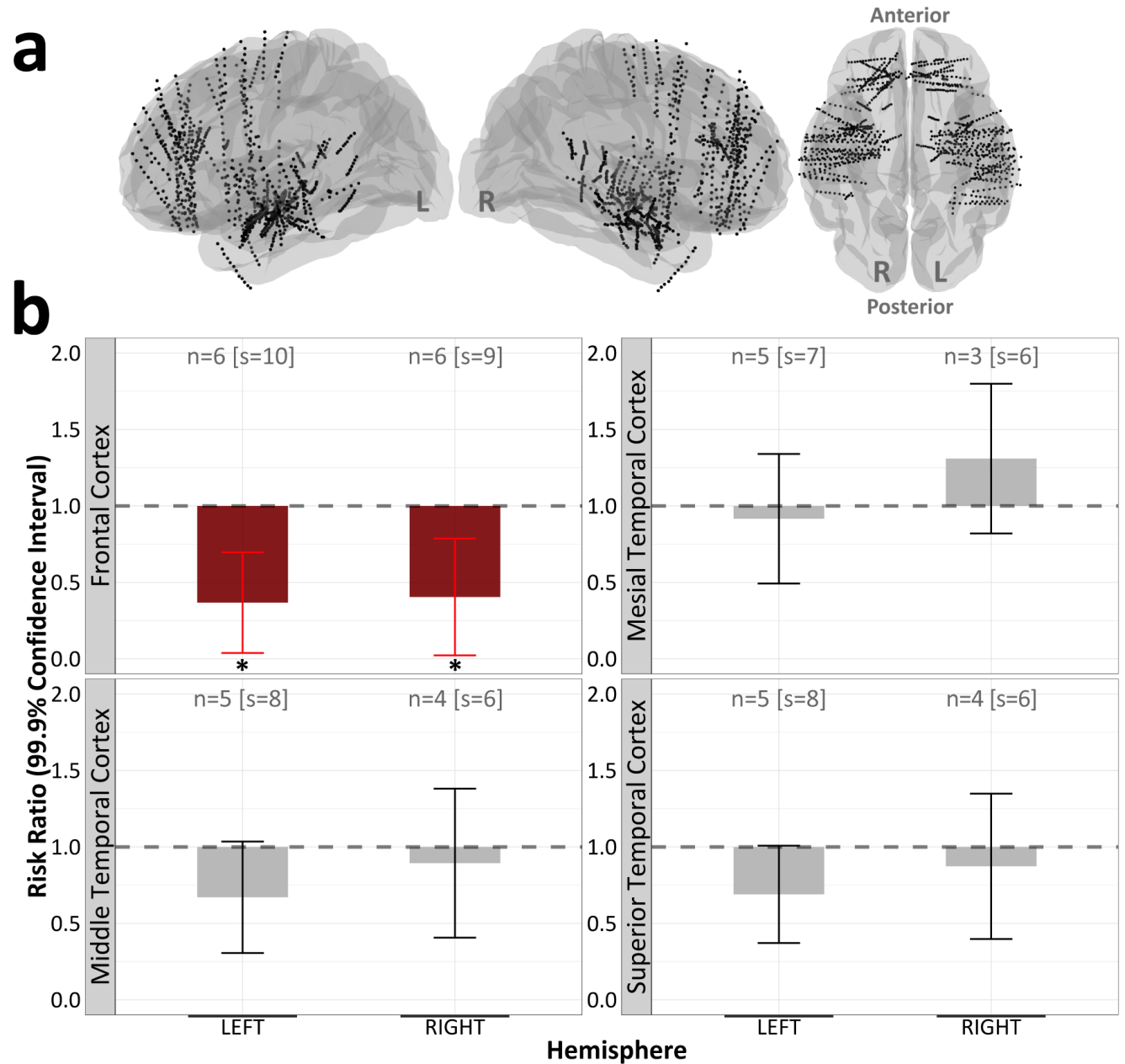


Wagner  
Liszt  
Chopin  
Preferred music

No effect



Where in the brain do we see most of this effect?



## Main Conclusions

- Mozart's K448 may reduce epileptiform activity and seizures, possibly memory
- Evidence for the preferential reduction of epileptiform activity in bilateral frontal regions
  - Implications for the activation of emotion networks regulated by the frontal cortex
- Maybe we can engineer some music that is antiepileptic and helps memory