# Decoding spatial location from aperiodic and alpha oscillatory activity in working memory

Distributed Mechanisms for Working Memory Nanosymposium

SfN, 11/13/2023

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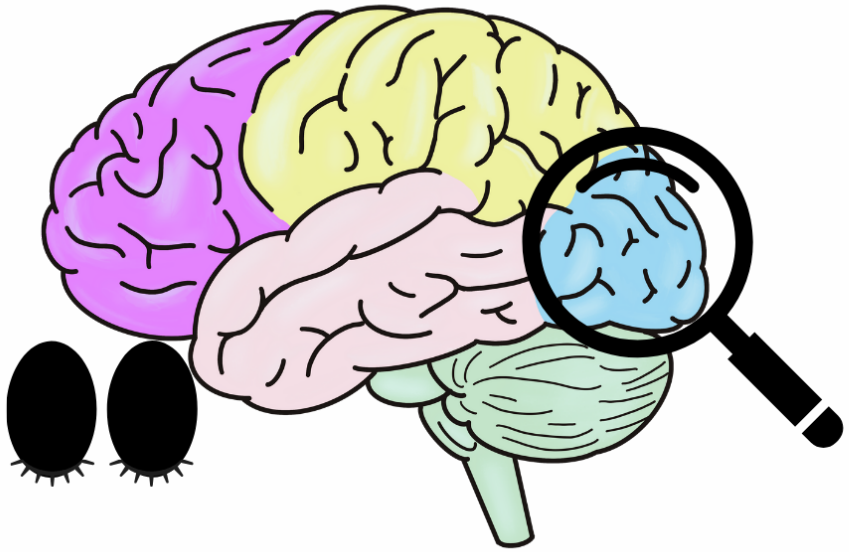
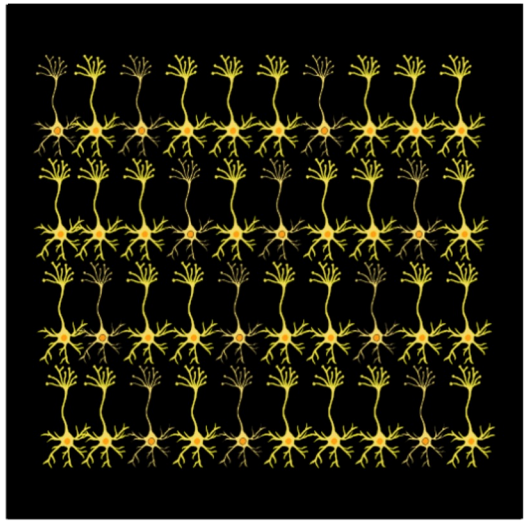
Voytek Lab

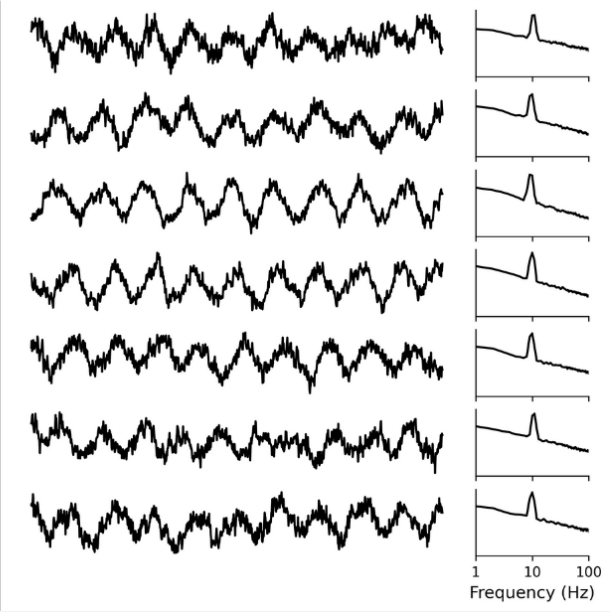
UC San Diego

# Introduction

## Alpha oscillations in spatial attention and WM







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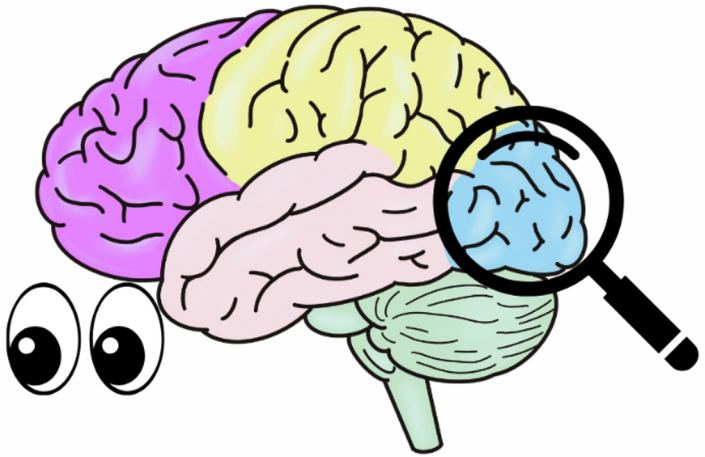

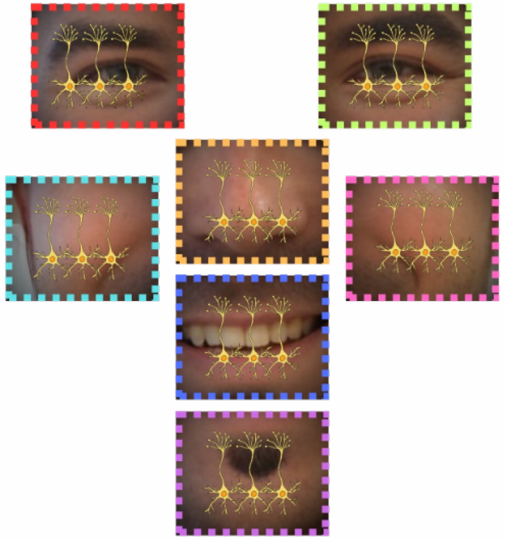

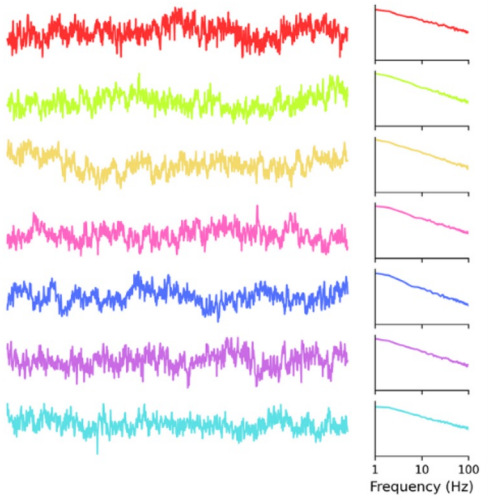


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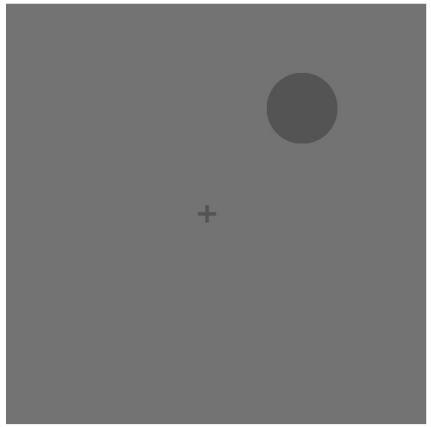
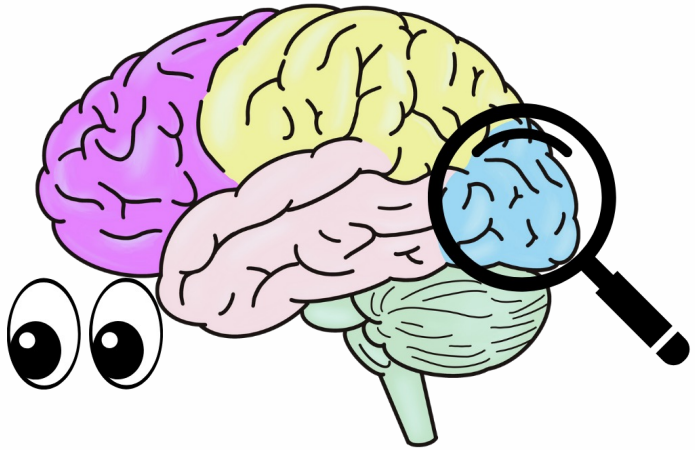
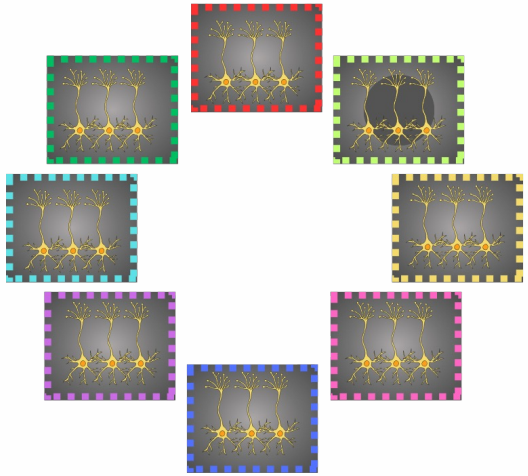
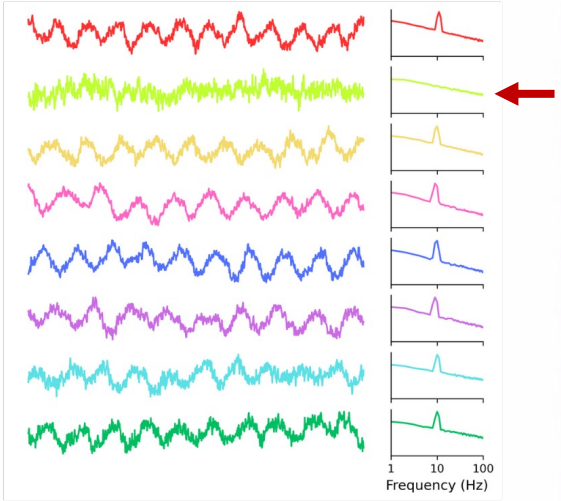


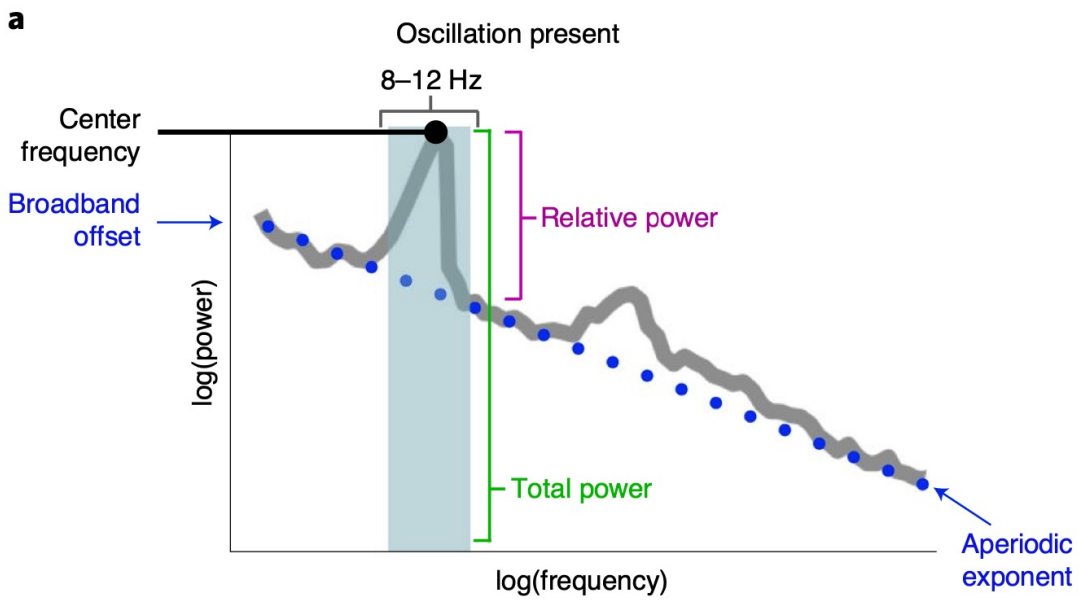


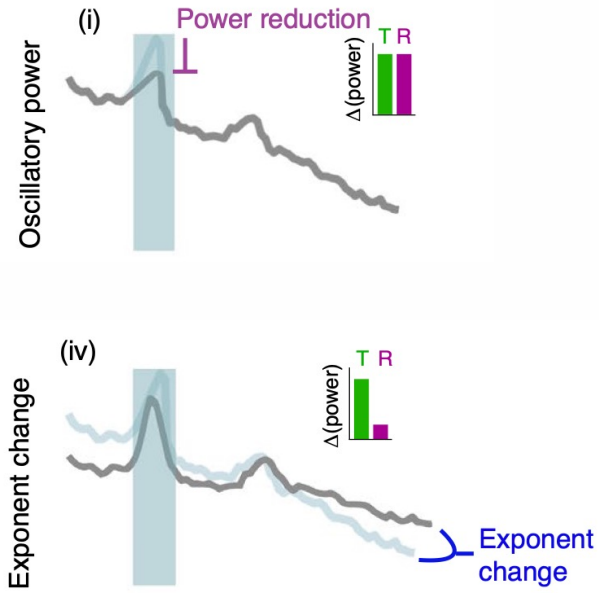




# Introduction

## Importance of spectral parameterization




- Hilbert transform confounds changes in aperiodic exponent with changes in alpha power
- **Without spectral parameterization, unable to adjudicate whether aperiodic exponent or alpha power underlies WM representations**

Donoghue, Haller, Peterson, et al. (2020)

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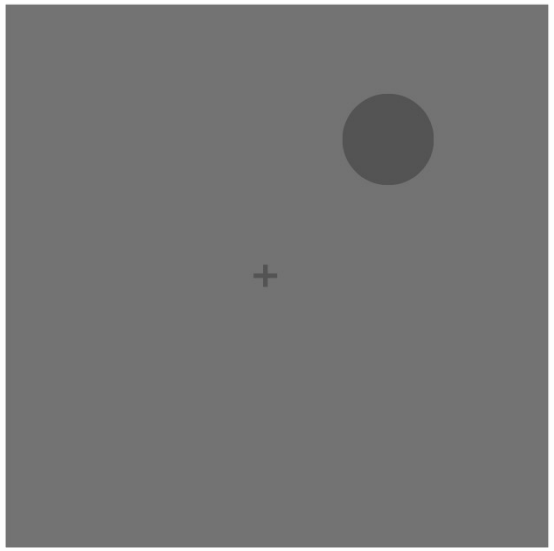
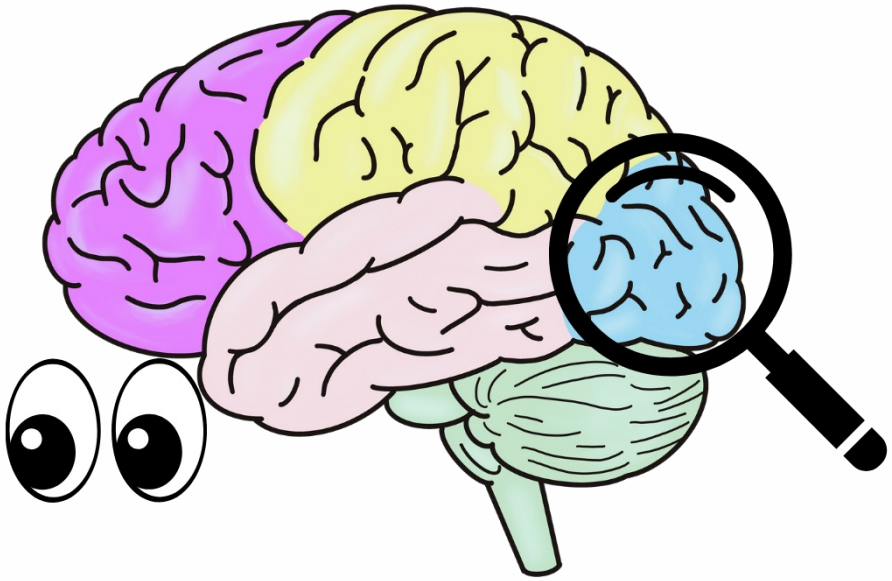
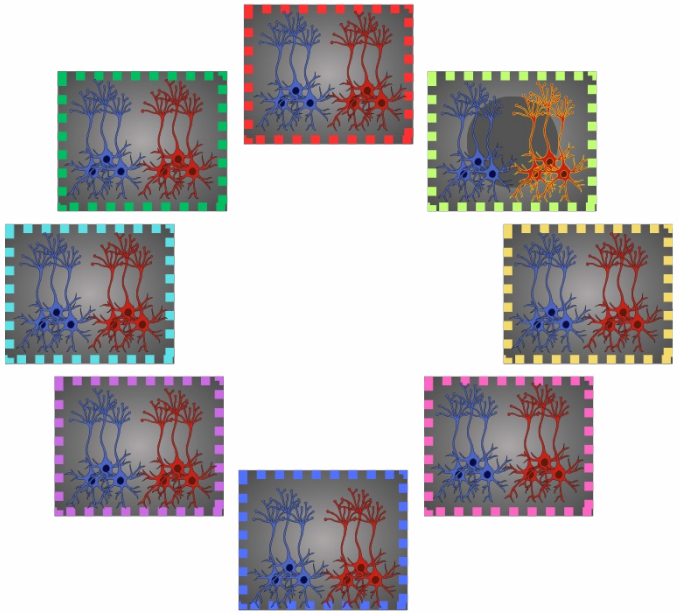
# Introduction

## Aperiodic exponent in working memory

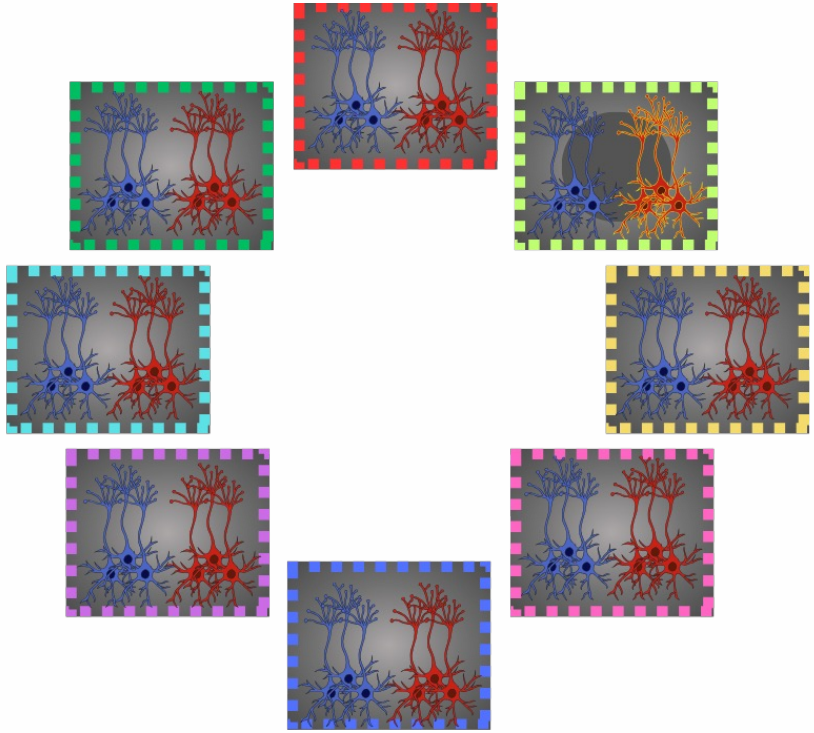


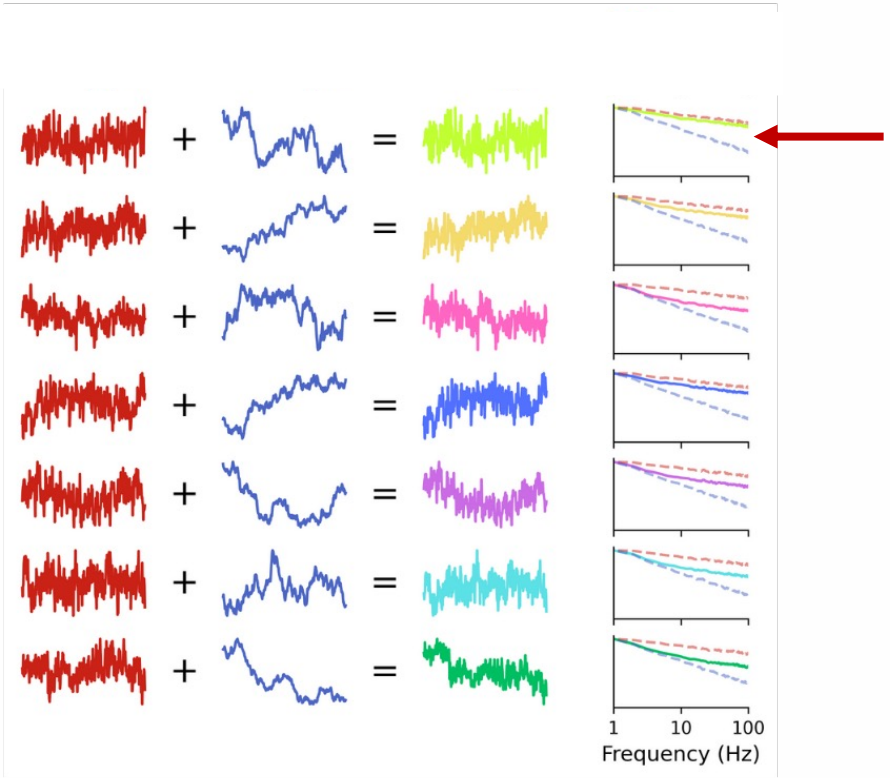




# Introduction

## Aperiodic exponent in working memory

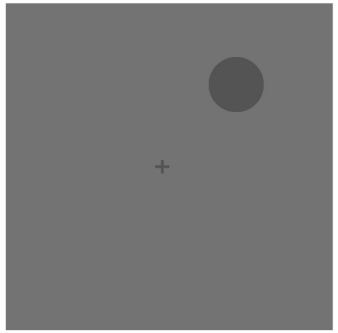


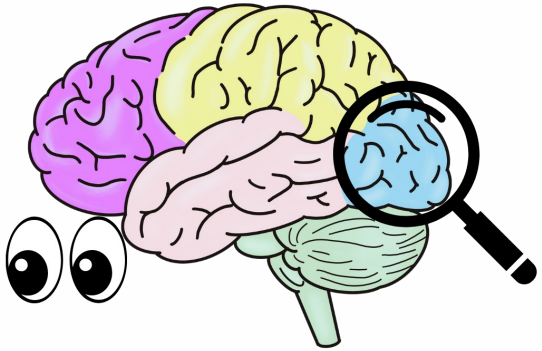


# Introduction

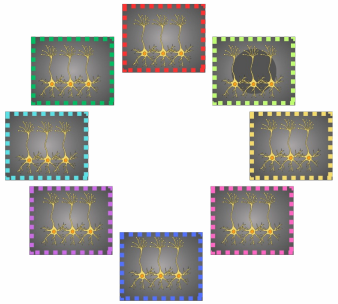
## Hypotheses

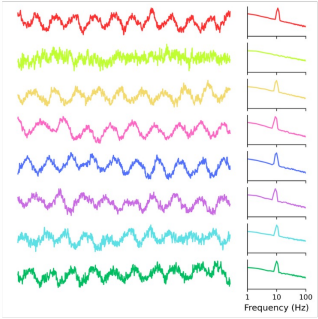
1. Encoding of spatial location by total alpha power during **WM maintenance** is reflective of true differences in **alpha oscillatory power**
2. Initial encoding of spatial location during **stimulus presentation** is supported by changes in **E/I balance** that are reflected in **aperiodic exponent** changes



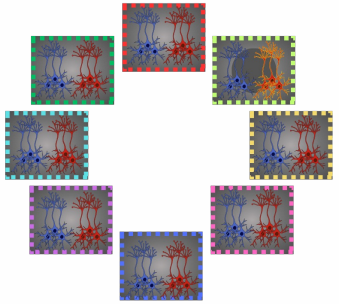


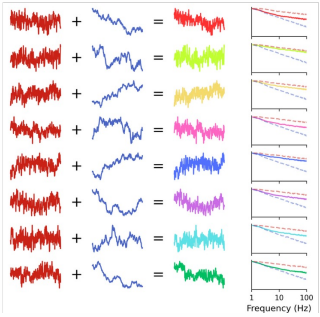
WM maintenance





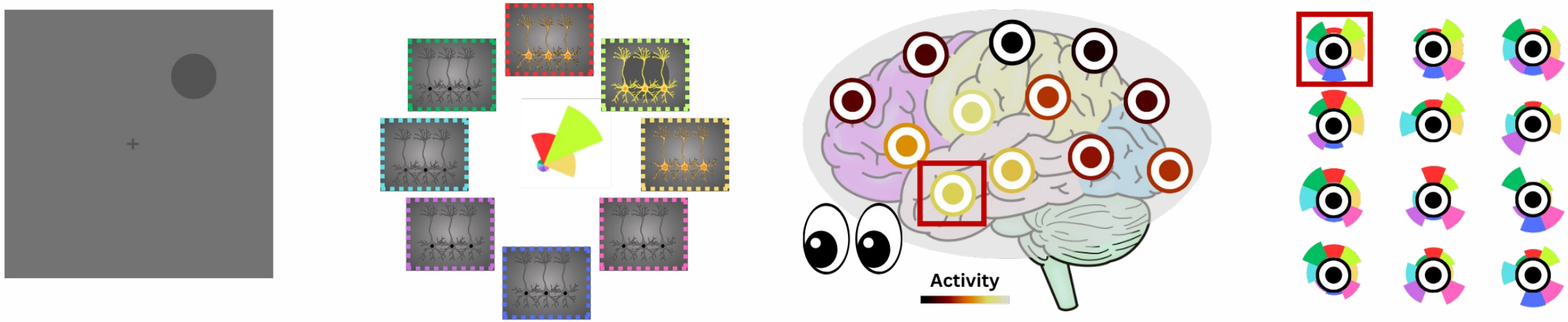

Stimulus encoding





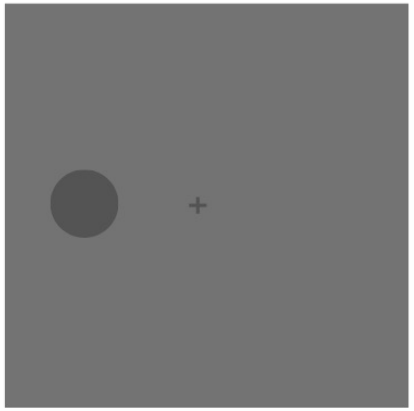
# Methods

## Fit encoding model of spatial location

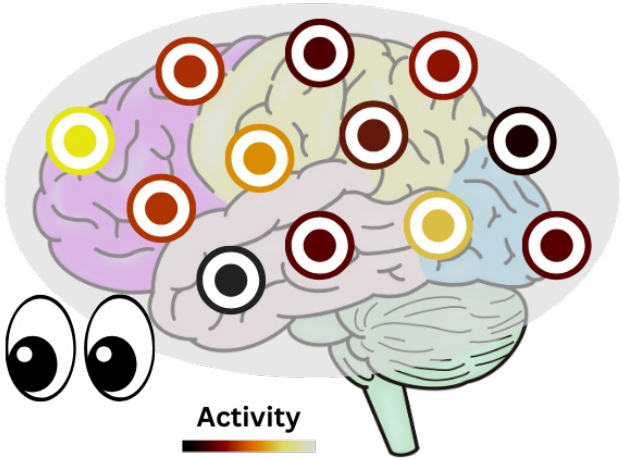


# Methods

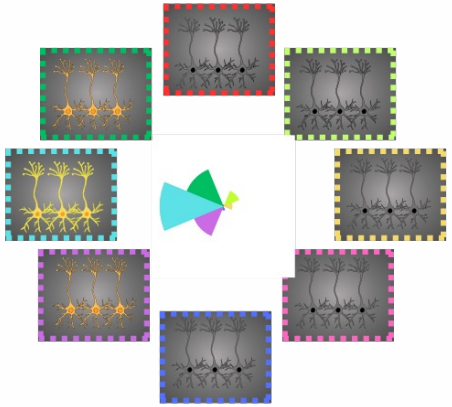
## Assess strength of spatial location representation from inverted encoding model

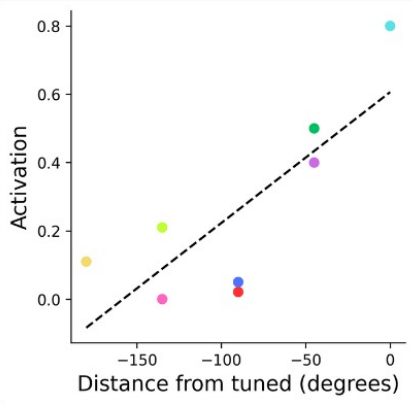


X




Channel tuning function (CTF)

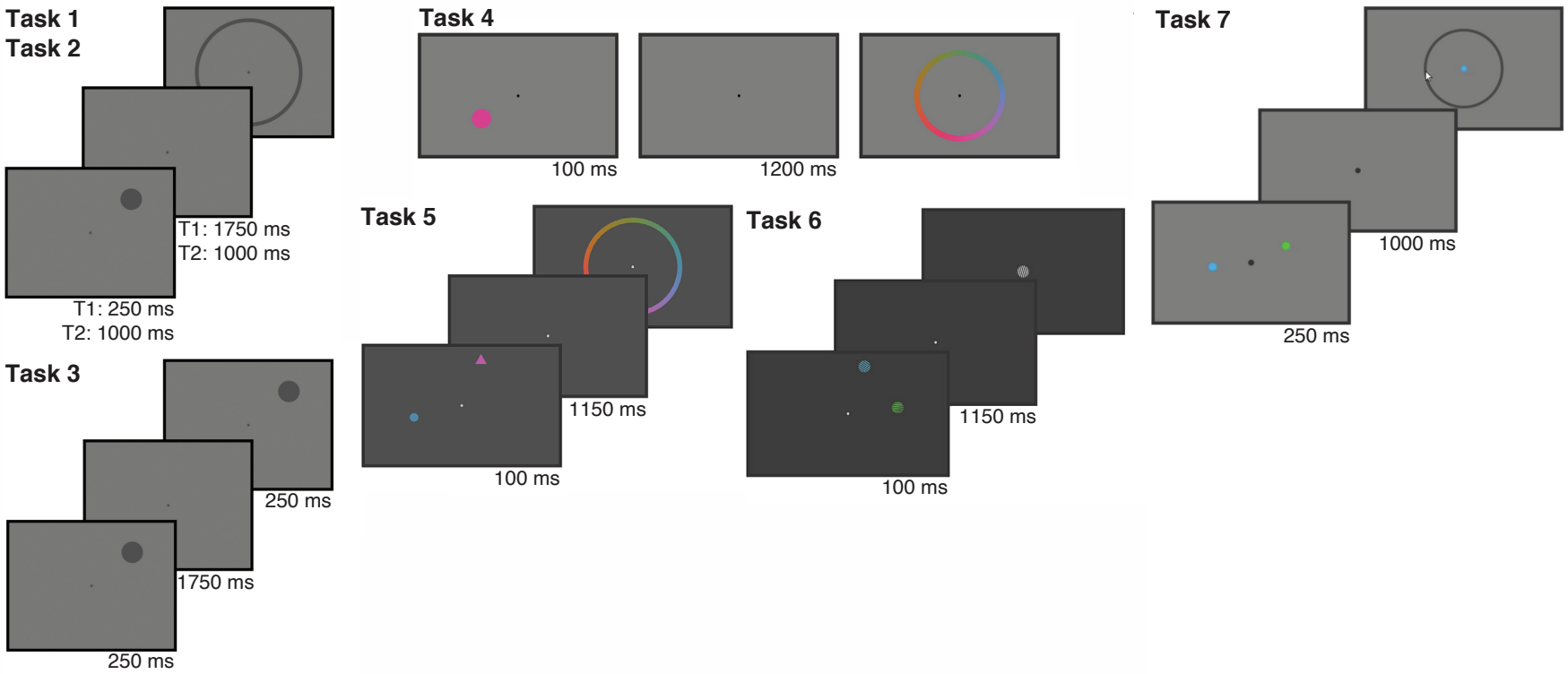





CTF slope

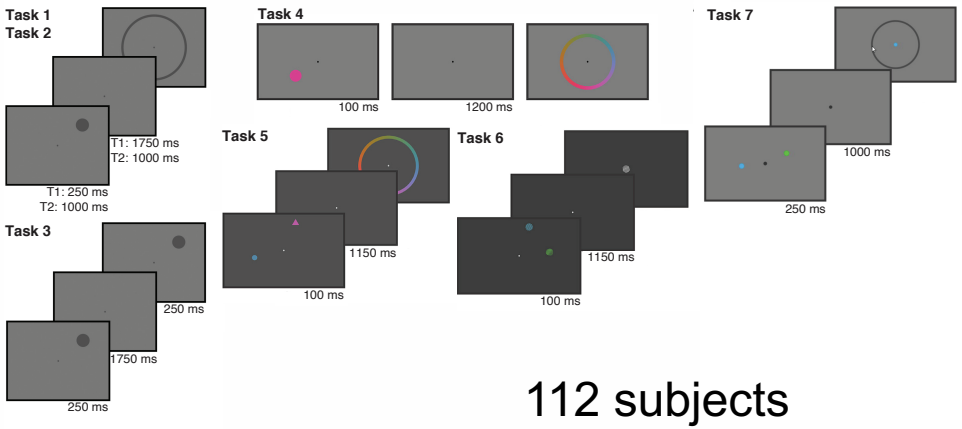
# Methods

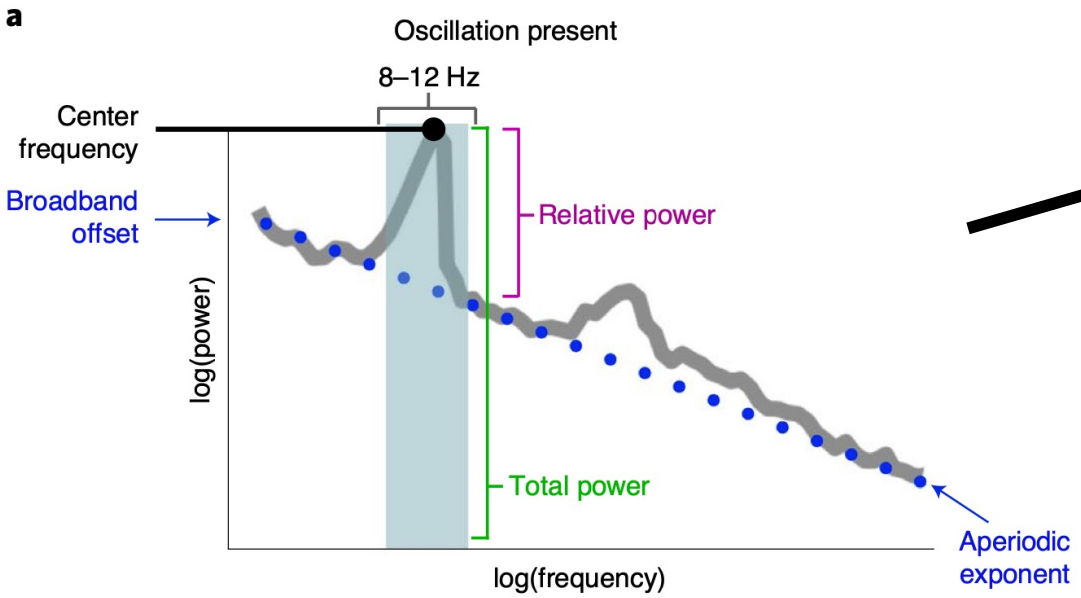
## Dataset: large collection of spatial WM tasks (*n* = 112)



# Methods

## Time-resolved spectral parameterization




112 subjects
~872 trials
~27 channels
~775 timepoints

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2,071,005,276 spectra
0.002 s
1 day/86,400 s

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~48 days
1/68 cores
24 hours/day

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~17 hours

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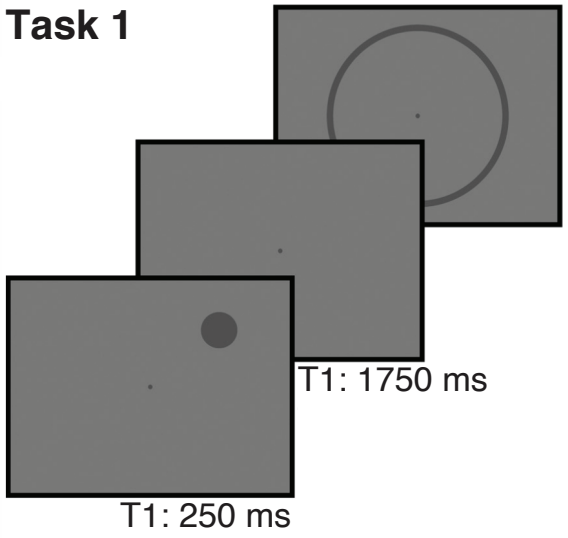
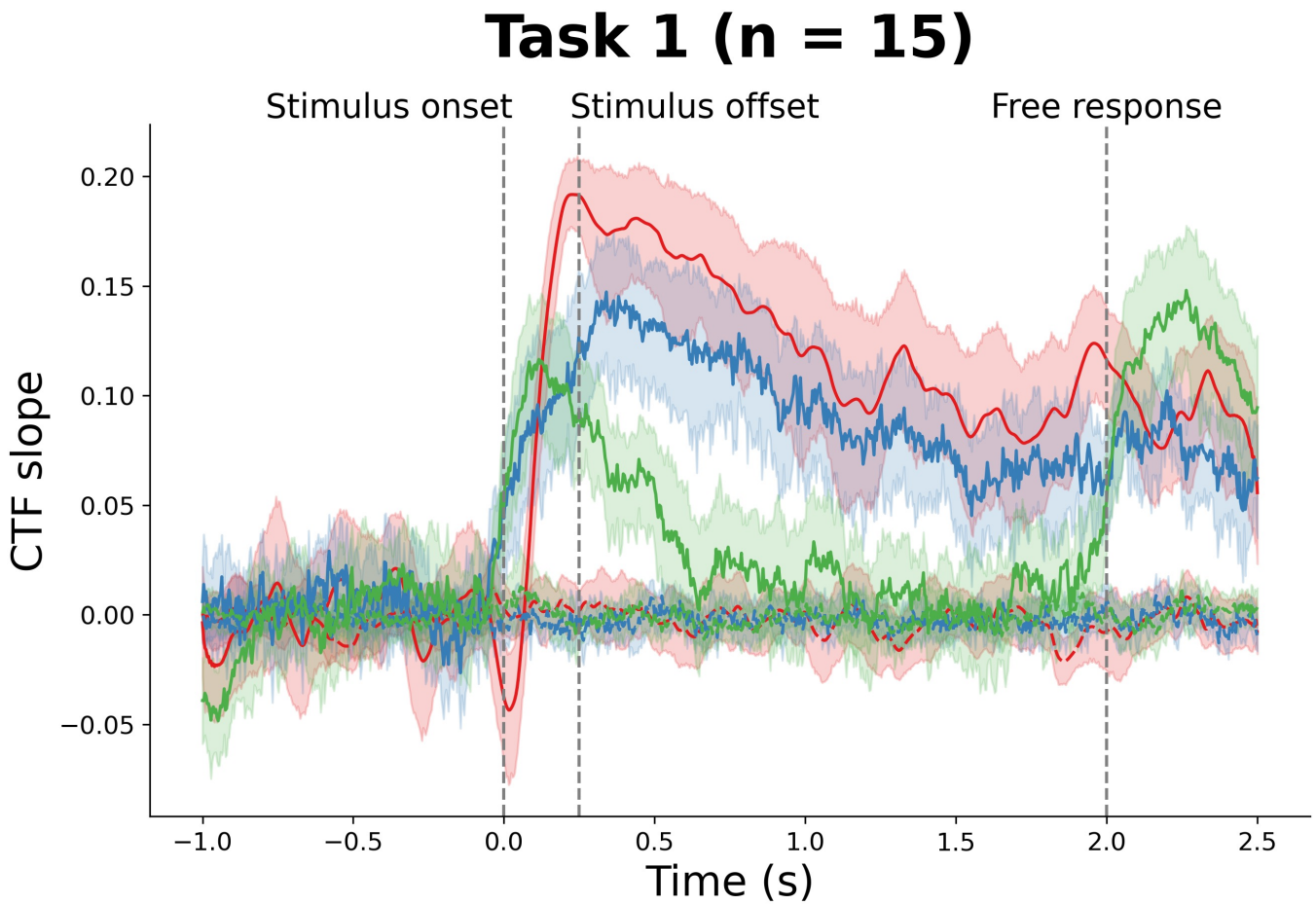
# Results

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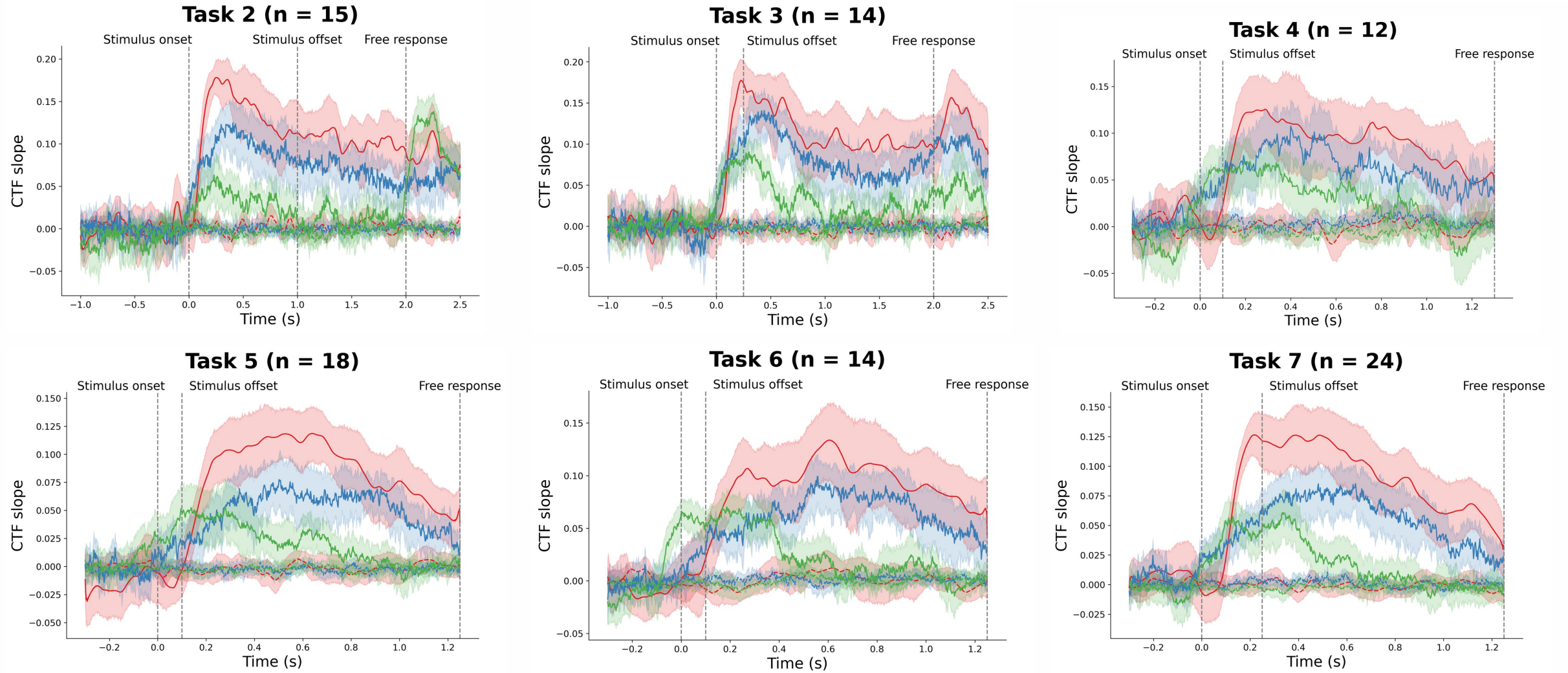
# Results

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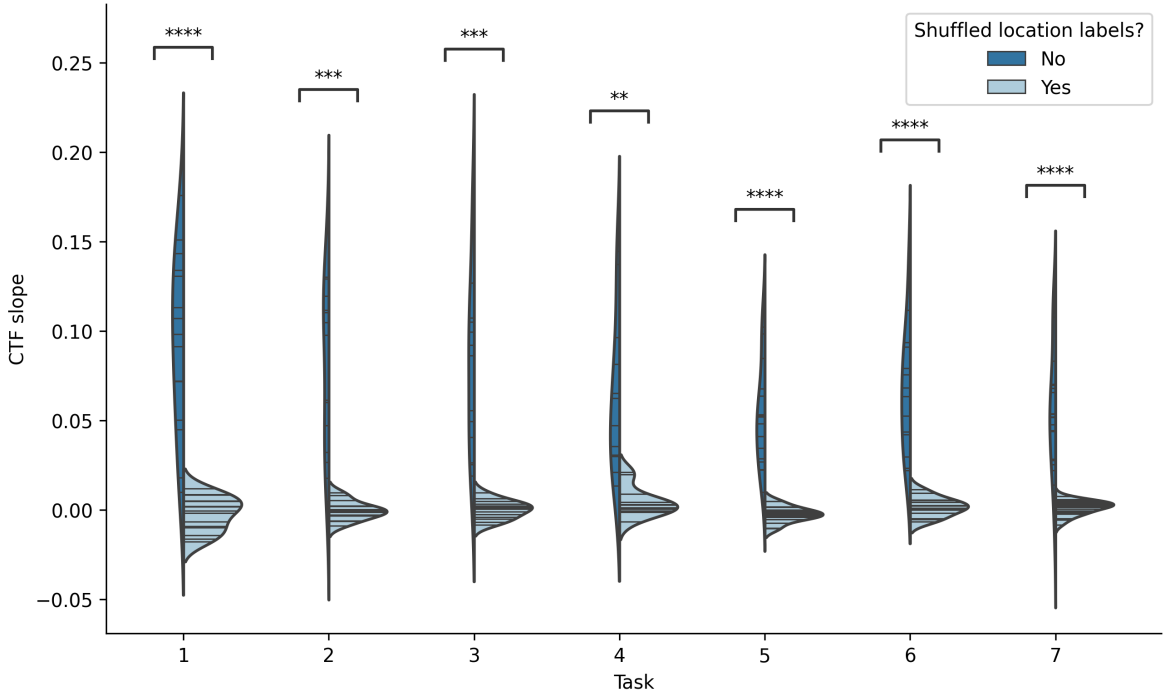
# Preliminary conclusions

1. Alpha oscillatory power encodes spatial location during **WM maintenance**

CTF slope for alpha oscillatory power during WM maintenance

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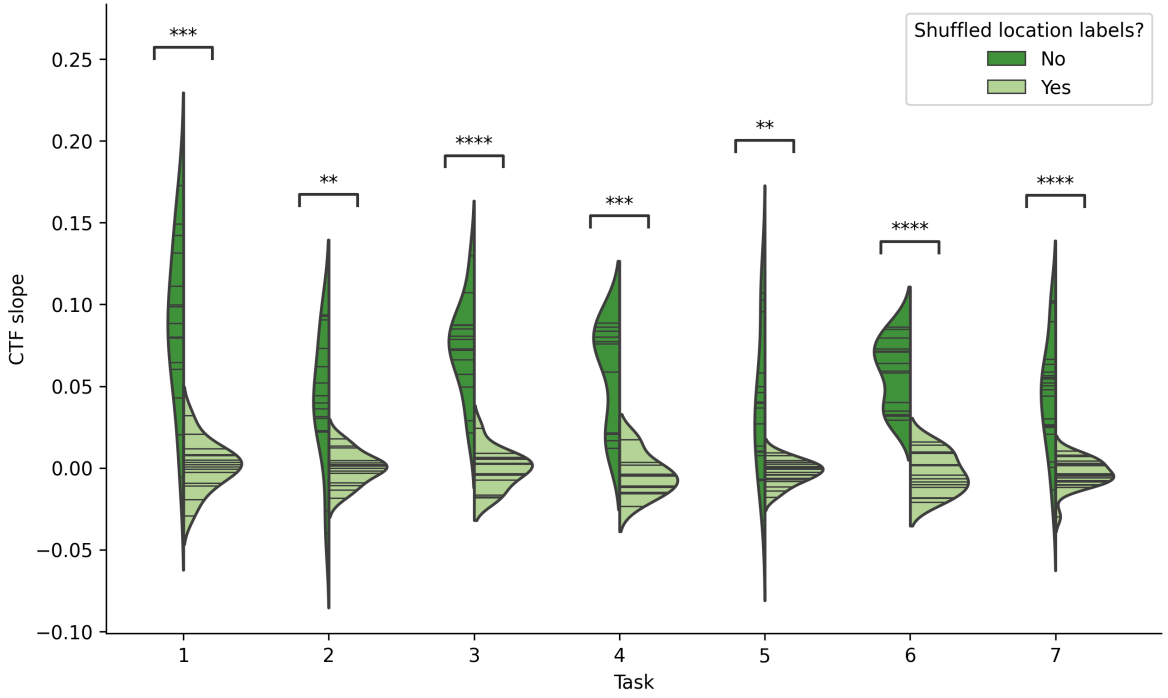
# Preliminary conclusions

1. Alpha oscillatory power encodes spatial location during **WM maintenance**
2. Aperiodic exponent encodes spatial location during **first 400 ms** after stimulus onset

CTF slope for aperiodic exponent during first 400 ms after stimulus onset

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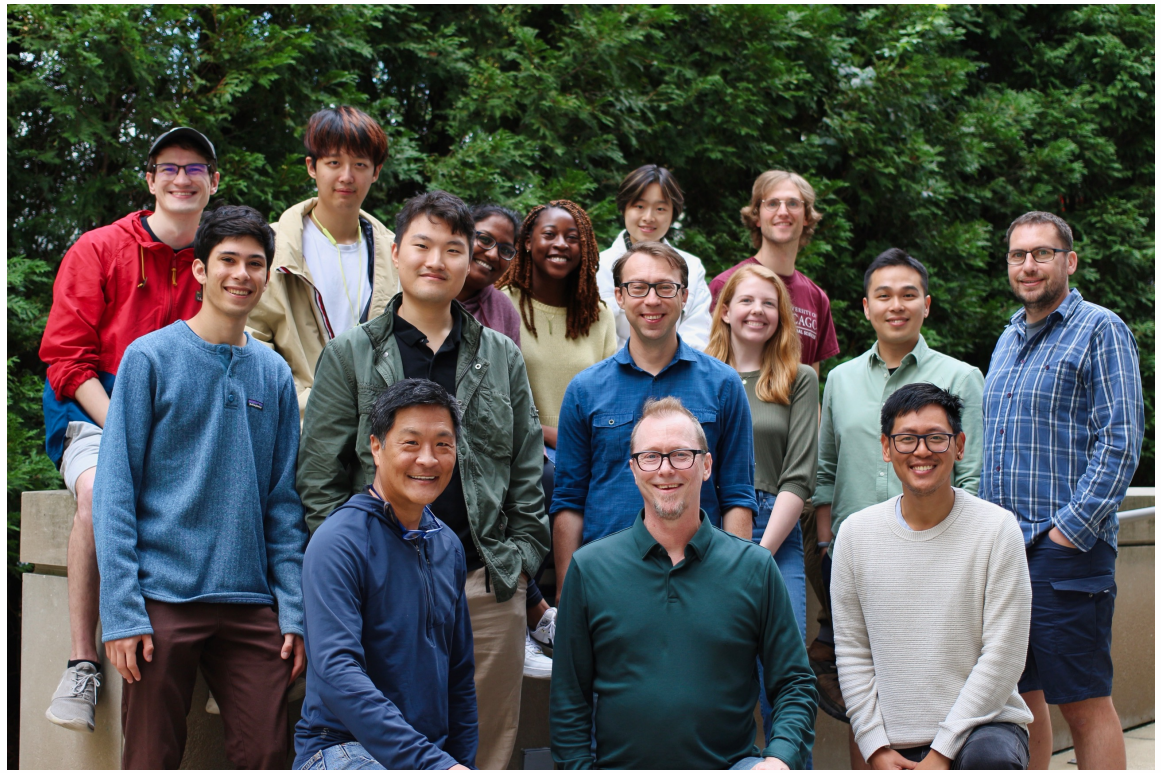
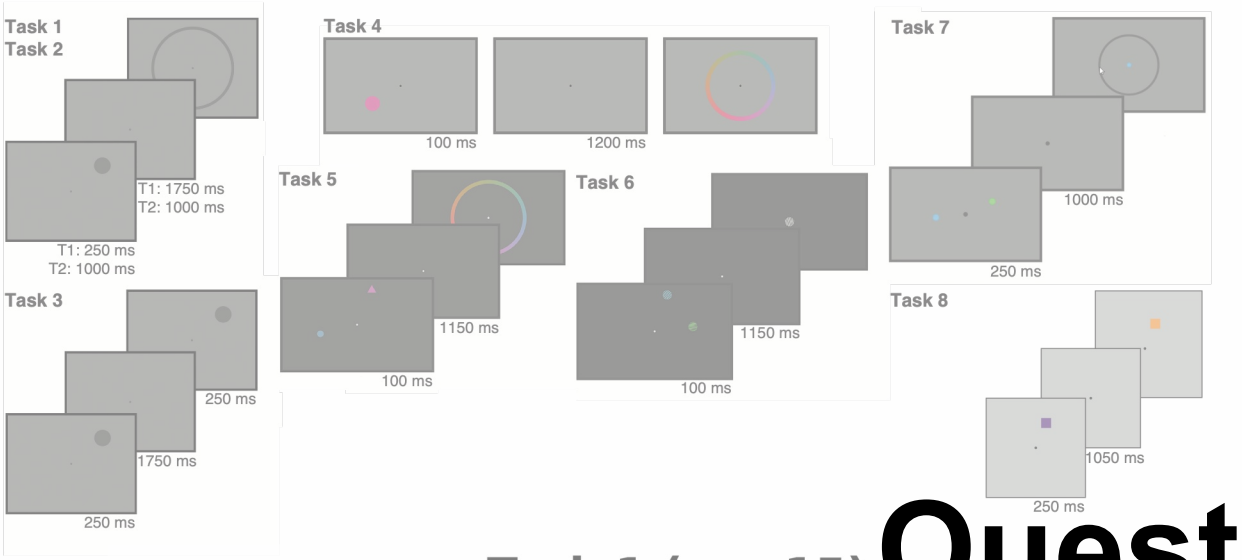
# Acknowledgments

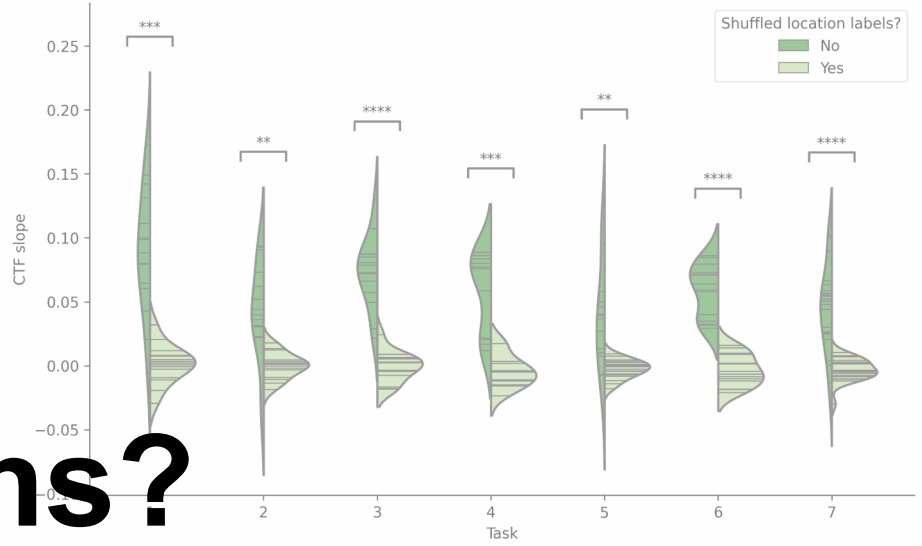
Voytek Lab @ UC San Diego

Awh/Vogel Labs @ UChicago



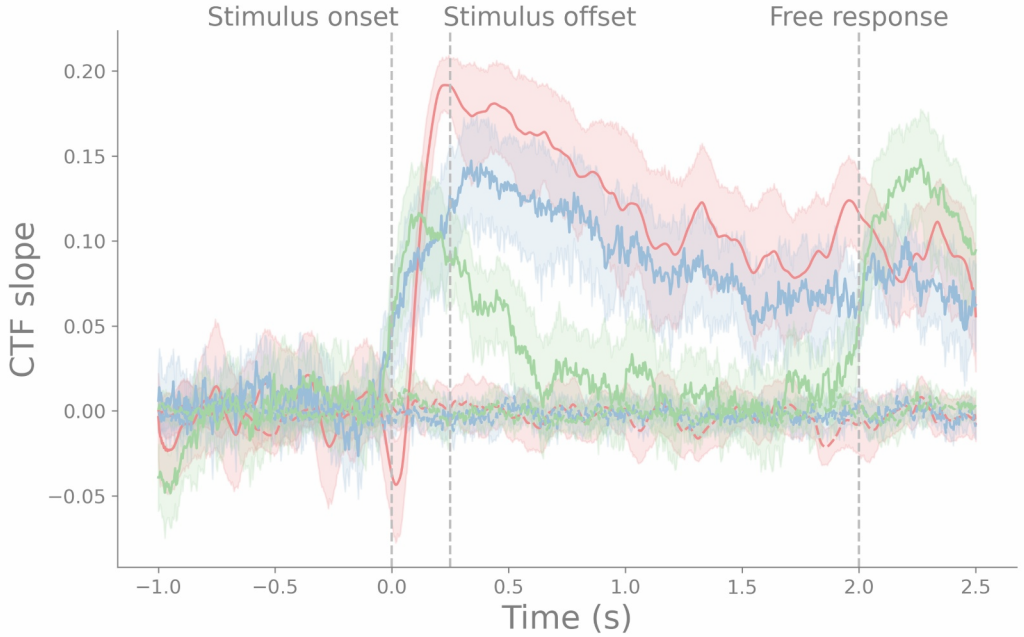



CTF slope for aperiodic exponent during first 400 ms after stimulus onset

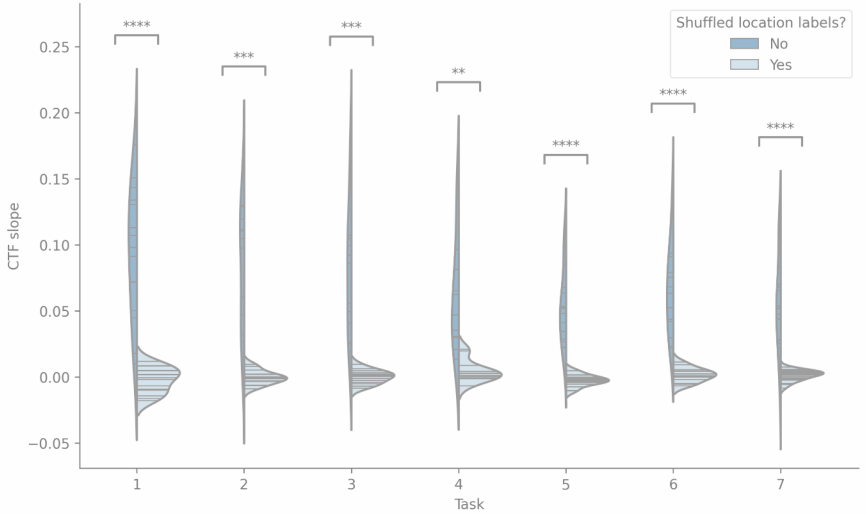



# Questions?

## Task 1 (n = 15)




CTF slope for alpha oscillatory power during WM maintenance

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