# Brain in Motion


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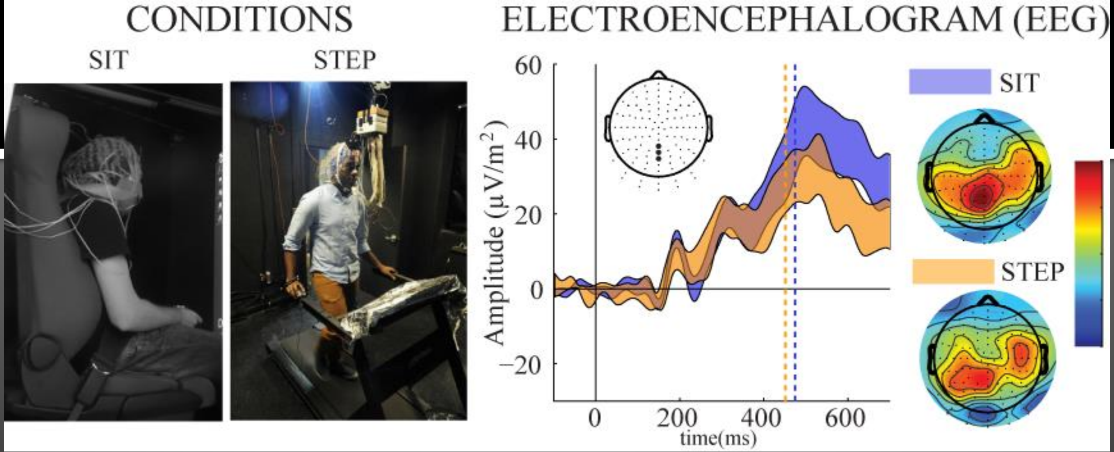
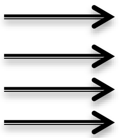
Technological University Dublin

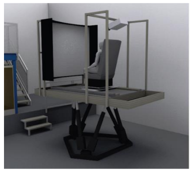



# My Background

- Numerical Analysis (Trinity College Dublin, PhD work)
  - Robust Numerical methods of Prandtl Boundary Layer Problems



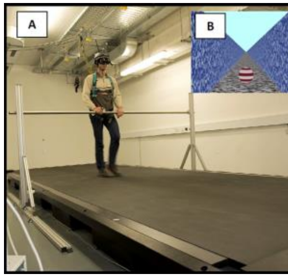
- Self-motion Perception (Max Planck Institute for Biological Cybernetics)
  - Walking
  - Driving



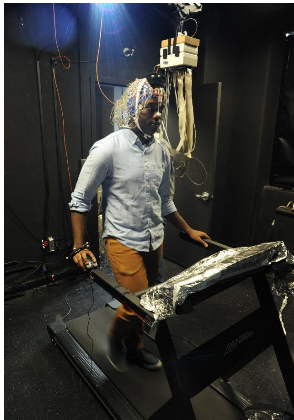
- Unisensory and Multisensory processing
  - Developmental Disorders (Albert Einstein College of Medicine)
    - Autism Spectrum Disorder, Niemann Pick Type C
  - Movement Disorders (Trinity Centre for Bioengineering)
    - Parkinson's Disease
    - Dystonia

# Talk Overview

1. Introduction
   I. Self-motion
   II. Virtual Reality



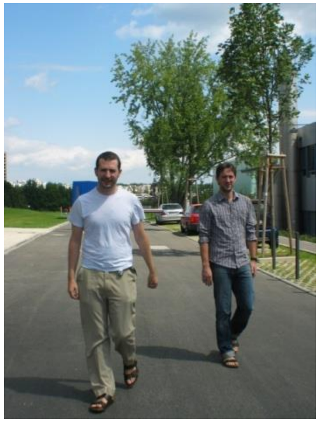

2. The Brain while walking



# Introduction

# Self-motion

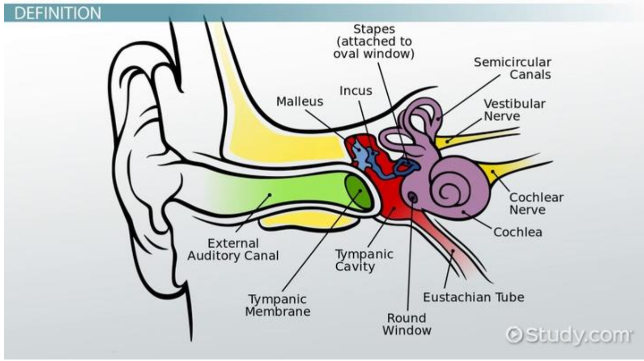
- Self-motion
  - Walking
  - Driving

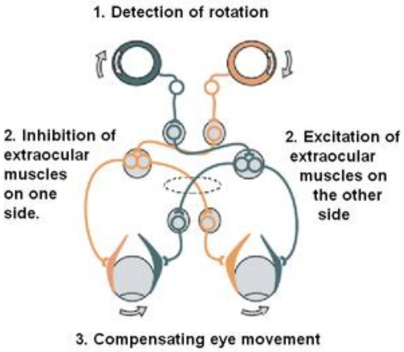


- Cues for Self-motion
  - Visual
  - Vestibular
  - Proprioception
  - Etc.

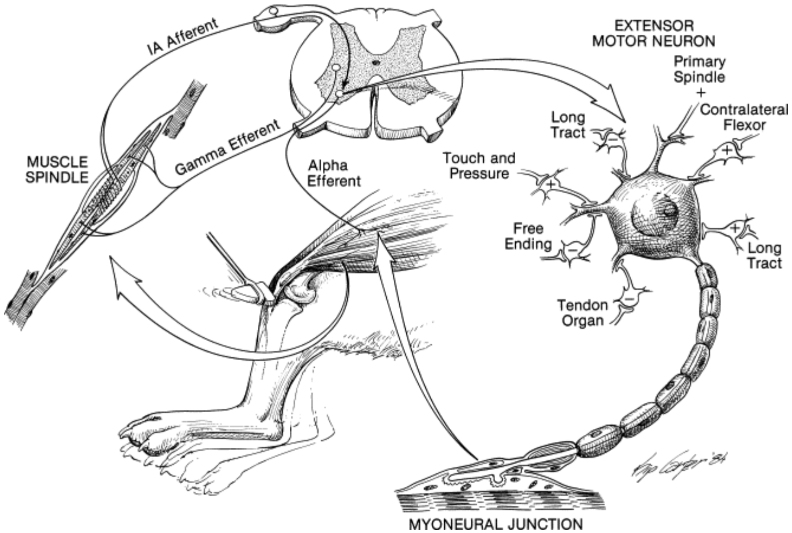
# Body motion Cues

- Vestibular
  - Eye movements
  - Heading
  - Acceleration

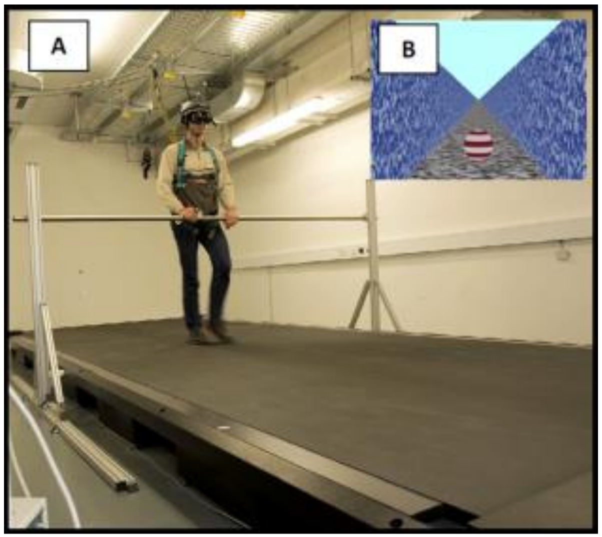


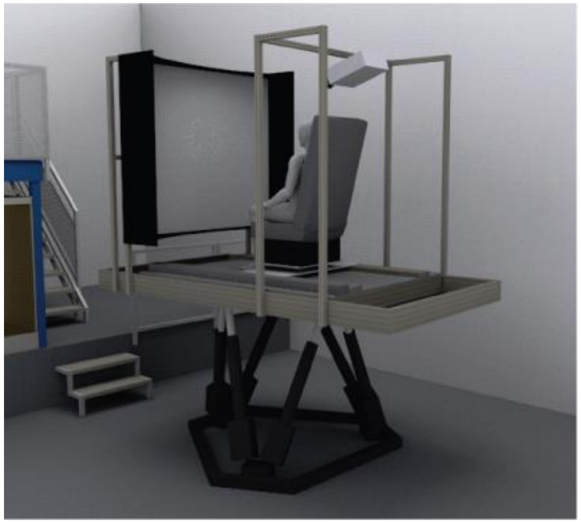




- Proprioception
  - Somatosensory
  - Joints



# Virtual Reality



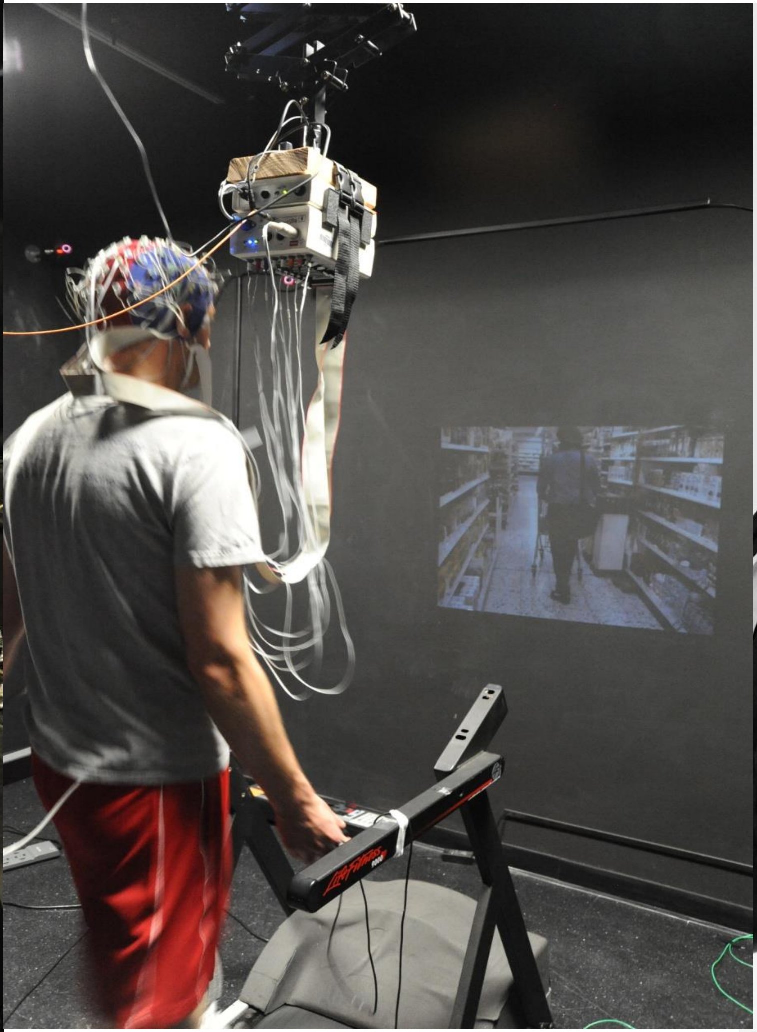



# Virtual Reality

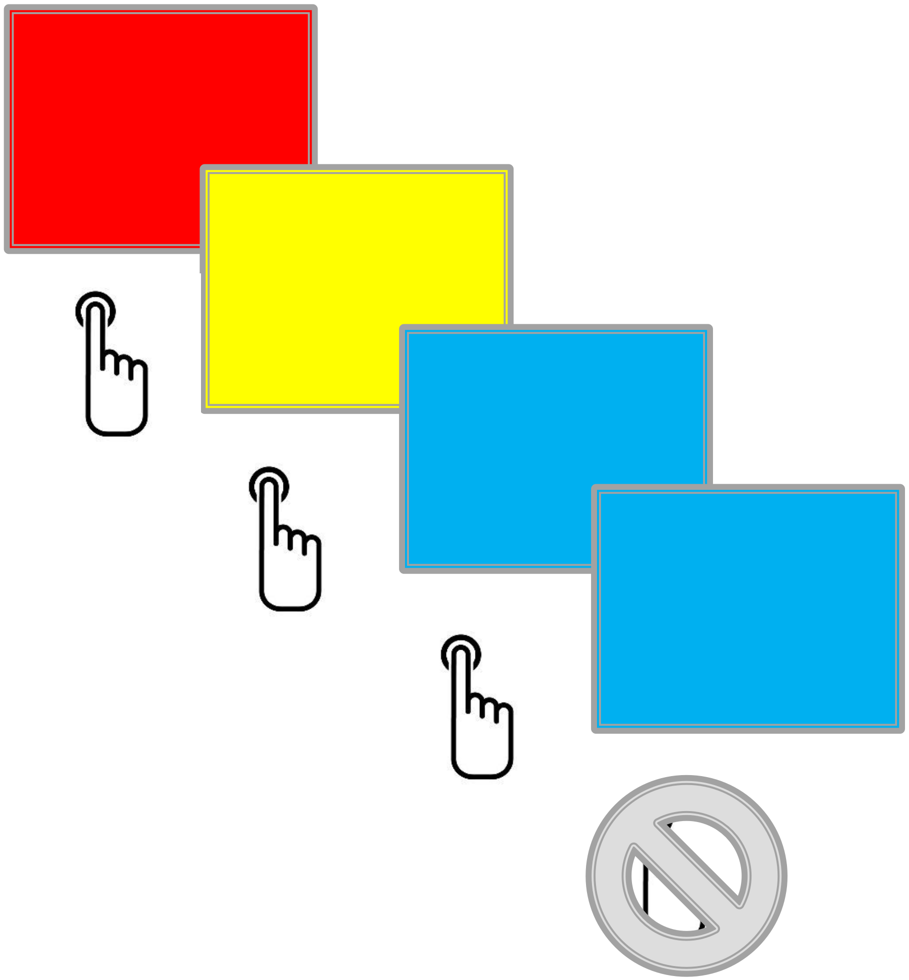
# Virtual Reality

# The Brain in Motion

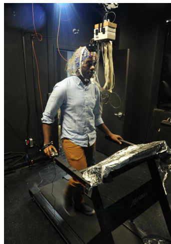
# EEG while Walking



# Response Inhibition Task



- Go Trials
- NoGo Trials
- Go/NoGo = 80/20%



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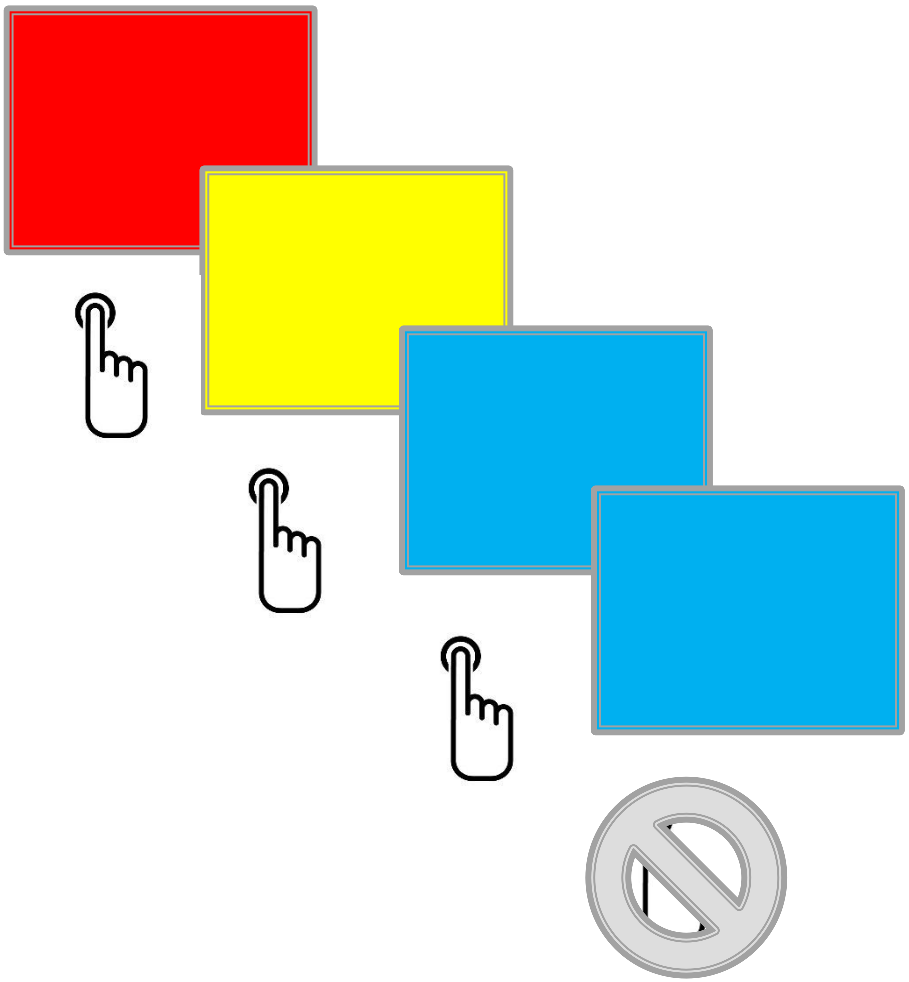
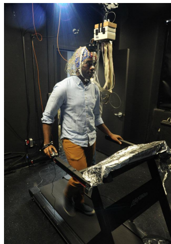


- Conditions
  - Sitting
  - Walking
- Participants
  - 18 Young [21-36yrs]
  - 18 Old [58-71yrs]



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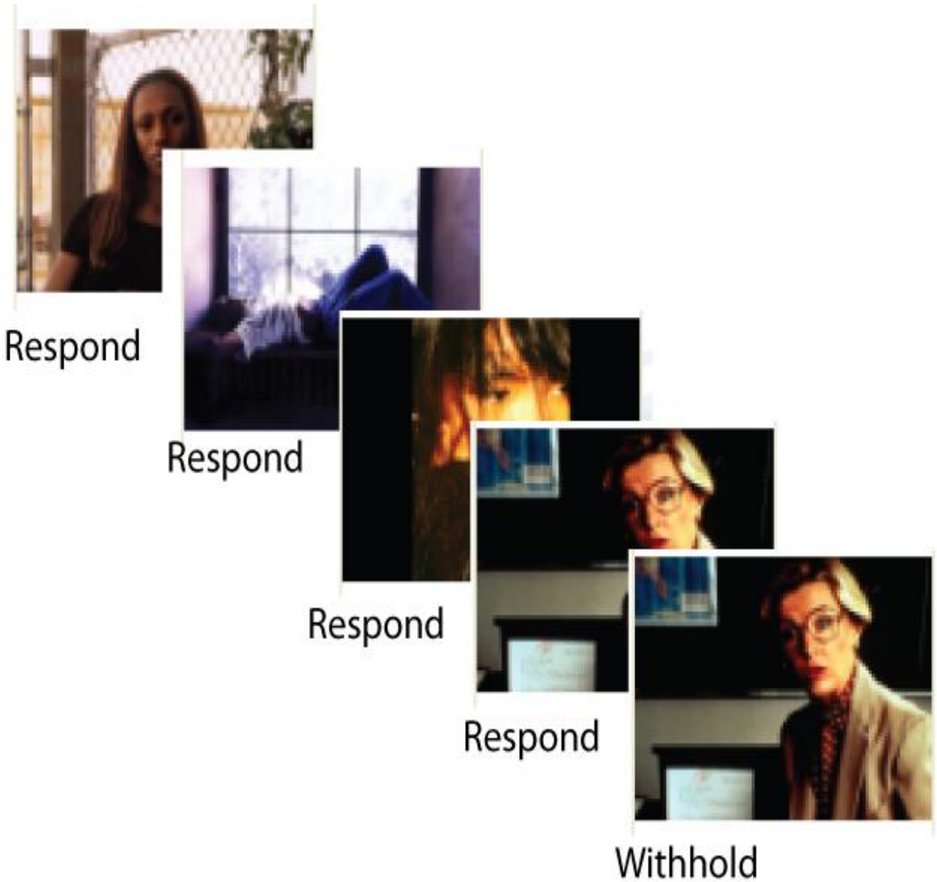



## Task

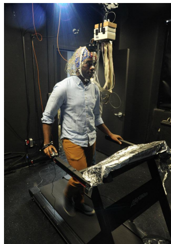
- Go trials
- NoGo trials
- Go/Nogo = 80/20%

## Conditions

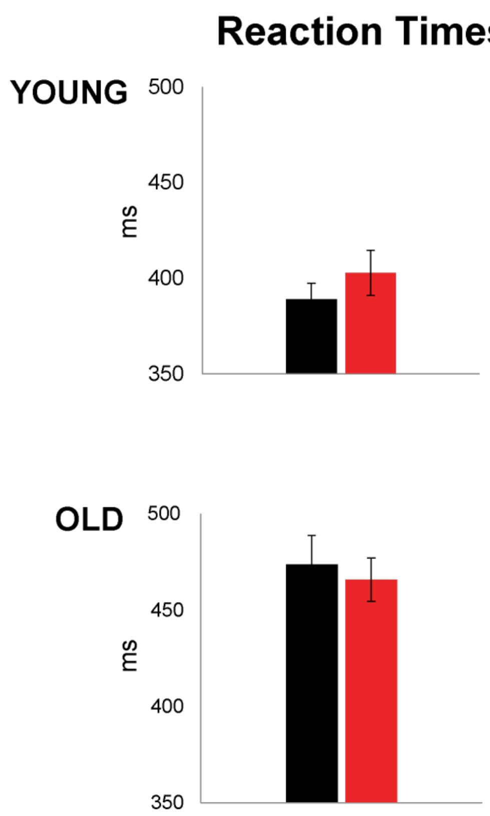
- Sitting
- Walking

## Participants

- 18 Young [21-36yrs]
- 18 Old [58-71yrs]

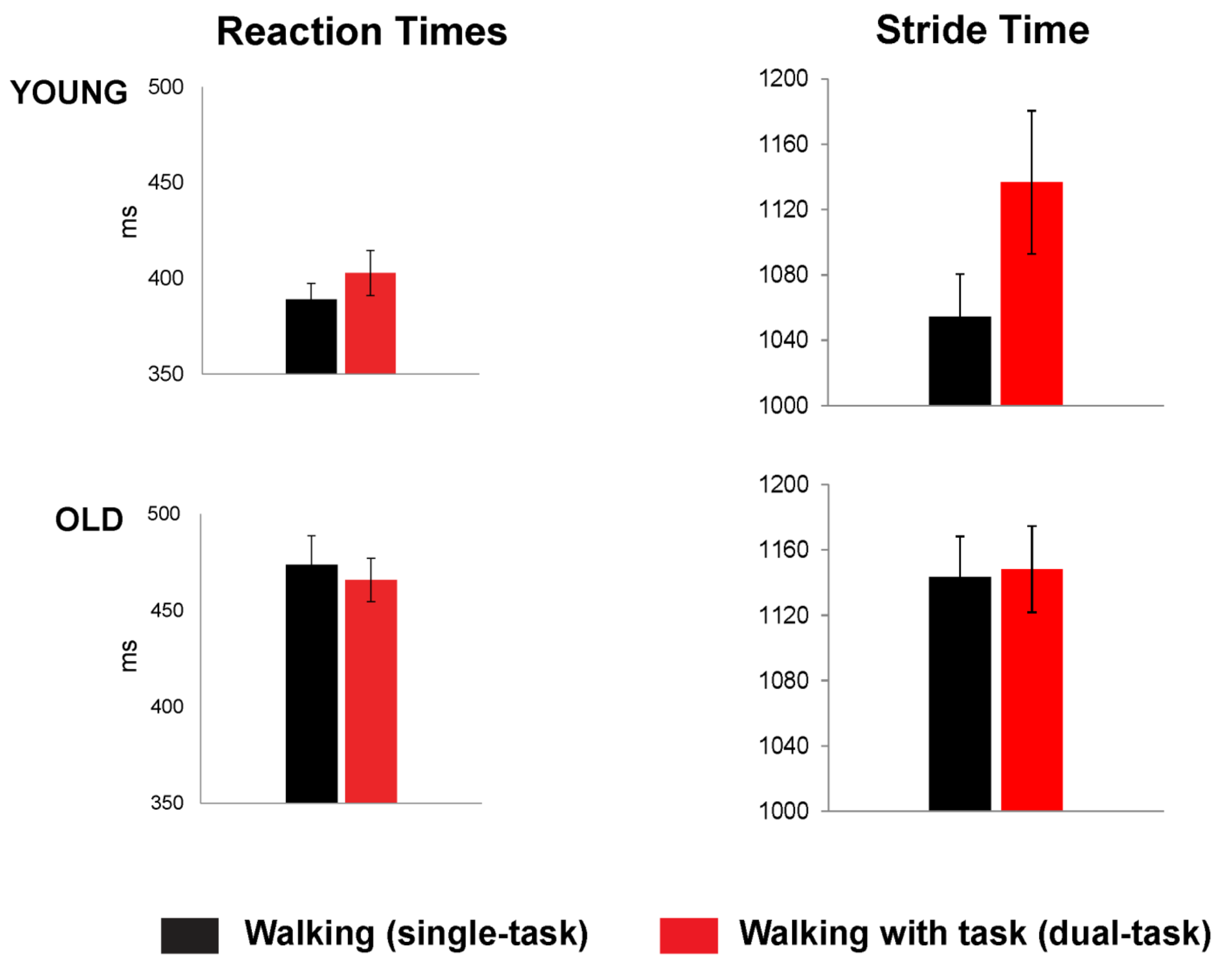


# Behavioural Results

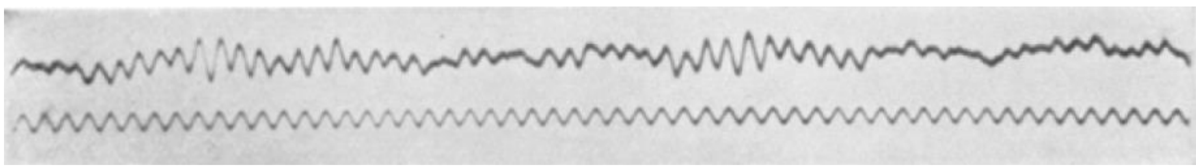


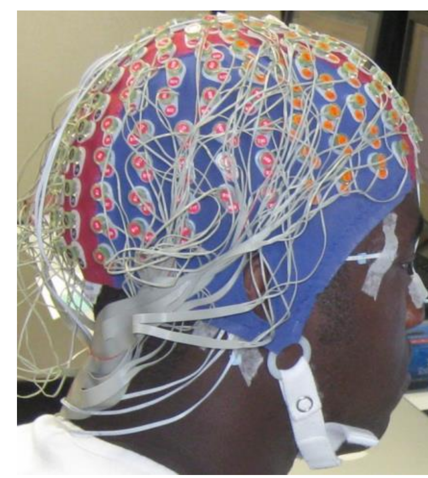

Walking (single-task)    Walking with task (dual-task)

# Behavioural Results




# Electroencephalogram (EEG)





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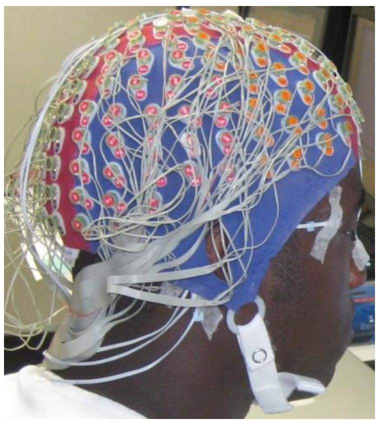
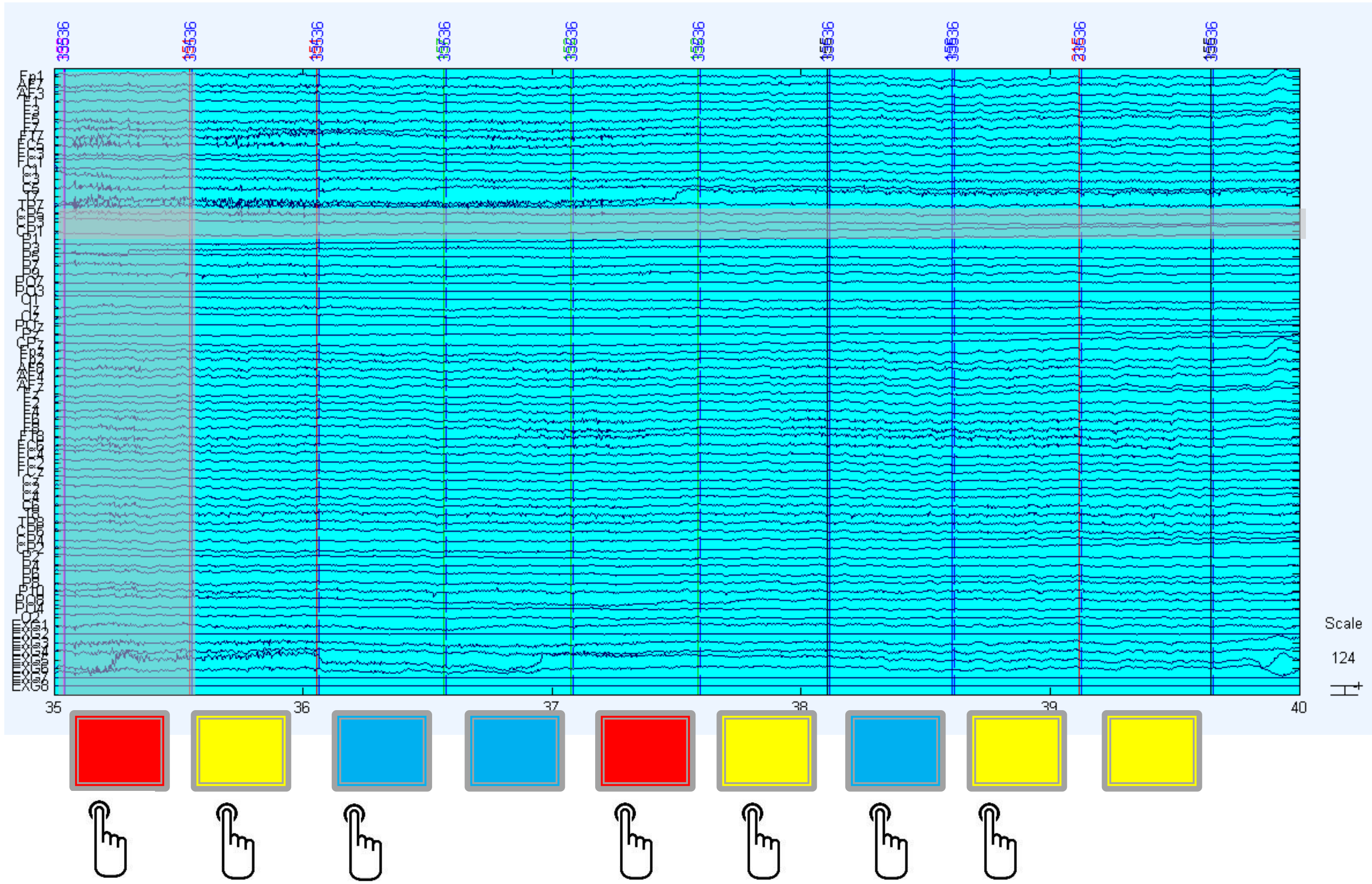
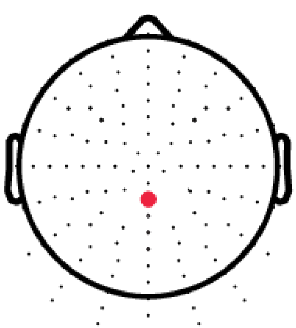
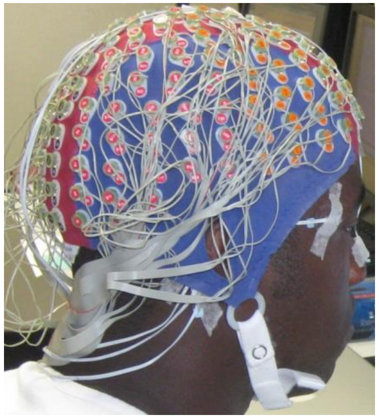
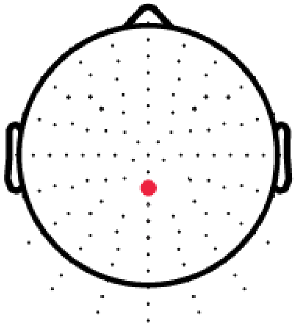


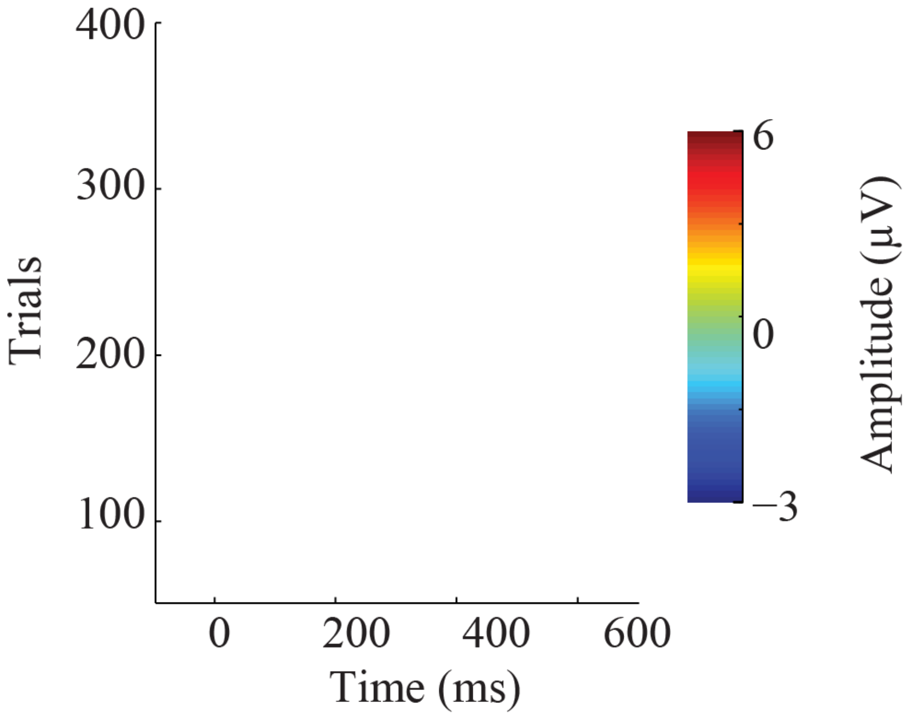


# Evoked Potentials Single Electrode







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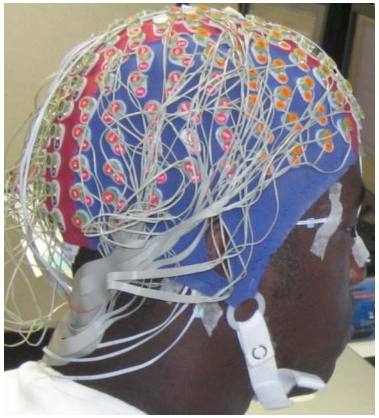

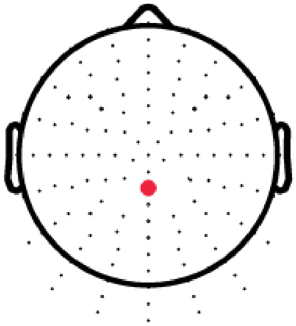

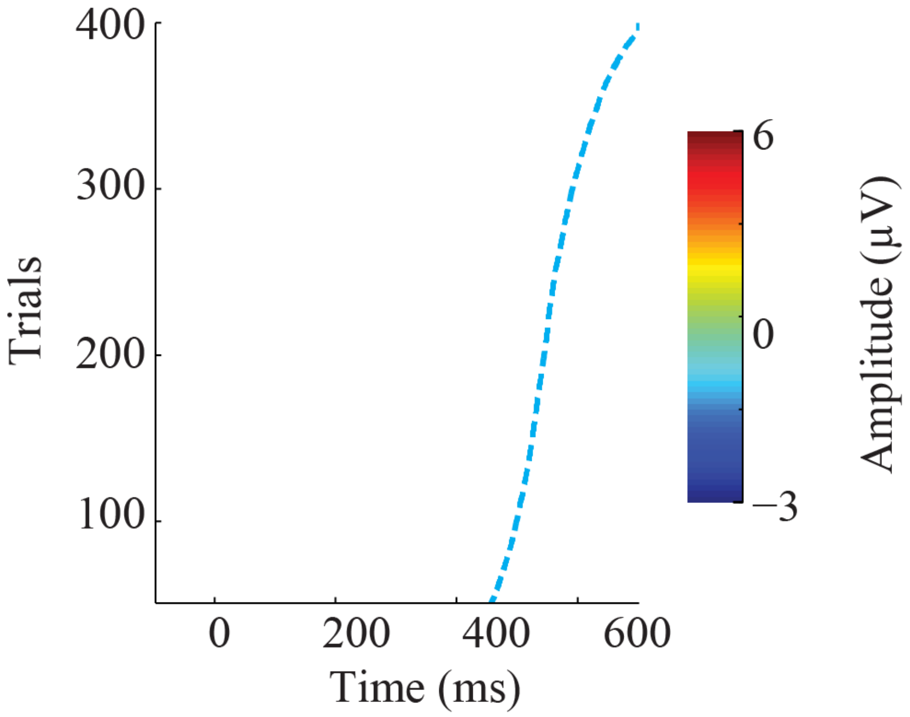

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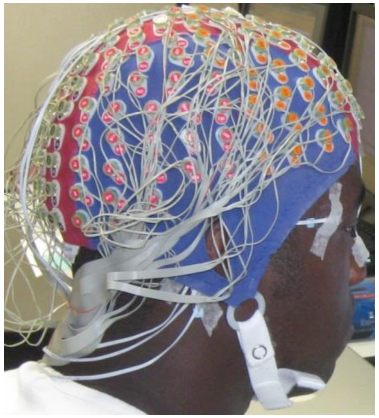

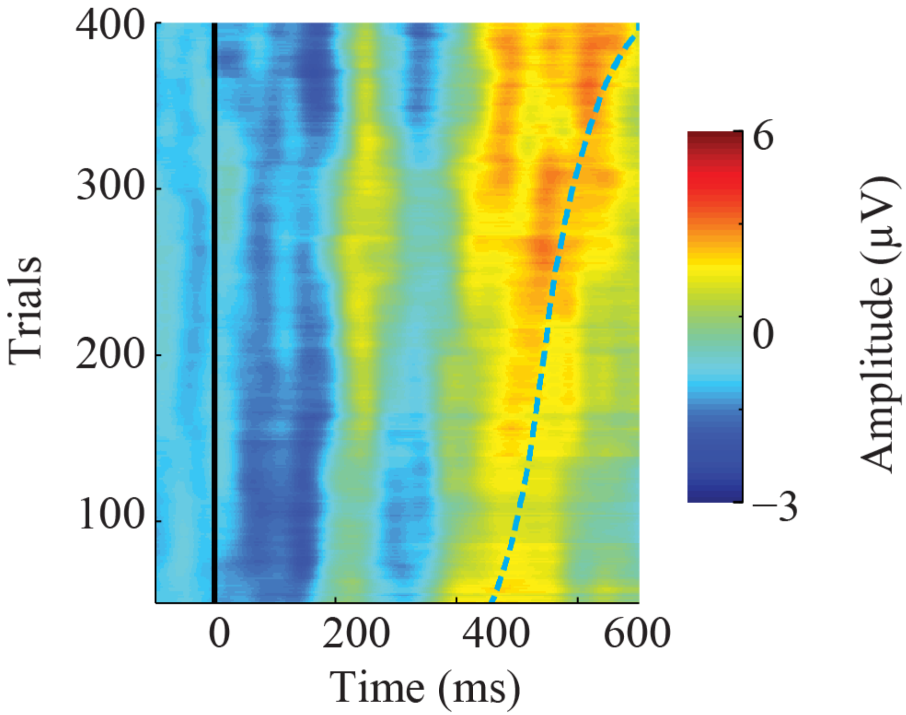


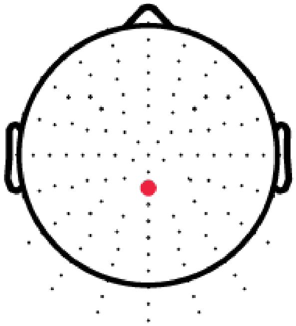

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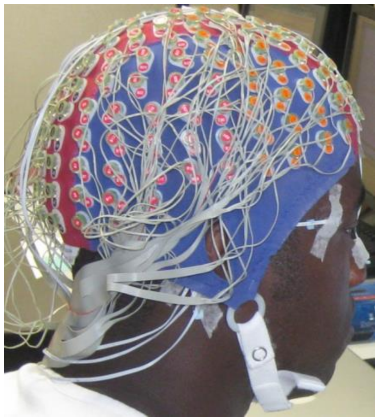

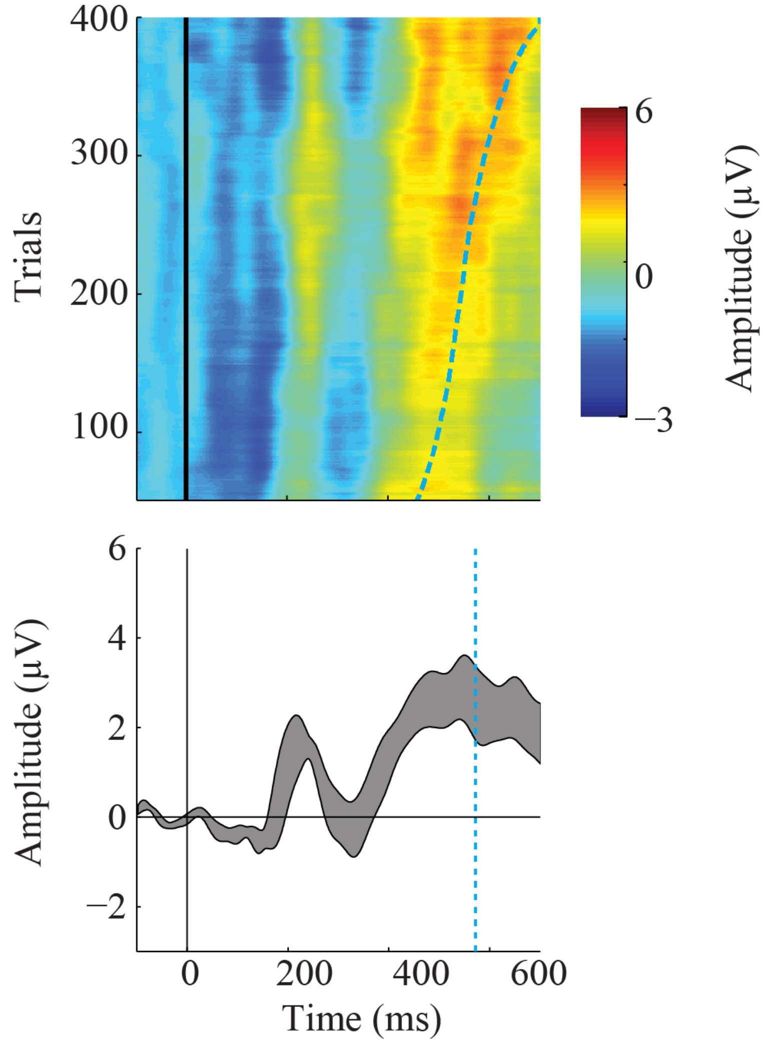


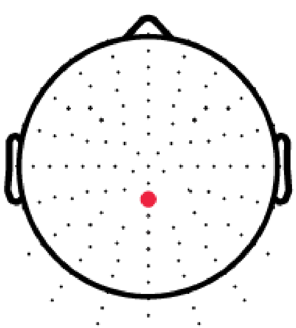

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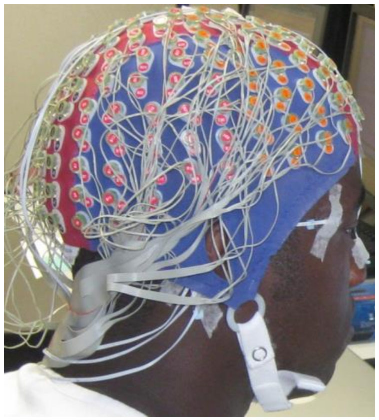
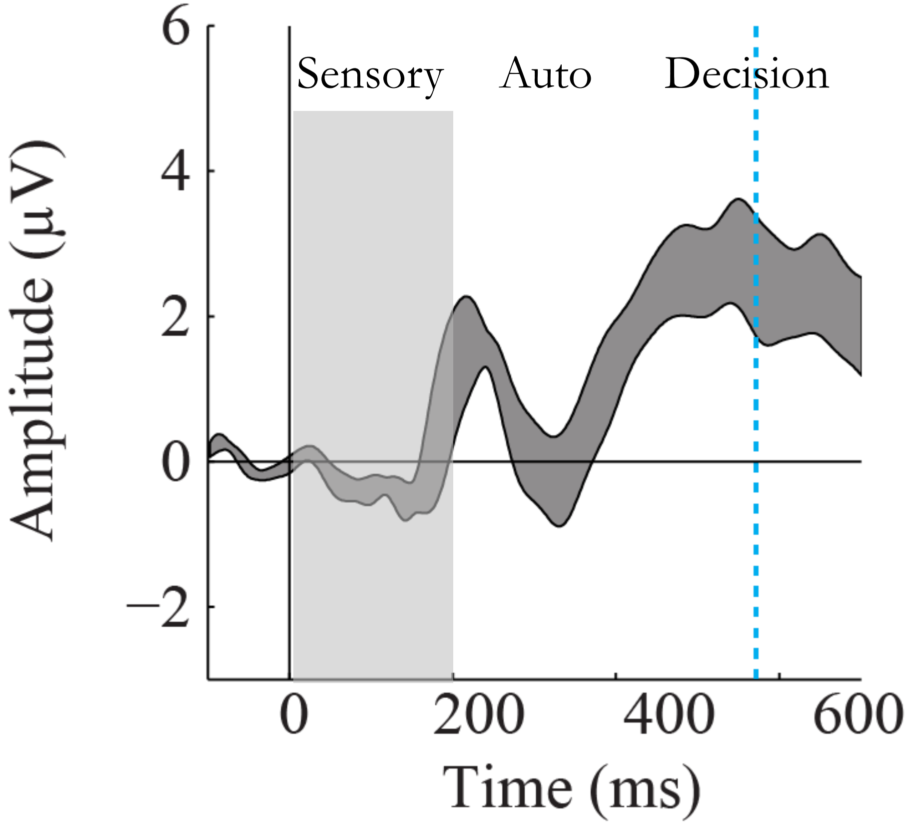
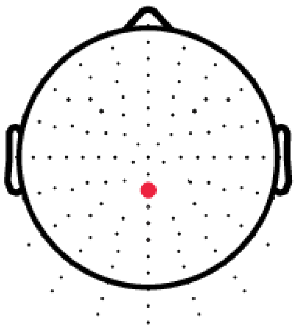
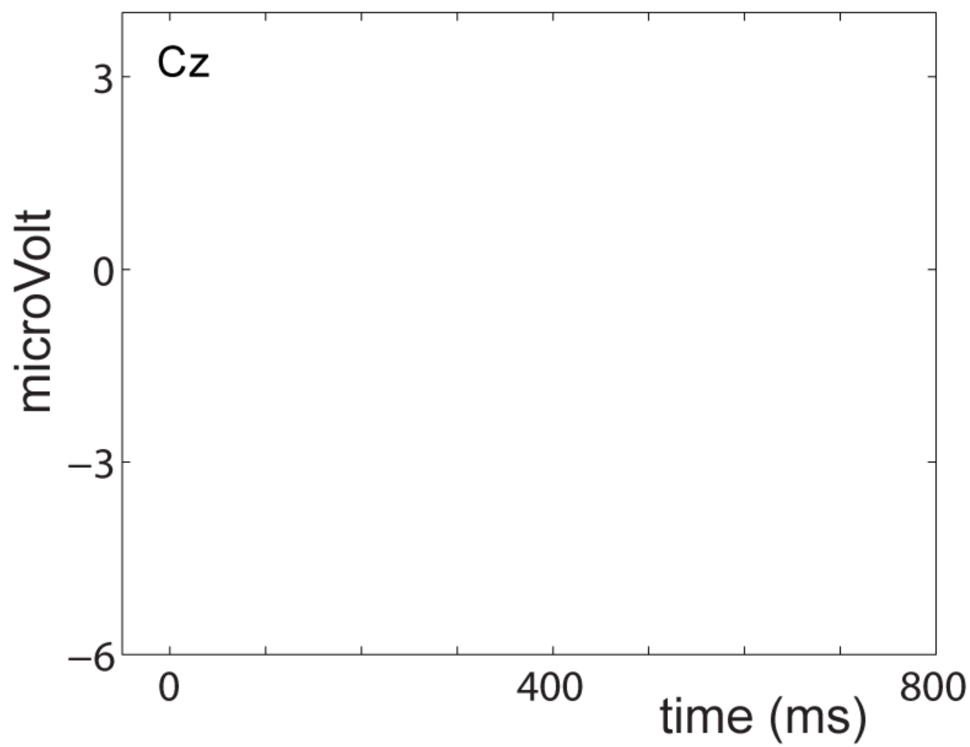




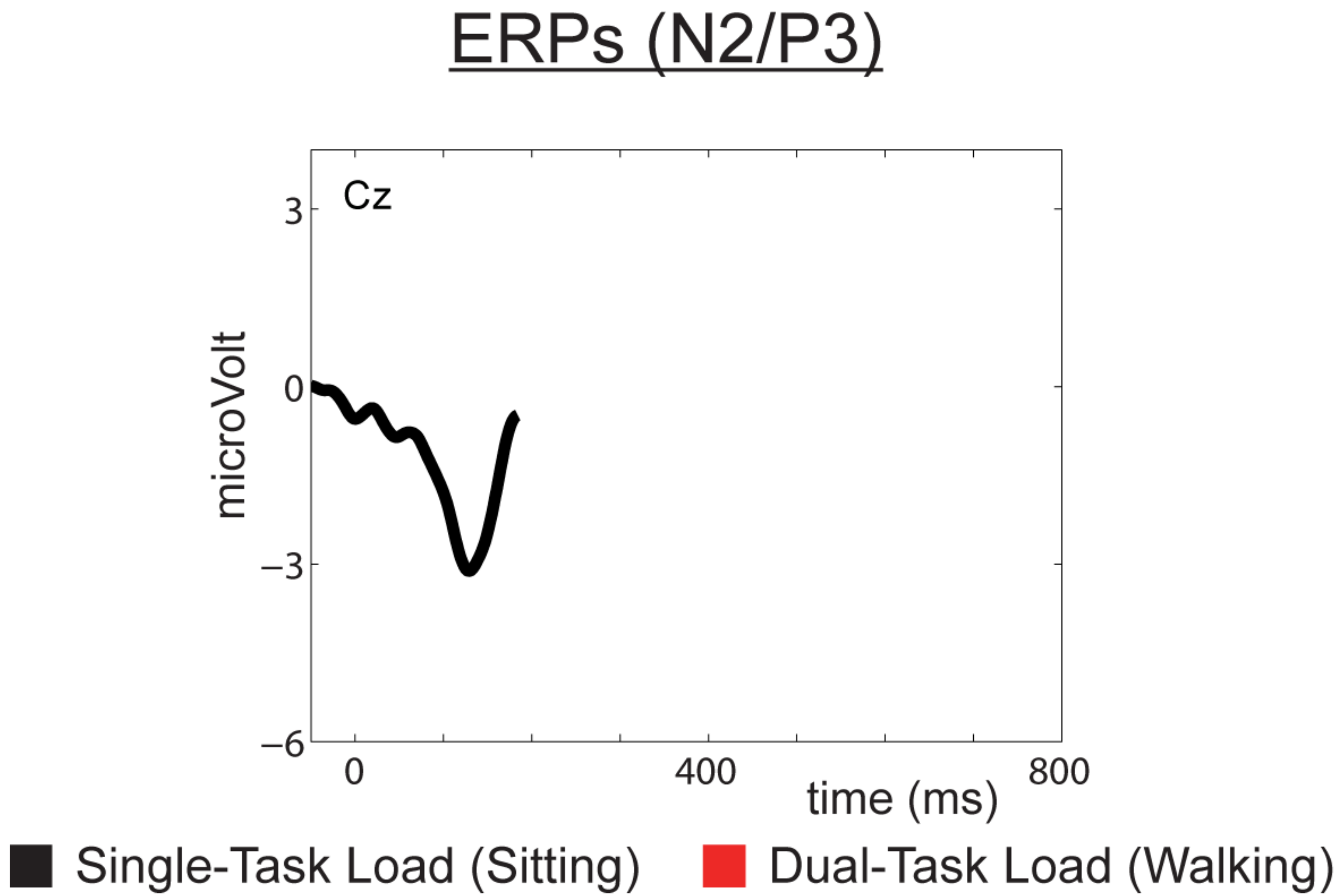
# Evoked Response

## ERPs (N2/P3)

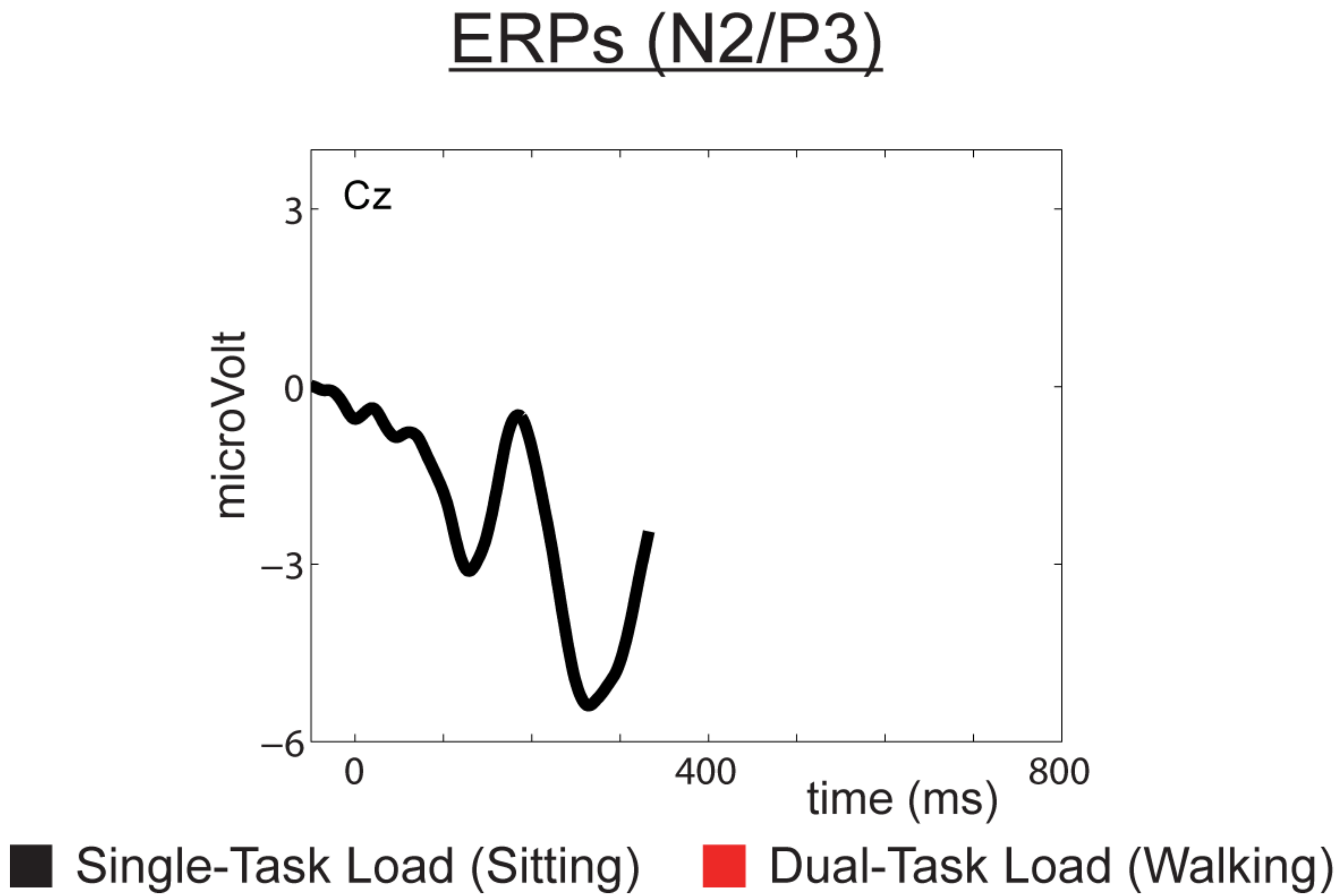



Single-Task Load (Sitting)   Dual-Task Load (Walking)

# Sensory Response

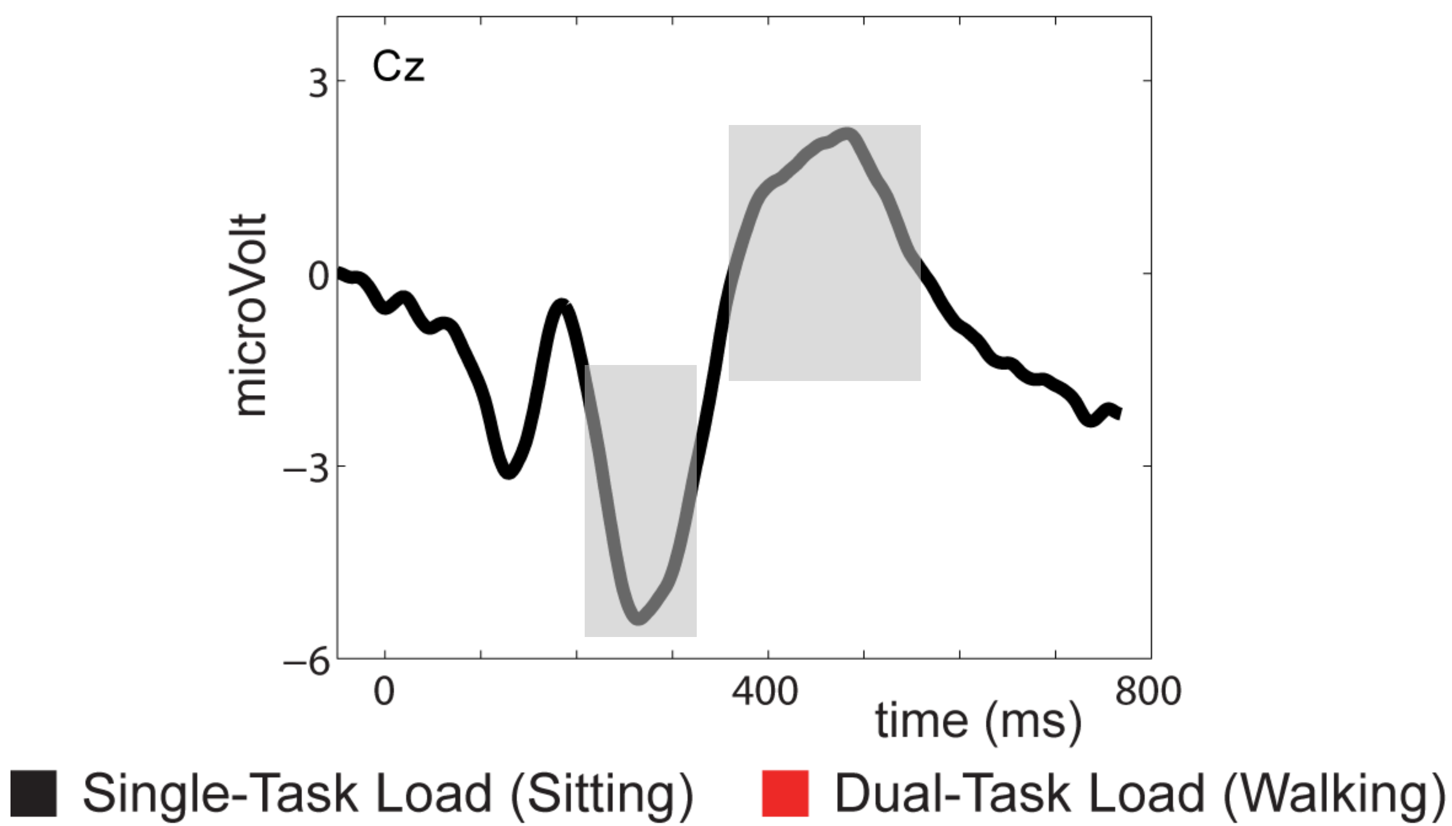


# Automatic Response (N2)

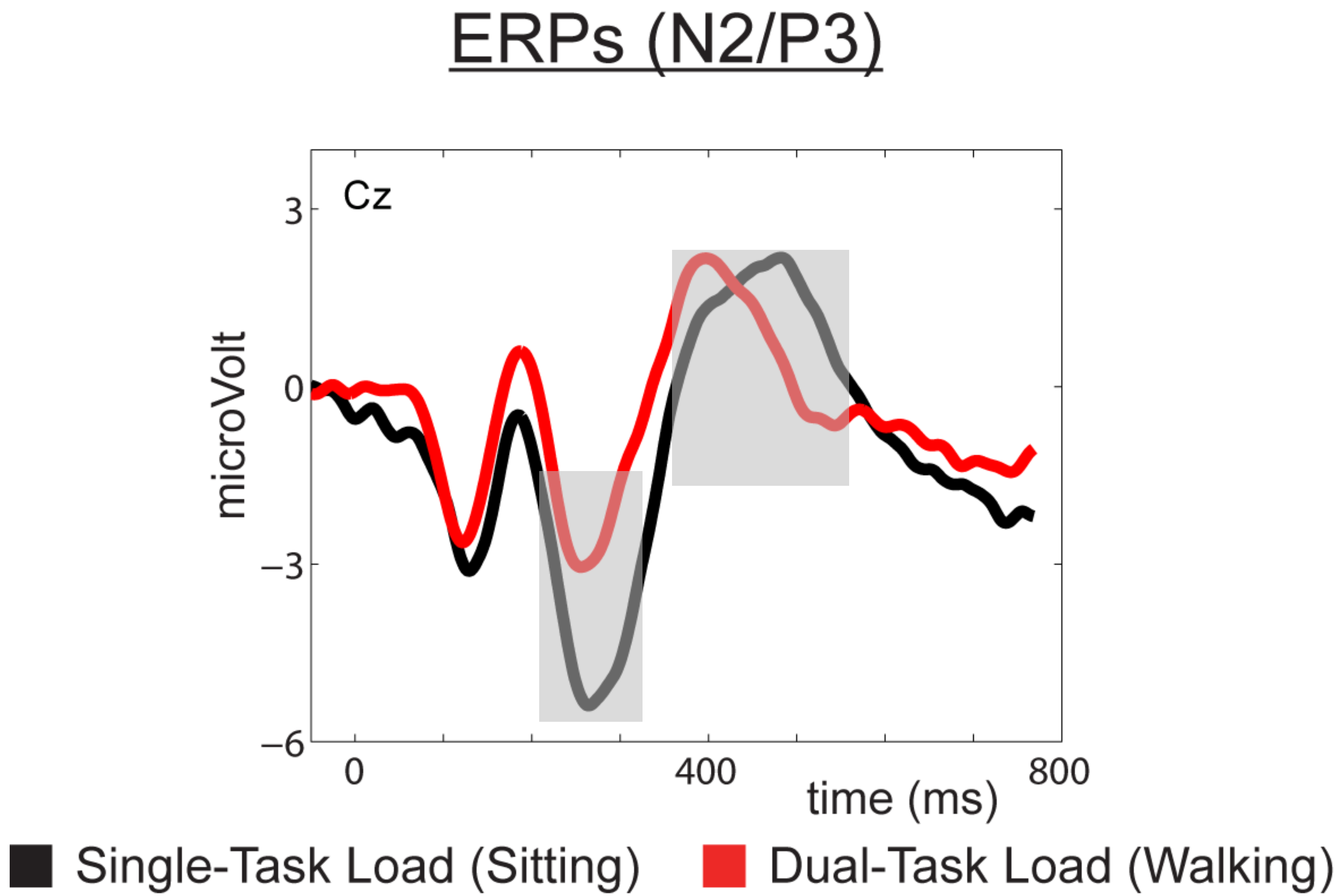


# Evoked Response

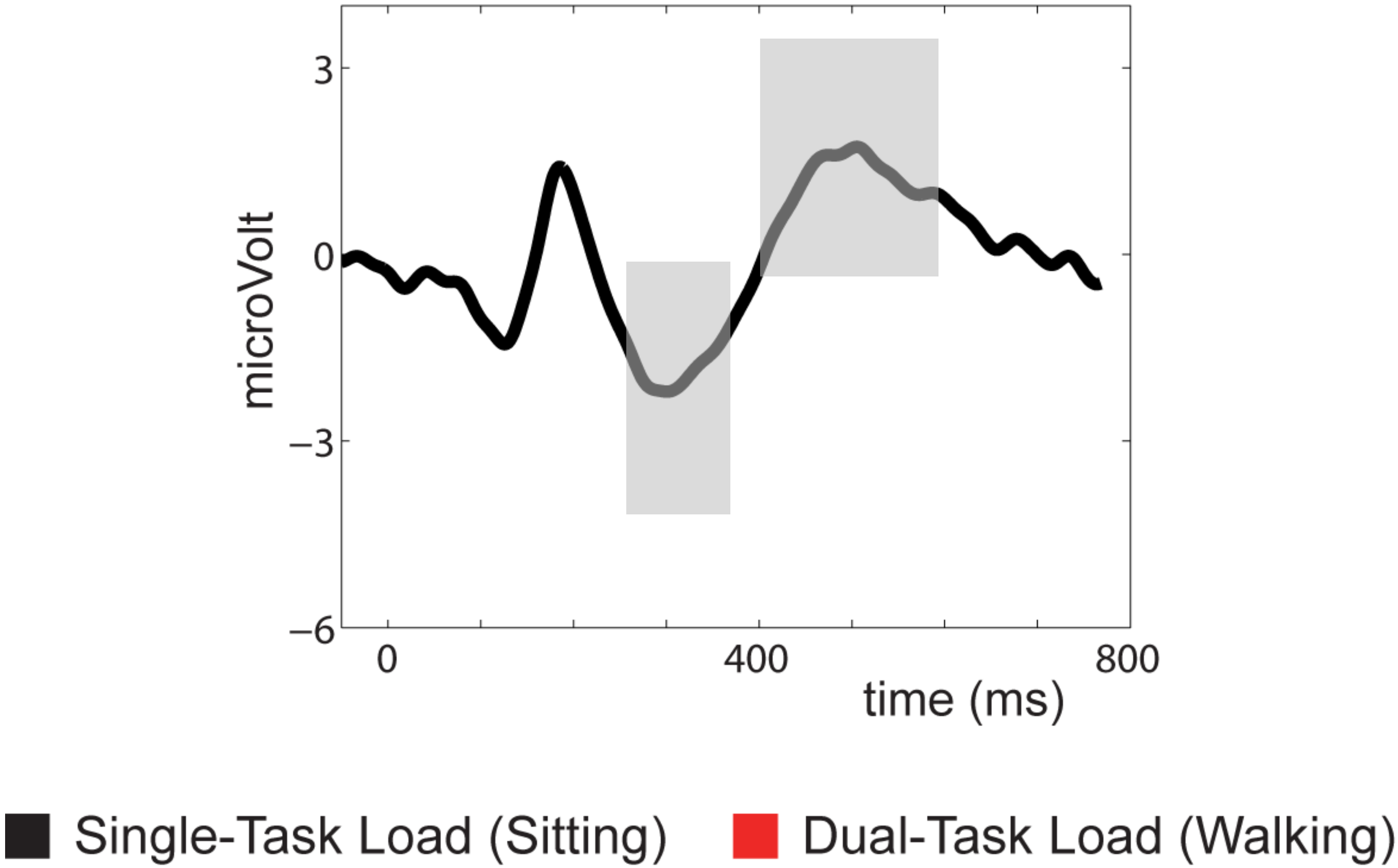
## ERPs (N2/P3)



# Evoked Response



# Older Adults



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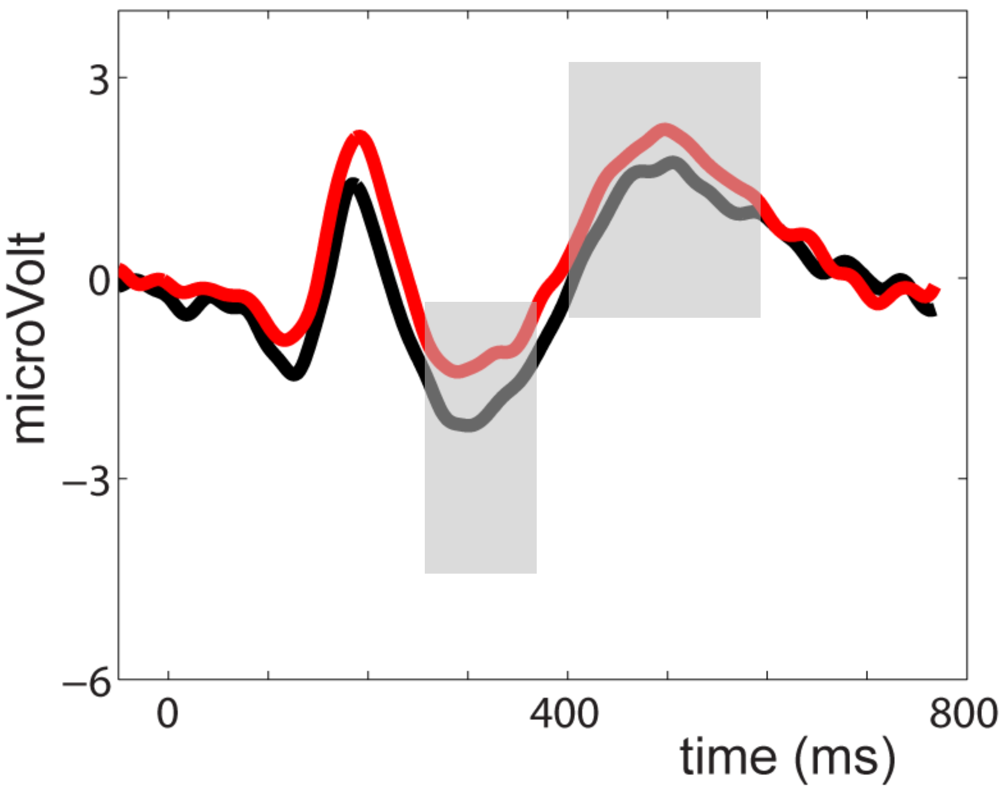
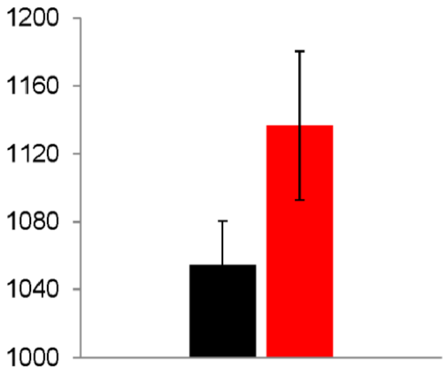


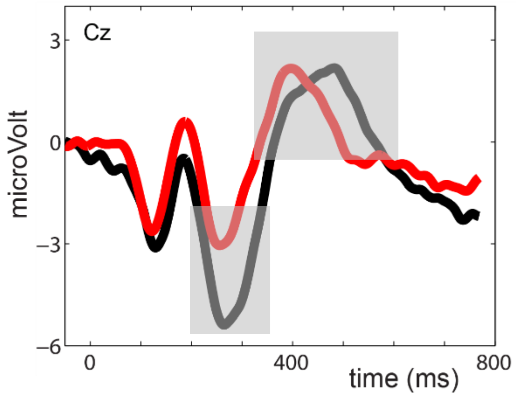

Single-Task Load (Sitting) Dual-Task Load (Walking)

# Behavioural and ERP data

Stride Time (ms)



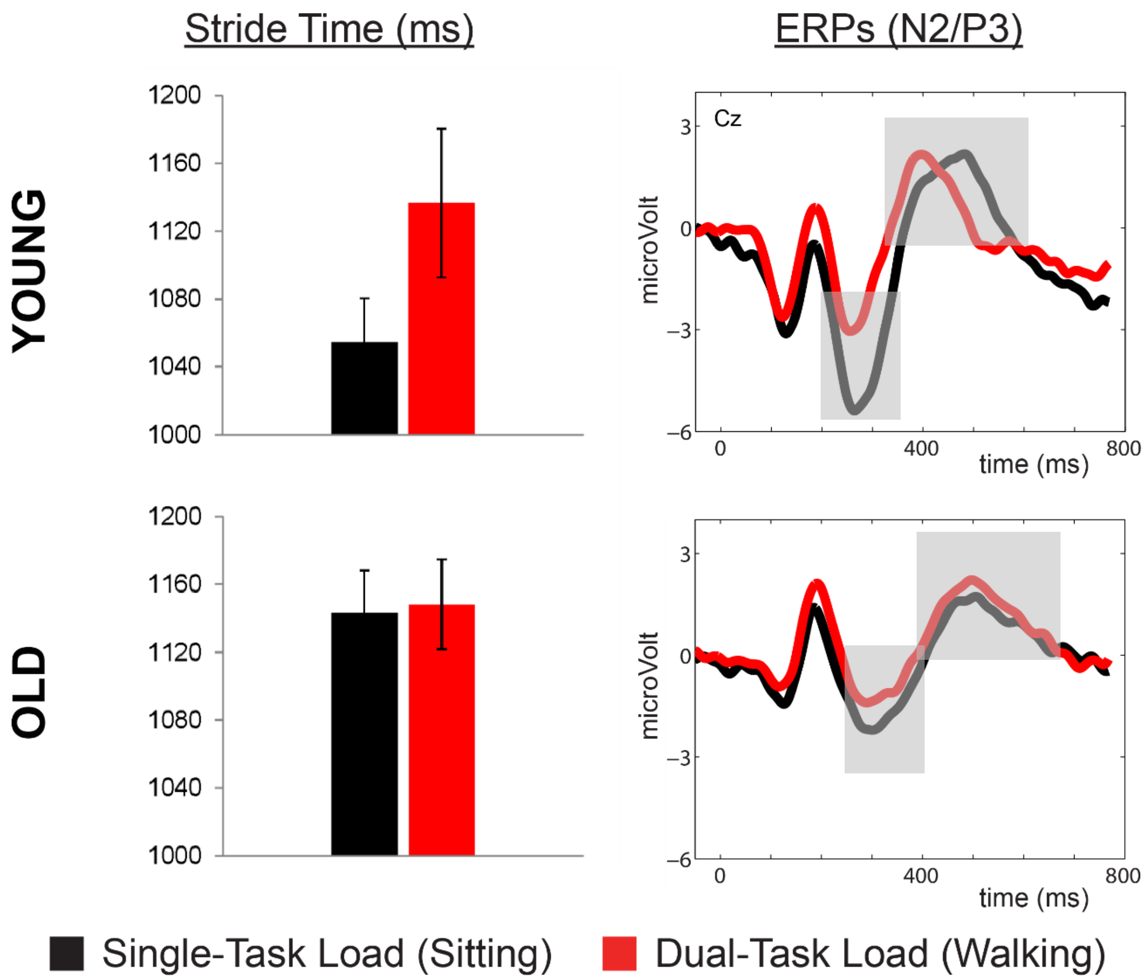

ERPs (N2/P3)




**YOUNG**

Single-Task Load (Sitting) Dual-Task Load (Walking)

# Behavioural and ERP data



# Conclusion

- Younger adults adjust gait and cognitive control when presented with a dual task situation

- Healthy older adults show a lack of flexibility, both in terms of adjusting physical behavior and in reconfiguring cognitive control mechanisms at the neural level.

# Thank you

Albert Einstein College of Medicine
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Hugh Nolan
Robert Whelan
**Richard Reilly**

Max Planck Institute for Biological Cybernetics
Jennifer Campos
**Heinrich Bülthoff**

EINSTEIN
Albert Einstein College of Medicine
OF YESHIVA UNIVERSITY

MPI FOR BIOLOGICAL CYBERNETICS

# Any questions