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PrAISED
Promoting Activity, Independence and Stability in Early Dementia

# Piloting a novel virtual reality-based balance task in older adults with dementia: A functional MRI study

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# Background



- Exercise can help balance and reduce falls for people with dementia (Burton et al, 2015).
- Neural mechanisms involved are not well understood in this population (Bherer et al, 2013).
- fMRI Studies in healthy older adults show altered activation relating to balance (Zwergal et al, 2012).
- Dementia related pathology results in altered functioning of networks involved in balance (Badhwar et al., 2017)
- Understanding neural networks involved in balance can contribute to improved tailoring of interventions (Aimee et al, 2019).

# Background

- Functional MRI is a non-invasive imaging technique.
- Great spatial and temporal resolution.
- Need to be very still in the scanner!
- Previous task fMRI studies looking at neural correlates of balance involve complex motor imagery/action observation-based tasks.
- These tasks rely on recalling complex instructions.
- Challenging for people with memory problems.
- Designed a VR based postural control task – simple instructions

# Postural control fMRI task

- 3 video conditions
  - Walking
  - Obstacle avoidance
  - Postural instability
- Used a block design (condition-rest-condition)
- Delivered using MRI compatible goggles

# Aims

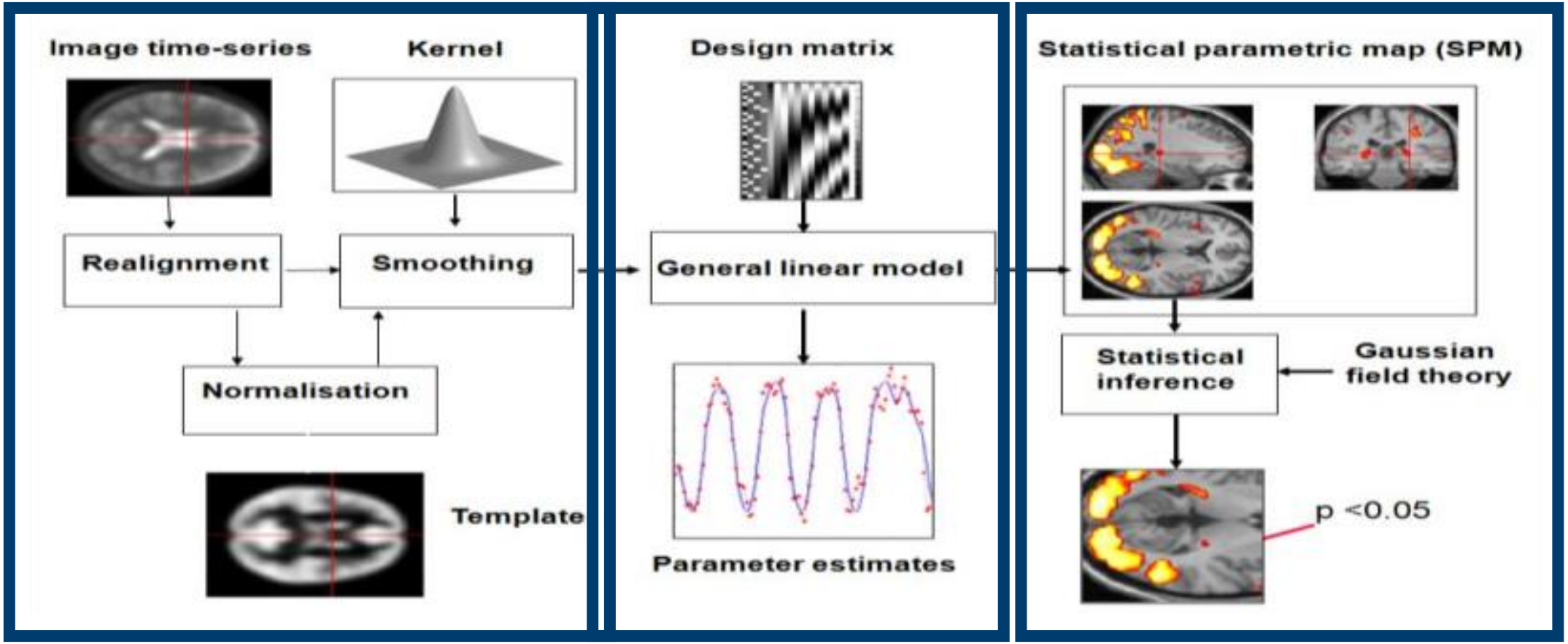
- Assess MRI tolerability and task experience
- Explore whole-brain activity in each condition/differences between conditions
- Exploratory region of interest analysis to investigate differences between conditions in brain areas involved in postural control.
- Investigate the relationship between task-related neural activity in regions of interest and performance on measures of balance

# Methods

- Participants recruited from Nottinghamshire and Derbyshire sites of PrAISED RCT
- PrAISED comprehensive baseline assessments (MoCA/CANTAB/BERG/TUG)
- Participants underwent multimodal MRI scans at Sir Peter Mansfield Imaging Centre at Queen's Medical Centre
- Participants were shown task videos before scanning
- After scanning:
  - Completed tolerability questionnaire
  - Written feedback on their task experience
  - Framework analysis approach

# fMRI data analysis

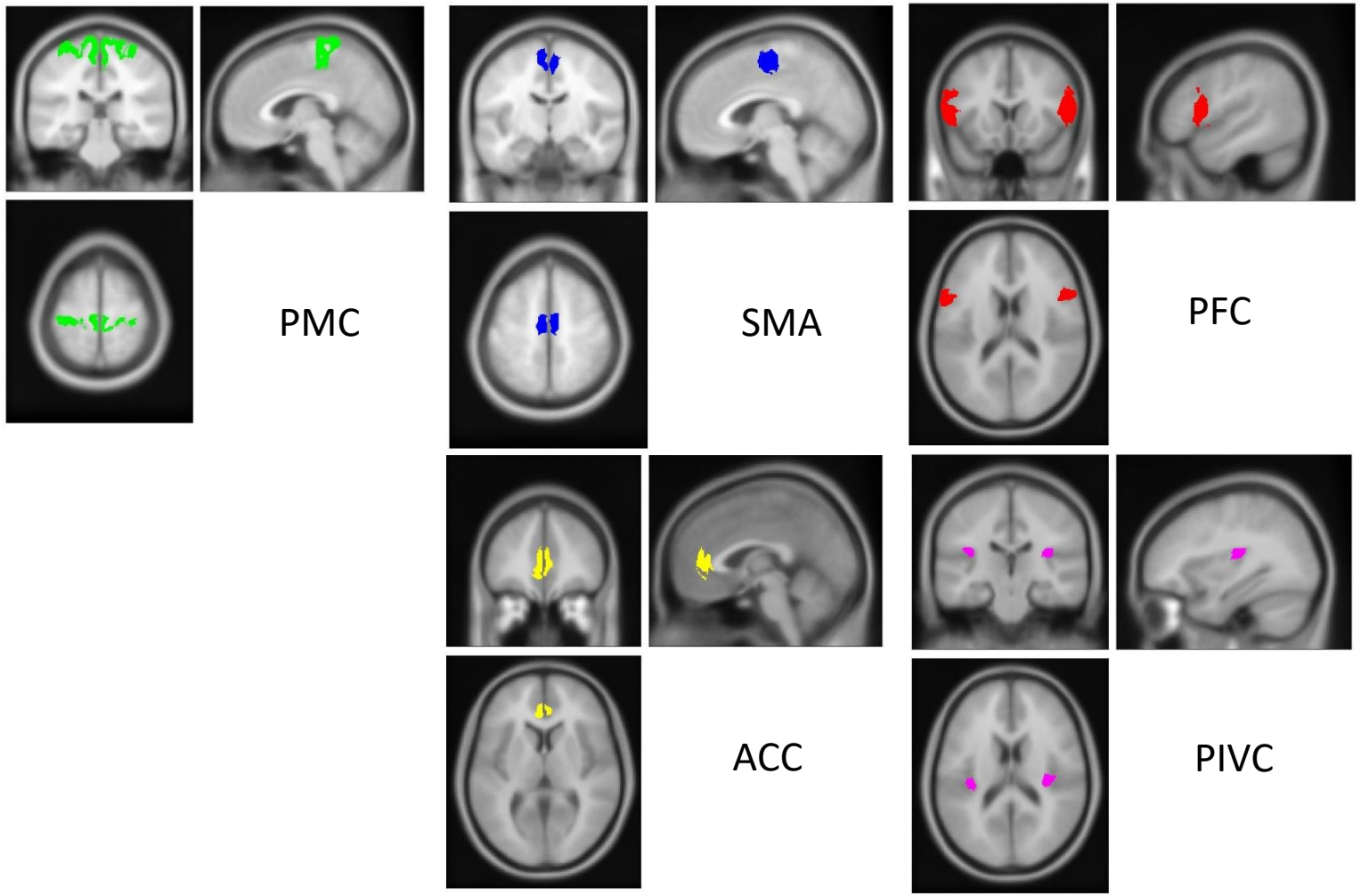
- SPM12 pre-processing steps for functional MRI data




Spatial pre-processing  1st level analysis  2nd level analysis

# Data analysis – Region of interest (ROI)

- Consulted previous work to inform the selection of ROIs.
- Repeated measures ANOVA
- Multiple linear regression to explore the relationship between ROI activation per condition and balance measures (BERG and TUG)




(Mouthon et al, 2018; Allali et al, 2015; Zwergal et al, 2012; Wittenberg et al., 2017; Hardwick et al., 2018; Dijkstra et al 2020)

# Results

## Demographics

- N= 45 (34 male and 11 female)
- Ethnicity: White = 43, Black = 1, South Asian = 1
- Mean MoCA score: 20 (S.D = 3.05, Min= 14, Max = 26).
- 36 datasets included in analysis

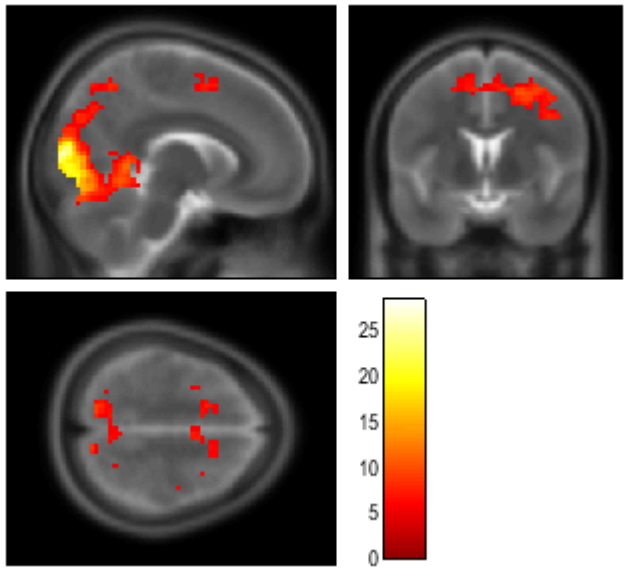
## MRI tolerability and task experience feedback

- Overall scanning experience rated 4/5
- Themes for task experience feedback included, video clarity, task difficulty and more general feedback

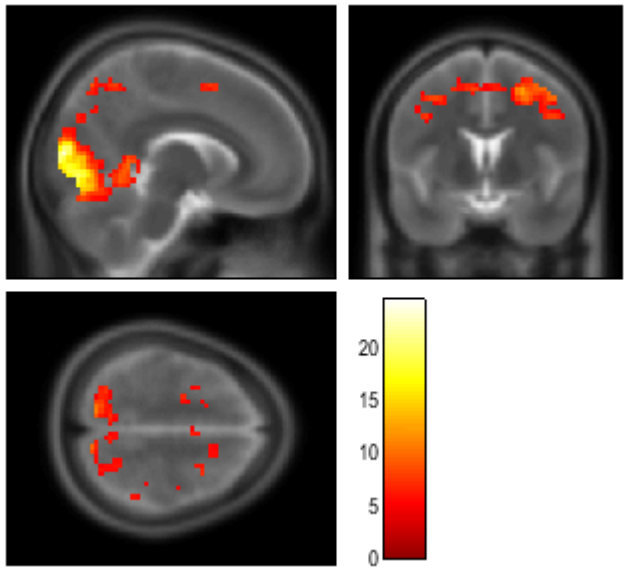
# Results

- Simple effects (p<.05 FWE corrected)

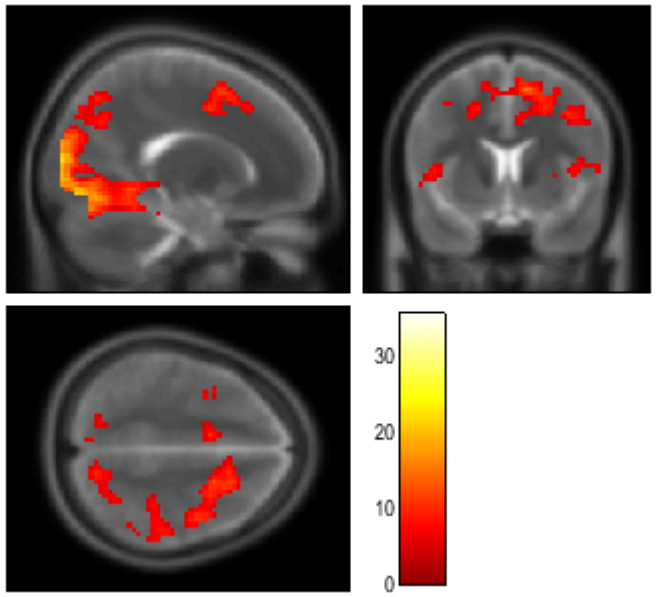
Walking




Obstacle




Balance



# Results

Exploratory ROI analysis

- ANOVA no significant differences between conditions.
- Regression analyses:
  - ROI activation within the supplementary motor area and premotor cortex were associated with BERG and TUG performance.
  - Additionally the activation within the anterior cingulate cortex in the obstacle navigation condition was related to BERG and TUG performance.

# Discussion

- Scanning procedures were well tolerated.
- fMRI task deliverable.
- Task-related fMRI to study neural correlates of balance in this population is feasible.
- No significant difference in activation between conditions (whole brain and ROI analysis).
- Interesting relationships between task-related motor / anterior cingulate region activation and balance performance.
- Small and homogenous sample size.
- Evaluate effects of imagery ability in older adults with cognitive impairments.

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