



# Rhythmic Auditory Stimulation and voluntary movement in Parkinson's disease

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## Summary

- Idiopathic Parkinson's Disease (PD) is characterized by motor symptoms including tremor, rigidity, postural instability, slowness of movement, and disturbances of gait. Furthermore, interlimb coordination may also be impaired and constitutes a major motor deficit in PD.
- In addition to the primary pharmacological approach, motor training approaches have been used successfully. One of the most prominent approaches is Rhythmic Auditory Stimulation which uses the priming and timing elements in rhythmic auditory cues to entrain motor responses such as step patterns during gait.
- RAS has been shown to increase gait speed and reduce freezing, falls, and variability in lower limb motor unit recruitment.
- The neural basis for the effects of rhythmic stimulation on motor performance remain largely unknown

## Design

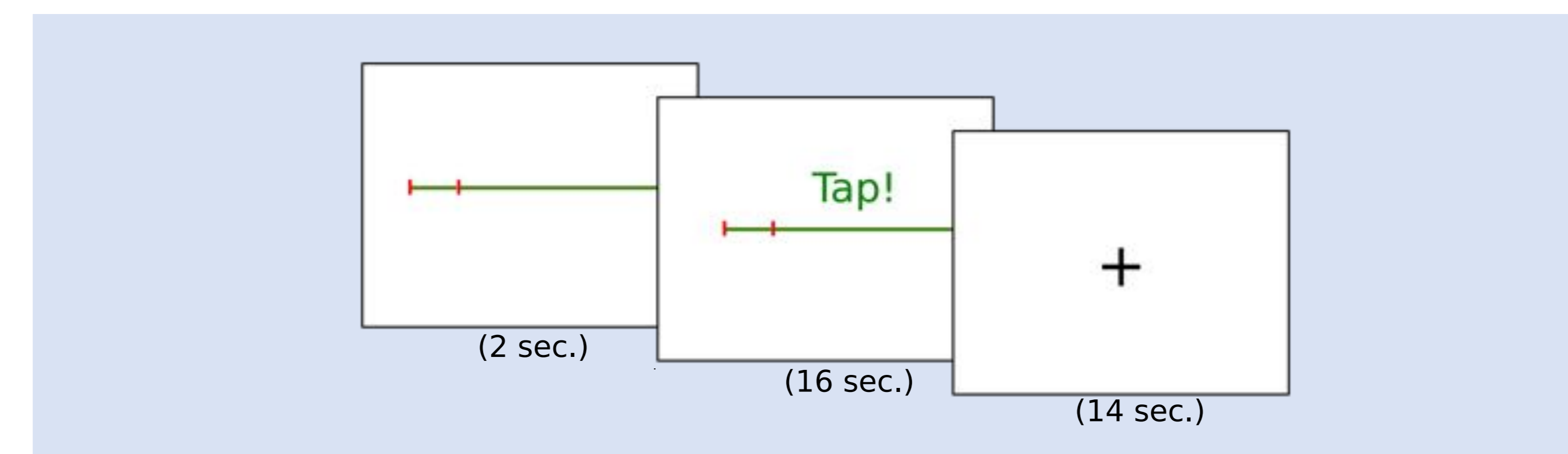
### Four Conditions:

Fast - No RAS:	4Hz Tapping 2 Second Auditory Cue
Slow - No RAS:	2Hz Tapping 2 Second Auditory Cue
Fast - RAS:	4Hz Tapping 16 Second Auditory Cue
Slow - RAS:	2Hz Tapping 16 Second Auditory Cue

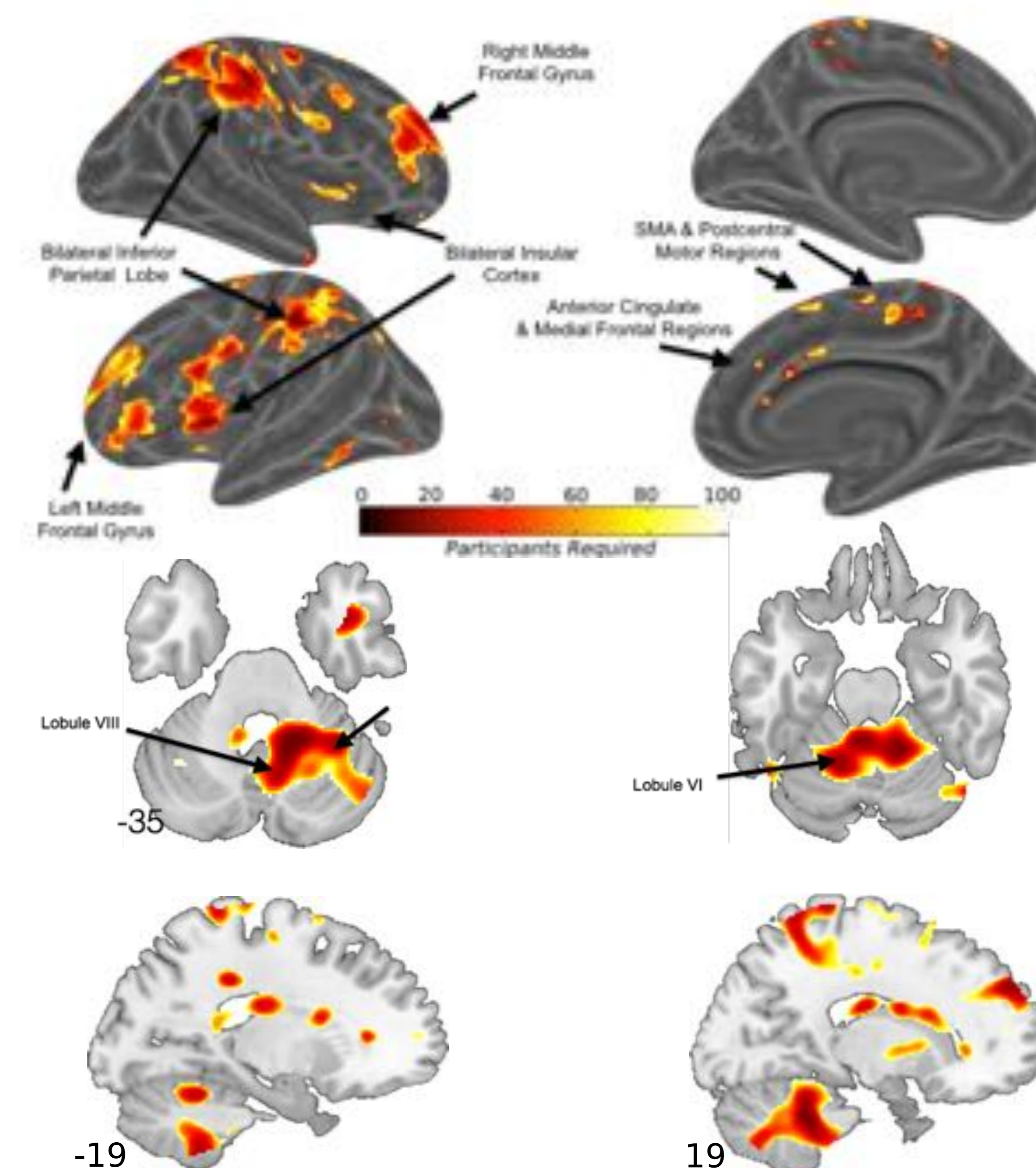
## Methods

- Participants:
- 10 Participants with PD (Hoehn and Yahr: stage 2)
  - on medication
  - 5 Healthy Participants
- Scanning:
- 3 Sessions
  - Block Design:
  - 2-second visual cue (shown above)
  - 16 seconds tapping
  - 14-second ITI

### Trial Format

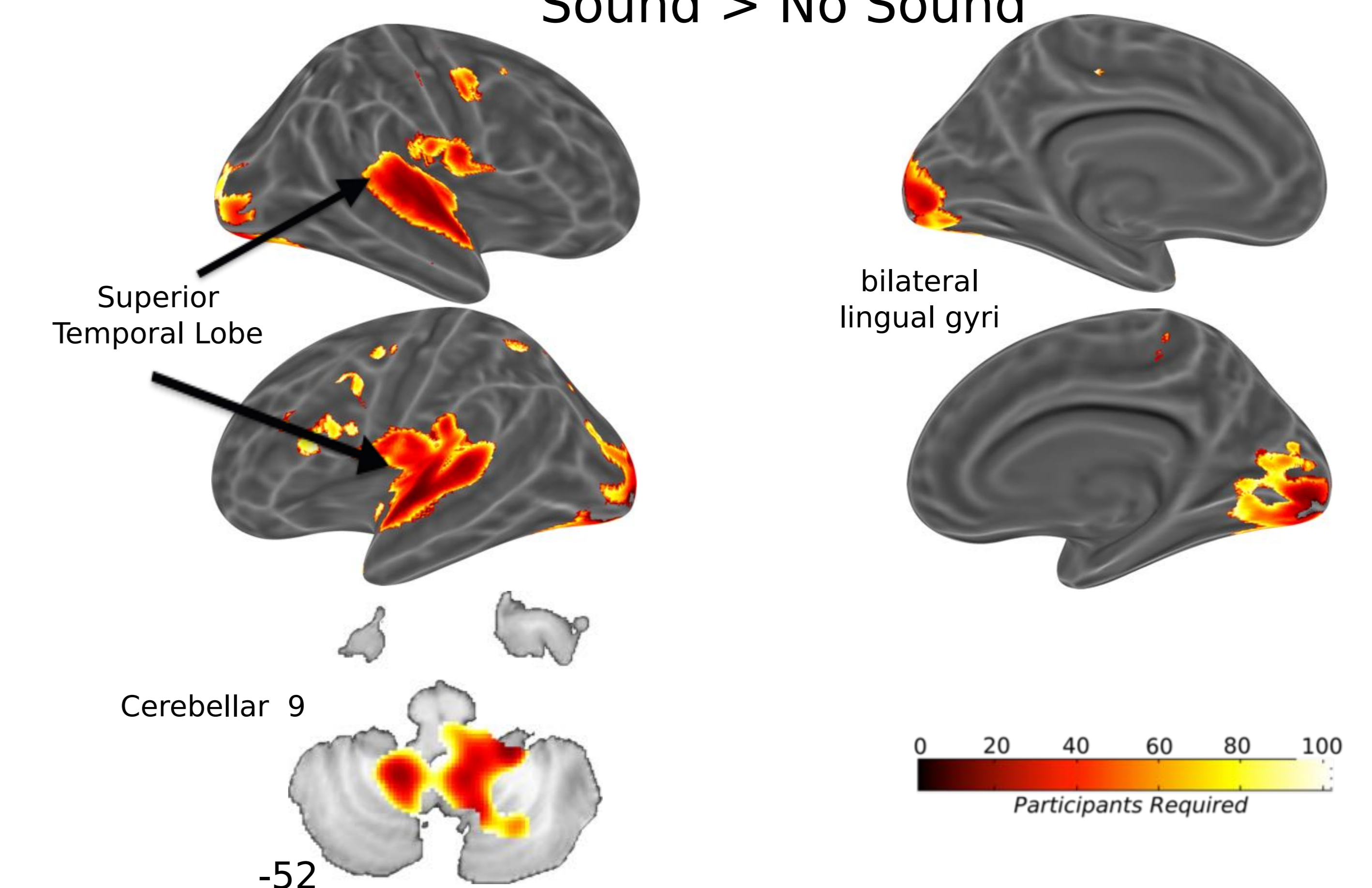


### PD > Healthy Sound > No Sound



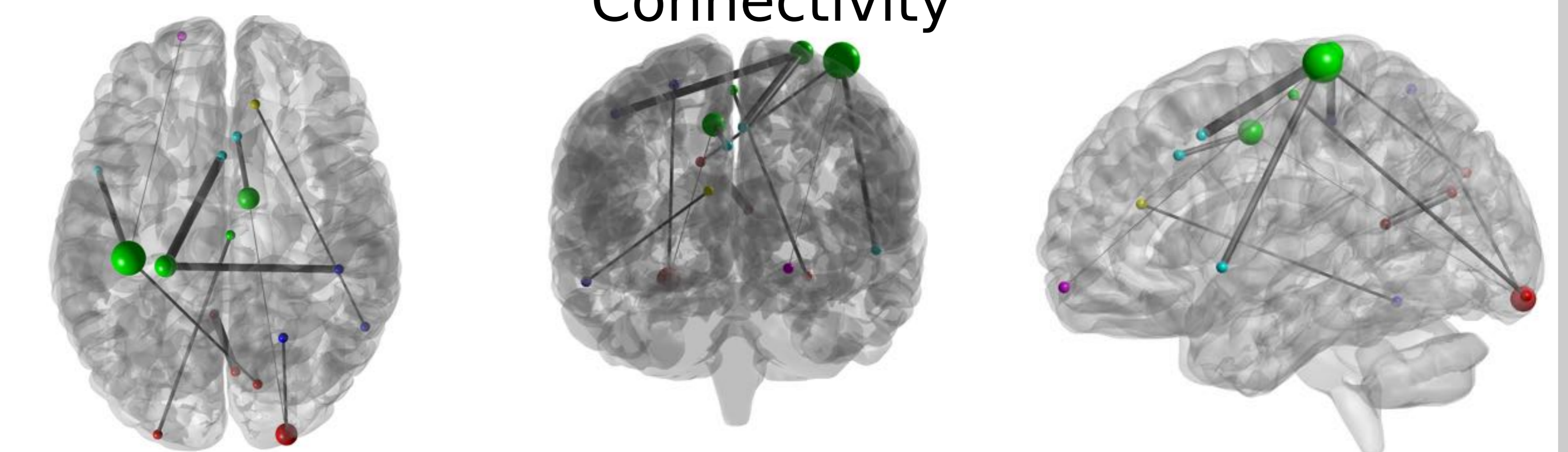
With rhythmic cues, PD patients showed greater activity in anterior cingulate and medial frontal regions, bilateral middle frontal gyri, bilateral inferior parietal lobe, cerebellar lobules I and VIII, and insular cortices than healthy participants.

### PD Only Sound > No Sound



With rhythmic cues, PD patients showed greater activity in the bilateral superior temporal lobes, visual cortices and cerebellar lobule 9 than without sound.

### Connectivity



With rhythmic cues, PD patients showed greater connectivity between left-lateralized motor regions (pre and post-central gyri), medial frontal regions (pre-SMA and anterior cingulate), superior-temporal lobe, cuneus, and left superior orbital gyrus.

## Conclusions

Within the PD group we found that the presence of simultaneous RAS increased activity across a wide neural network including the bilateral inferior parietal lobe, middle frontal gyrus, insula, and anterior cingulate. When PD subjects were compared with controls, RAS led to greater activity in subcortical regions of the basal ganglia and cerebellum. Functional connectivity measurement using cPPI (not illustrated) indicated that RAS increased functional interaction between motor cortices and SMA, and perceptual cortices (both auditory and visual) to a greater degree for the PD patients than the controls.