Beta-band dynamics during motor learning

Ryan Hill[1], Elena Boto[1], Niall Holmes[1], Charlie Stagg[2], Mark Woolrich[2], and Matthew Brookes[1]

[1]Sir Peter Mansfield Imaging Centre, University of Nottingham, UK
[2]Wellcome Centre for Integrated Neuroimaging, Oxford, UK

OPMs offer a new generation of magnetoencephalography (MEG) instrumentation with better data quality, lifespan compliance, and a route to more naturalistic neuroscientific experimentation – the latter enabled because subjects are free to move during a scan. In this work, we aimed, for the first time, to assess brain oscillatory dynamics whilst a subject learned to play a musical instrument. Three participants took part in the study; each scanned 5 times on consecutive days. The task involved repeatedly playing a sequence of 5 chords on a ukulele. A visual representation of the chords was displayed on a screen and the participant had to complete the sequence in a specified time. This task involved significant head movement, as the participant looked at chord patterns on the screen, and then to their fingers to form the chords. Nevertheless, we were able to collect high fidelity data.

Results (Figure 1) showed that modulation of beta band (13-30 Hz) neural oscillations was localized to primary motor cortex. We were able to measure the expected response which involves a drop in beta amplitude during the task followed by an increase above baseline (the beta rebound) on task cessation. Further, we observed that the amplitude of the beta rebound, in two of the three subjects, was significantly modulated by the way in which the chords were played, with poorly played chords eliciting a smaller rebound. This study demonstrates the flexibility of OPM-MEG to enable new types of motor learning, and confirms the fact that high quality data can be acquired even in the presence of large head movement.

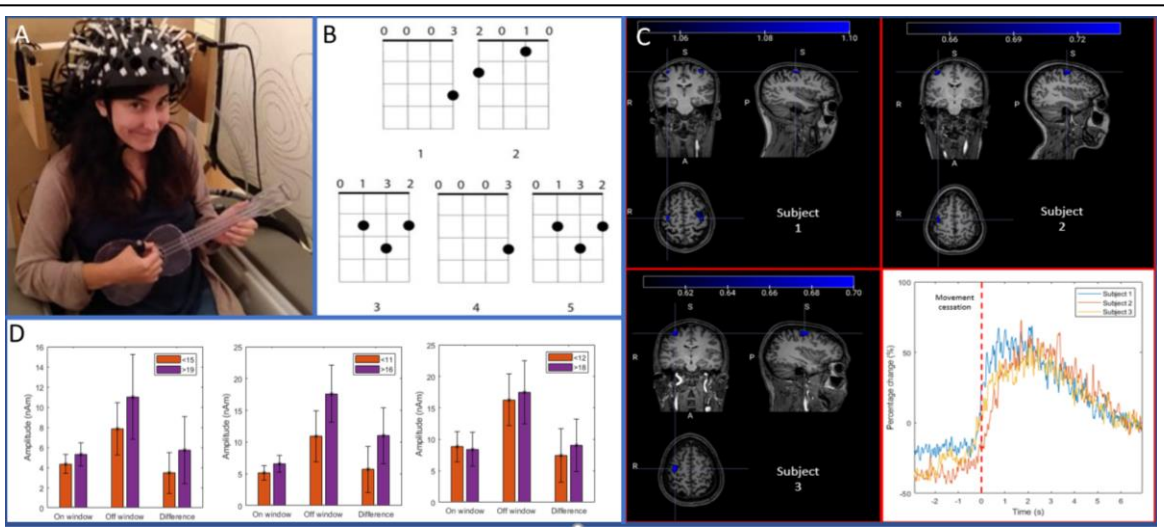

Figure 1: A) Experimental set up; subject wears an OPM helmet whilst playing a Ukulele. B) Visual representation of the chord sequence; this is shown on a screen and the subject must complete the sequence in an alotted time. C) Functional images showing the spatial signature of beta modulation during the task for all 3 subjects. Bottom right shows timecourses of beta amplitude. Note that there is a reduction in beta amplitude when the subject is playing the chords, which is localised to sensorimotor cortex. D) A comparison of the magnitude of the beta rebound for well played, and poorly played chords. Note the measured behavioural difference modulates the beta response.

References

[1] Hill et al, Nature Communications, 10 (1) 1:11 (2019).