

Changes in brain oscillations and evoked-related potentials during prolonged motor imagery and subsequent actual isometric knee extensions

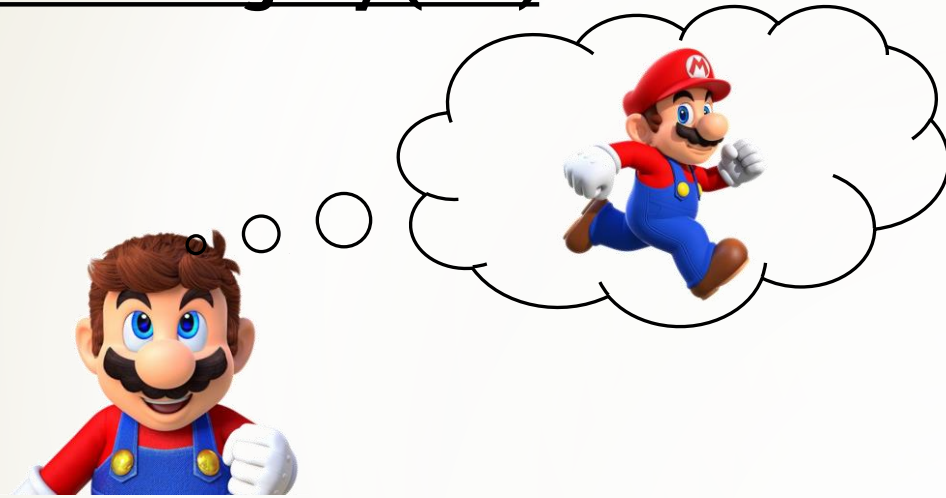
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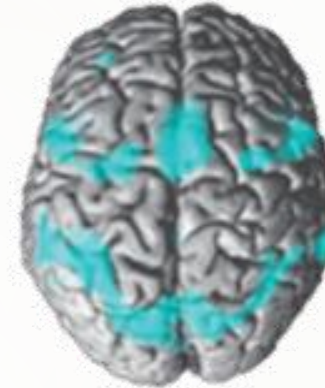
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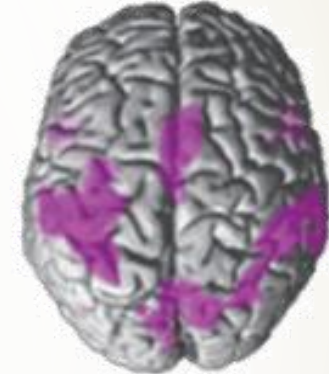
Motor Imagery (MI)



Motor Imagery



Movement



(Hanakawa et al., 2008)

Positive effects of an MI training

- Strength increases after MI training
(Yue and Cole, 1992)
- Less strength decrease after immobilisation
(Newsom et al., 2003)

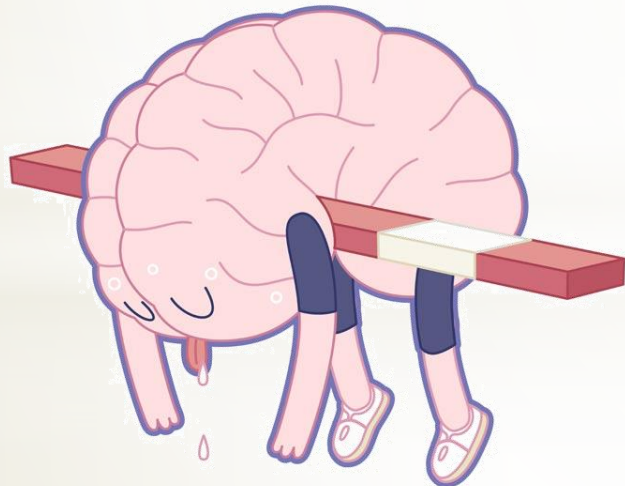
Guidelines for MI practice

- Kinesthetic MI
- Combine MI and actual movement
- 30 min mental practice and 30 min physical practice
(Malouin et al., 2013)

What happens if MI is prolonged?



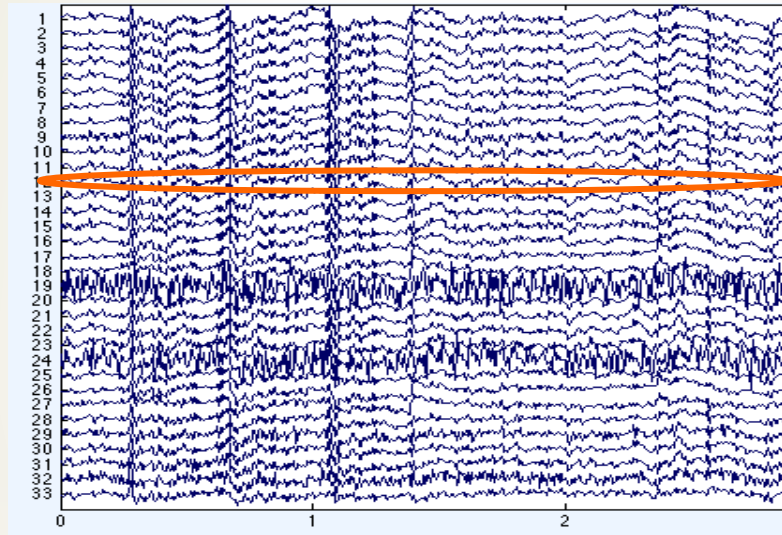
Rozand et al., (2015)



- Decrease in vigilance
- Decrease in endurance performance
- Increase in perceived effort
- Alteration of motor control
- Changes in brain activity

Van Cutsem et al., (2017)
Boksem, (2008)

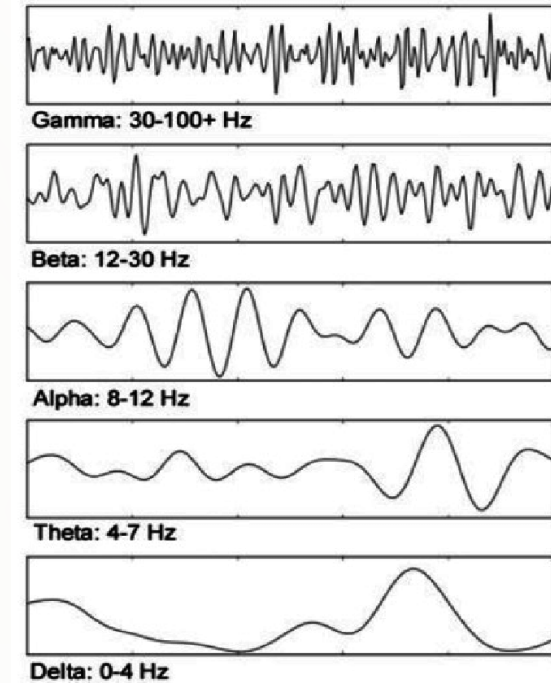
EEG : spectral analyses



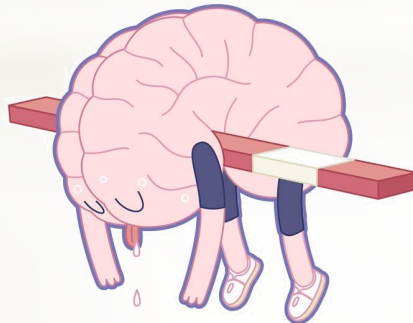
**Fourier
transform**



Comparison of EEG Bands



Good indicators of mental state

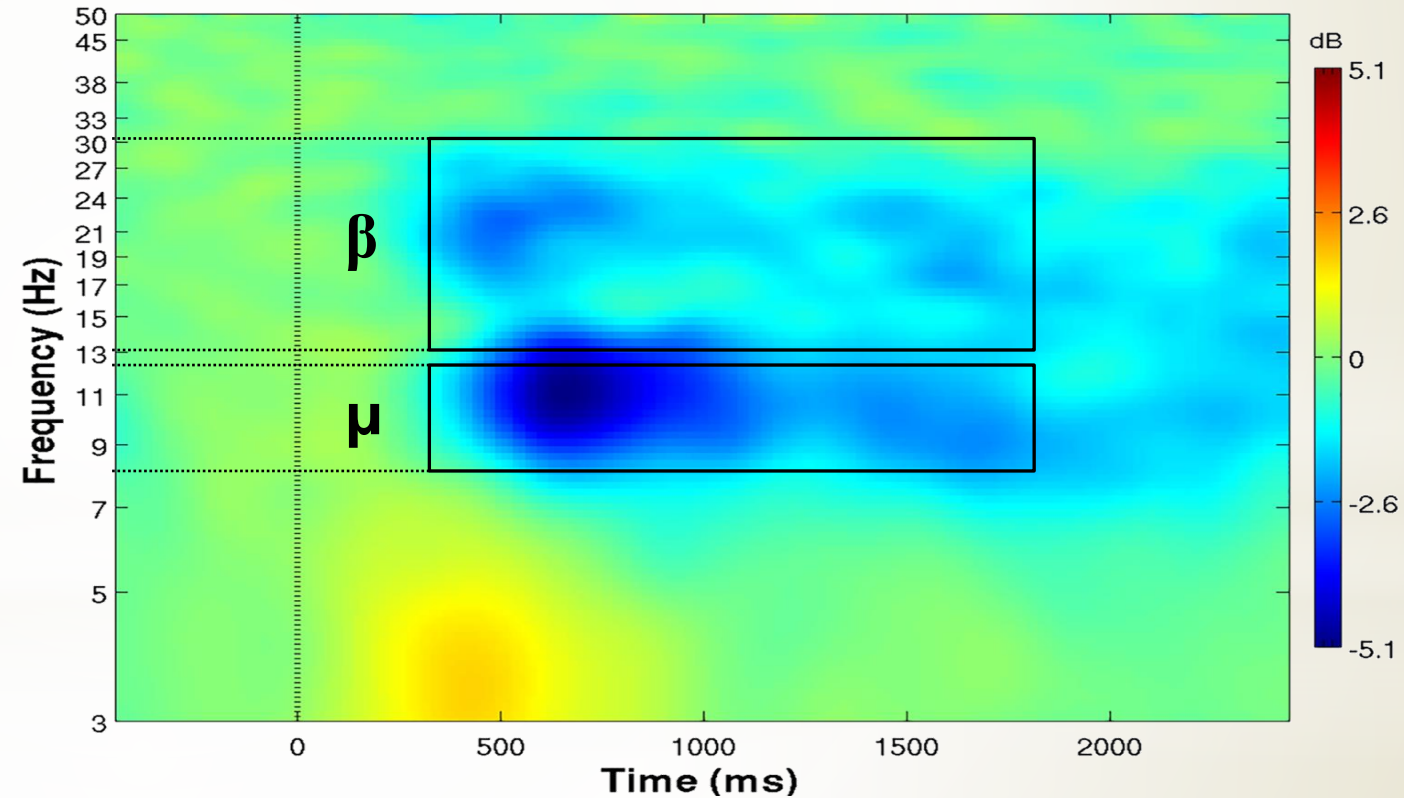


- Increase in theta band
- Increase in alpha band
- Decrease in beta band

EEG : time-frequency analyses

➔ Event-Related Spectral Perturbations (ERSP)

- Modulations are event-related
- Baseline during rest
- Variation in brain oscillations compared to baseline



(Duann et al., 2016)

Scientific questions

- Could changes observed in EEG-spectral parameters during prolonged MI indicate a mental fatigue state?
- What happens to ERSP during both imagined and actual isometric knee extensions?



Hypotheses

- Prolonged MI should induce mental fatigue with associated brain modulations
- Similar modulations in ERSP during both imagined and actual isometric knee extensions with decrease in mu and beta rhythm during contraction

Experimental design

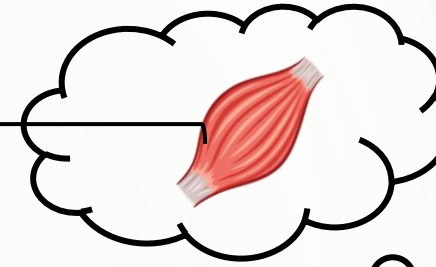
13 Subjects (7 ♂ ; 6 ♀)

A familiarization session + 2 experimental sessions

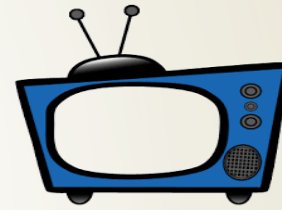


EEG recording

order



OR



MI condition
200 maximal
imagined knee
extensions
5 s ON – 10 s OFF

Feeling of
fatigue

53 min

Feeling of
fatigue

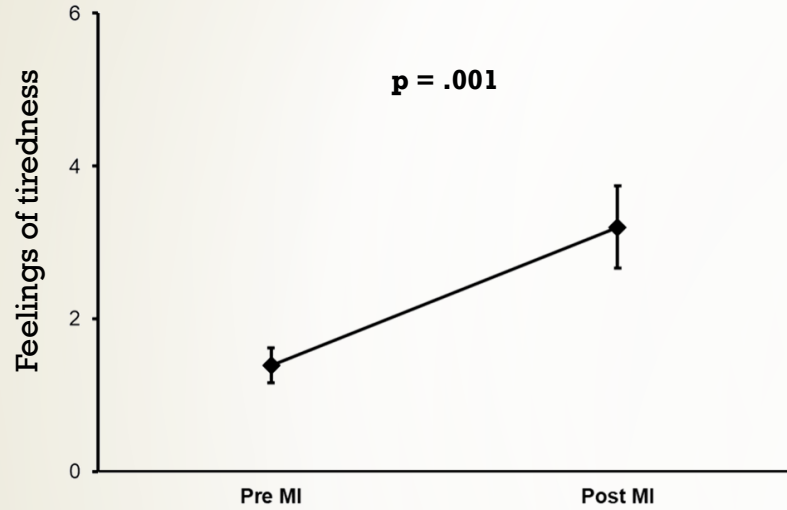
Control condition
(watching
documentary)

Perceived effort

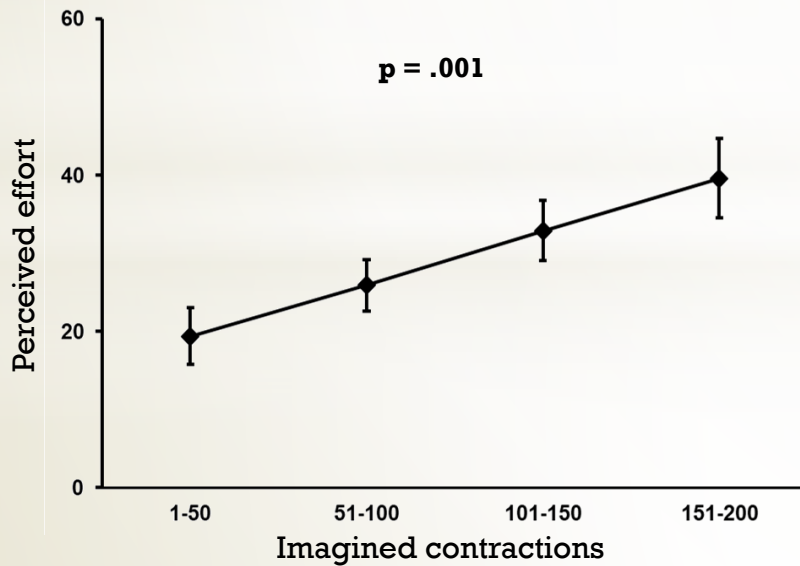
Physical exercise
150 isometric knee
extensions at 50% MVC
2.5 s ON – 5.5 s OFF



Prolonged MI : a fatiguing task

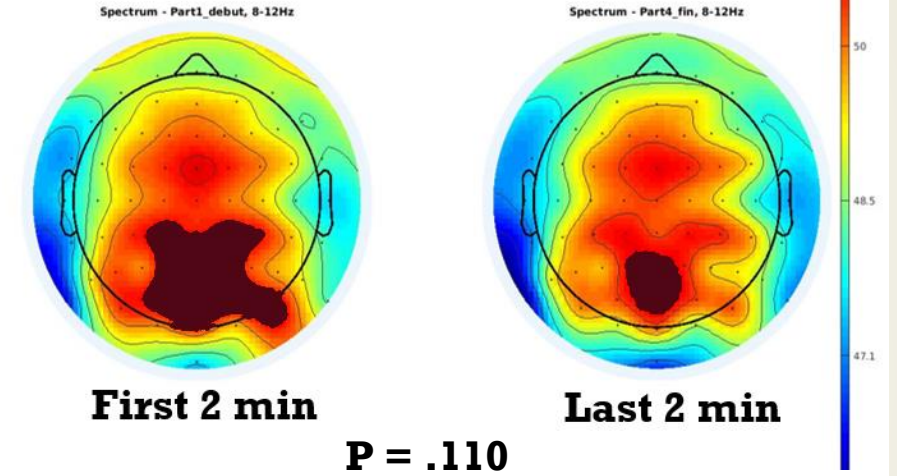


Increase in feelings of tiredness

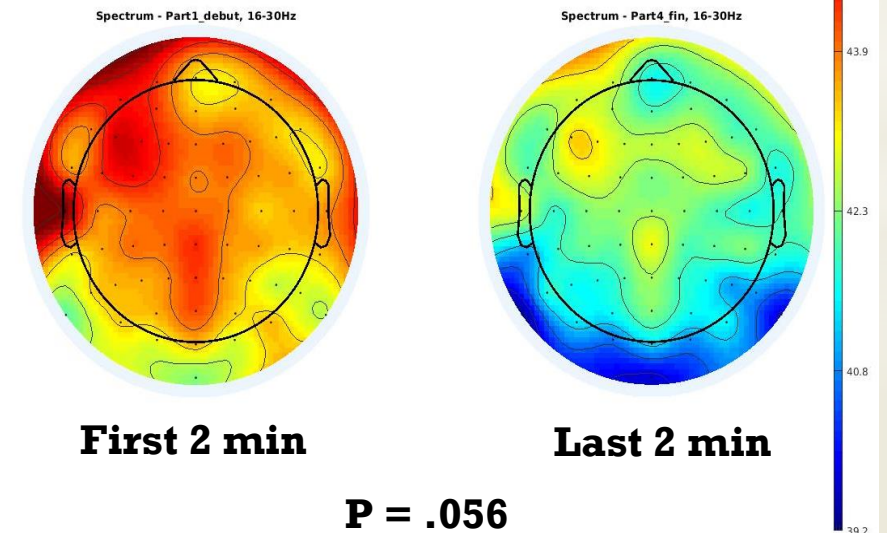


Increase in perceived effort

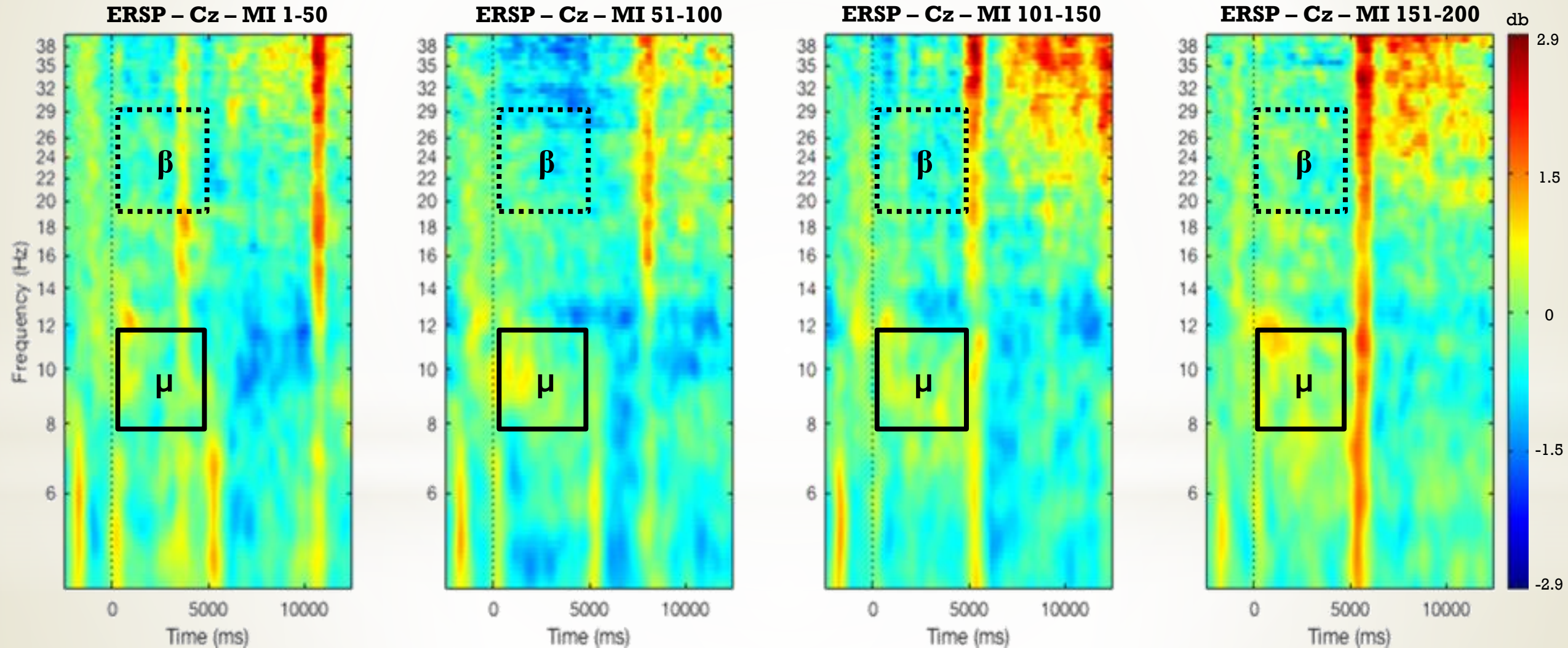
Alpha



Beta

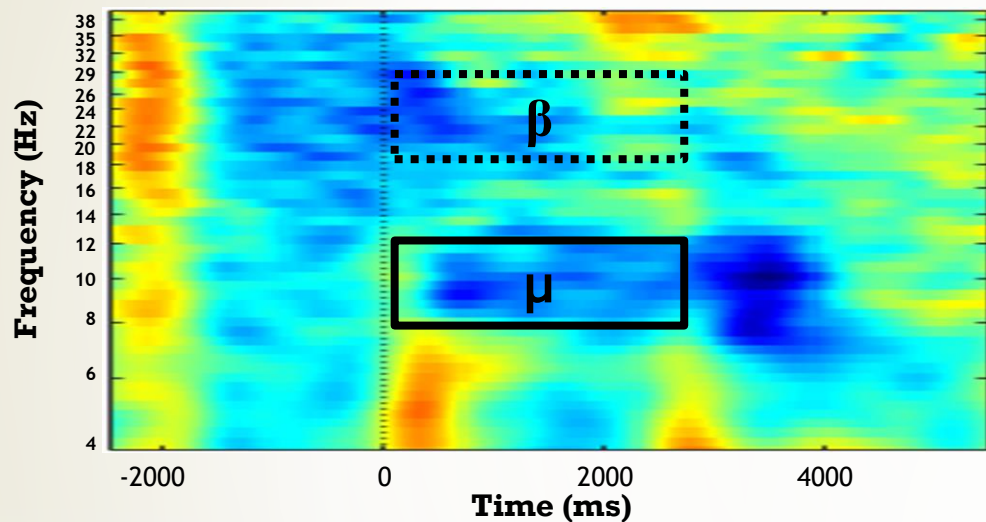


ERSP during IMAGINED CONTRACTIONS

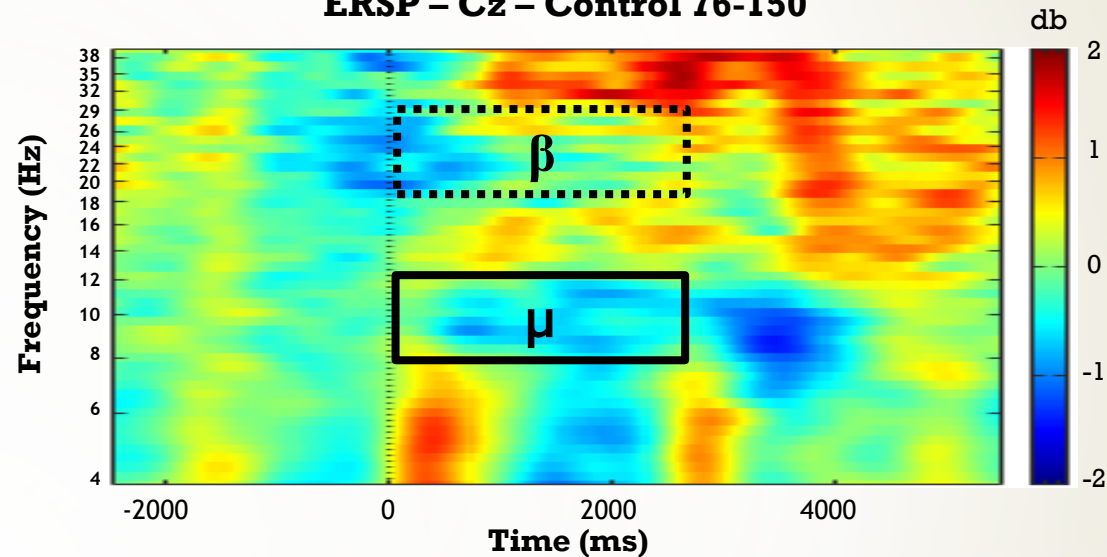


ERSP during ACTUAL CONTRACTIONS

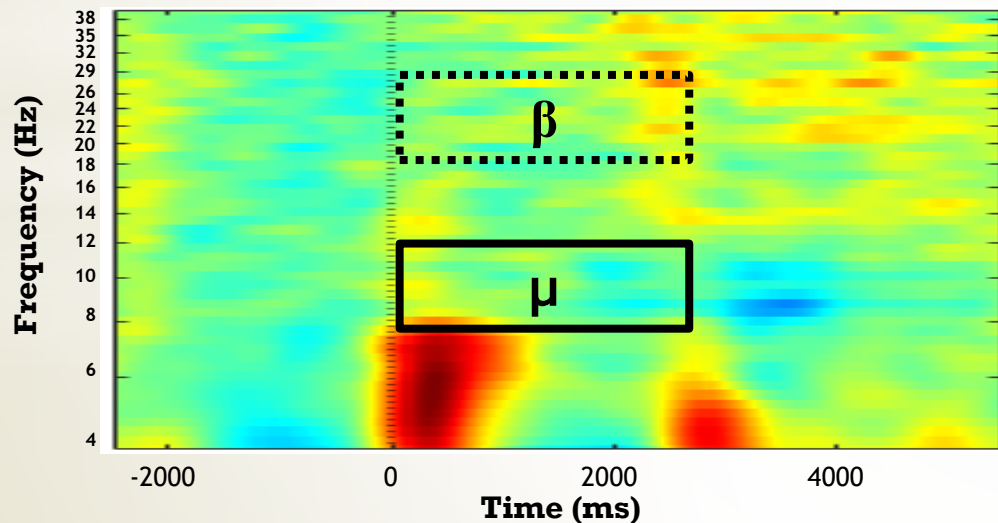
ERSP – Cz – Control 1-75



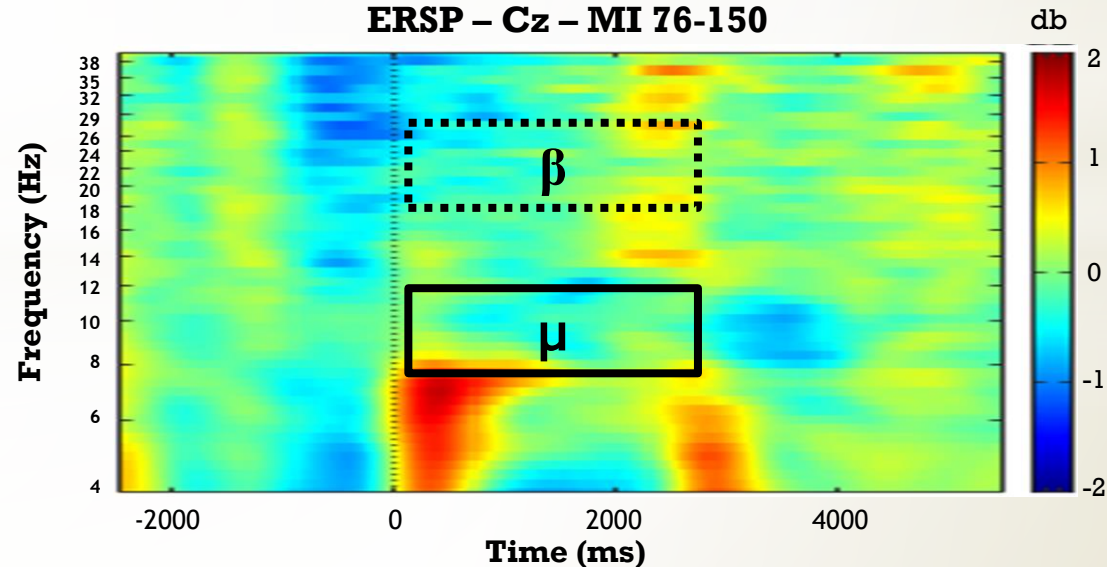
ERSP – Cz – Control 76-150



ERSP – Cz – MI 1-75



ERSP – Cz – MI 76-150



Conclusion

Could prolonged MI induce mental fatigue ?

- Increase in feeling of tiredness
- Increase in perceived effort
- Decrease in Beta band



What happens to ERSP during both imagined and actual isometric knee extensions?

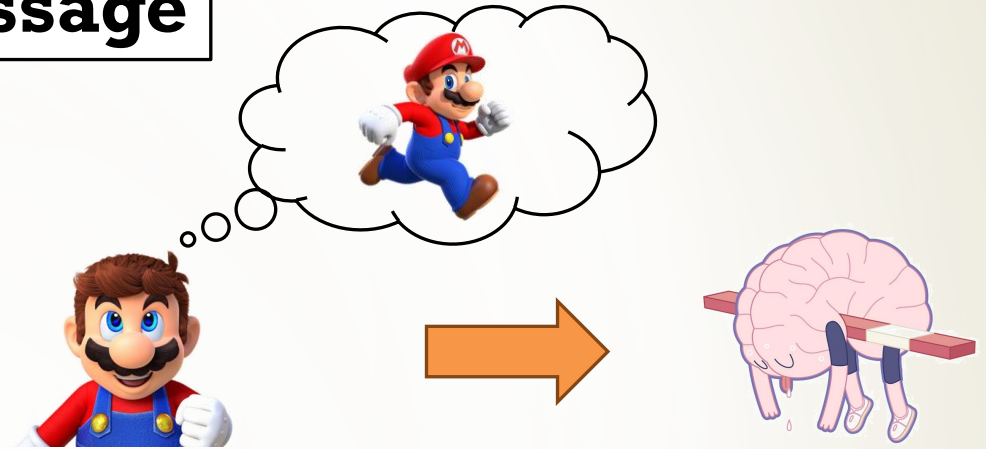
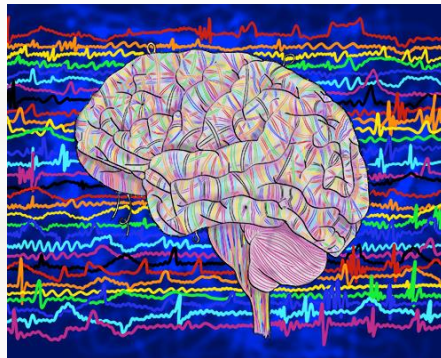
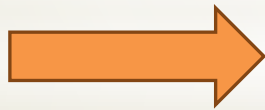
- Differences between ERSP for actual and imagined movements
- The absence of mu desynchronisation could be explained by an increase of fatigue (mental or physical)

Take home message

Prolonged MI induces mental fatigue



or



Fatigue (mental or physical) influences brain oscillations related to movement



**THANKS FOR
YOUR
ATTENTION**

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