Exploring tempo and modality effects on modulation of brain oscillations during rhythm perception

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Introduction:

Rhythm = repetition of external stimulus at regular interval (Grahn, 2012)
↳ Inter stimuli interval (Grahn, 2012)

Spontaneous synchronisation to perceived rhythm (Repp & Su, 2013)
↳ Sensorimotor synchronisation (Repp & Su, 2013)
↳ Voluntary or not (Repp & Su, 2013)

⇨ First step to synchronisation is perception

Electroencephalographic (EEG) studies ⇨ desynchronisation during perception:
- Central electrodes (Pineda, 2005; Pineda *& al*., 2013)
- Mu-rhythm (around 10Hz) (Pineda, 2005; Pineda *& al*., 2013)

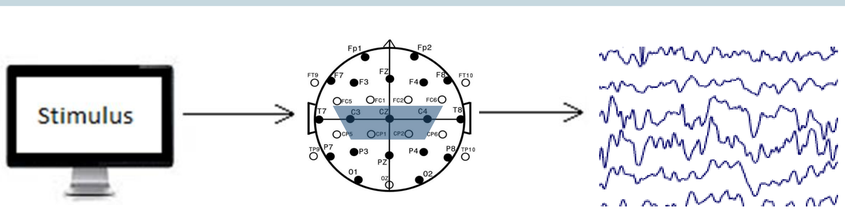
Rhythm perception can be modulated by:
- Modality (Vroomen & Keetels, 2010)
- Tempo (Zalta *& al.,* 2020)
  ↳ Spontaneous motor tempo (Repp & Su, 2013)

Aim: Quantifying EEG activations of the combined effect of tempo and sensory modality when perceiving rhythmic stimuli

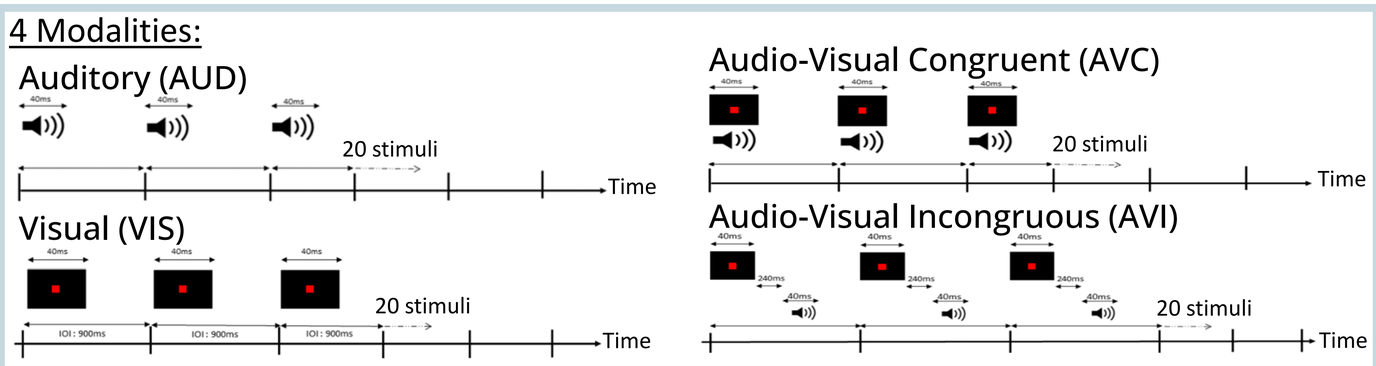
Hypothesis: Lower EEG activation over the central electrodes, reflecting higher cerebral activity, in the mu-rhythm frequency band for audio-visual modality, even more for the tempo supposed to be near the spontaneous motor tempo.

Method:

Participants:
15 healthy right-handed adults (age: 23.9 ± 1.7 years)



4 Modalities:



3 Tempi:

500ms

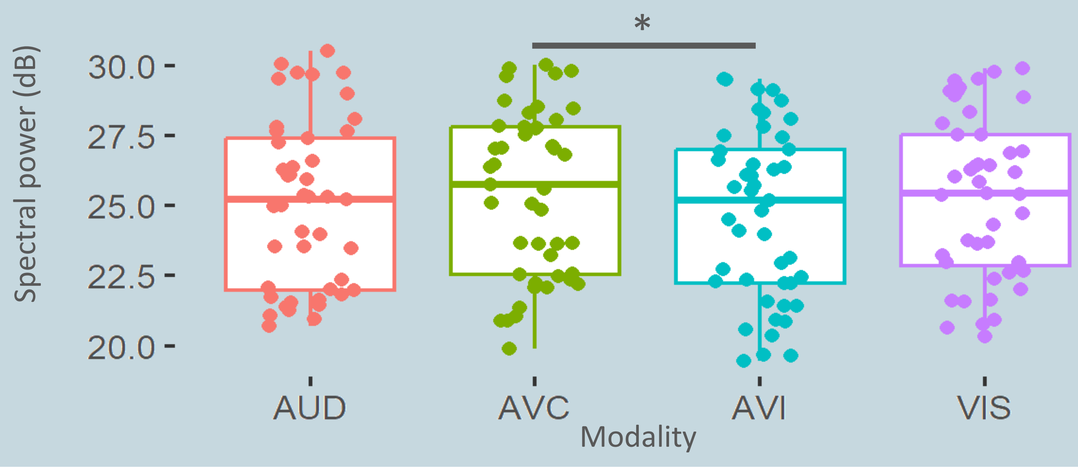
700ms

900ms

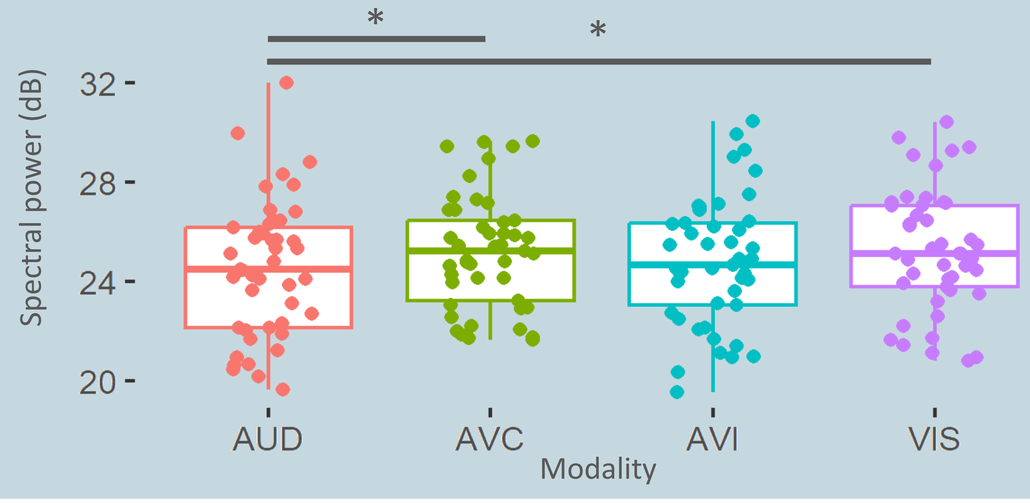
↳ EEG spectral power of *mu* frequency band (9-11Hz) ⇨ Statistical analysis: linear mixed-effects model Modality x Tempo

Results:

C3 electrode Significant Modality effect: $F = 2.912$, $p = 0.036$
Post hoc test: AVC vs AVI $t(154) = 2.716$, $p_{bonf} = 0.44$



Cz electrode Significant Modality effect: $F = 4.521$, $p = 0.005$
Post hoc test: AUD vs AVC $t(154) = -2.924$, $p_{bonf} = 0.024$
AUD vs VIS $t(154) = -3.175$, $p_{bonf} = 0.011$



Discussion & Conclusion:

C3 electrode:

➖ spectral power in AVI than AVC ➕ cerebral activity while perception ⇨ More ressources needed for more complex modality
≠ litterature ⇨ No tempo difference
↳ Zalta *et al.,* 2020: Beat discrimination task

CZ electrode:

➖ spectral power in AUD than AVC & VIS ➕ cerebral activity while AUD perception
↳ Link between perception and action of the lower limb?
↳ Exploring EMG responses during auditory perception

Results seem to be in agreement with the litterature: perception lead to higher cerebral activation in mu band frequency in the sensorimotor cortex

Reference: Grahn, J. A. (2012). Neural Mechanisms of Rhythm Perception : Current Findings and Future Perspectives. *Top Cogn Sci;* Pineda, J. A. (2005). The functional significance of mu rhythms : Translating « seeing » and « hearing » into « doing » *Brain Res. Rev.;* Pineda et al., (2013). EEG sensorimotor correlates of translating sounds into actions. *Front Neurosci;* Repp, B. H., & Su, Y.-H. (2013). Sensorimotor synchronization : A review of recent research (2006-2012). *Psychon Bull Rev;* Vroomen, J., & Keetels, M. (2010). Perception of intersensory synchrony : A tutorial review. *Attent Percep Psychophys;* Zalta, A. et al., (2020). Natural rhythms of periodic temporal attention. Nat Commun.