



HAL
open science

Asymmetries in Cerebellar Activation during Finger Movements: A Functional Near-Infrared Spectroscopy Study

Giulia Rocco, Jerome Lebrun, Olivier Meste, Marie-Noële Magnie-Mauro

► **To cite this version:**

Giulia Rocco, Jerome Lebrun, Olivier Meste, Marie-Noële Magnie-Mauro. Asymmetries in Cerebellar Activation during Finger Movements: A Functional Near-Infrared Spectroscopy Study. *Acta Physiologica: 4th Congress of Physiology and Integrative Biology, 88th Congress of French Physiological Society, Faculté de Médecine, Nice, France, 2-4 September, 2021, French Physiological Society, Sep 2021, Nice, France. pp.9-10, <10.1111/apha.13745>. <hal-03529215>*

HAL Id: hal-03529215

<https://hal.science/hal-03529215v1>

Submitted on 17 Jan 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



HAL Authorization

Asymmetries in Cerebellar Activation during Finger Movements: A Functional Near-Infrared Spectroscopy Study

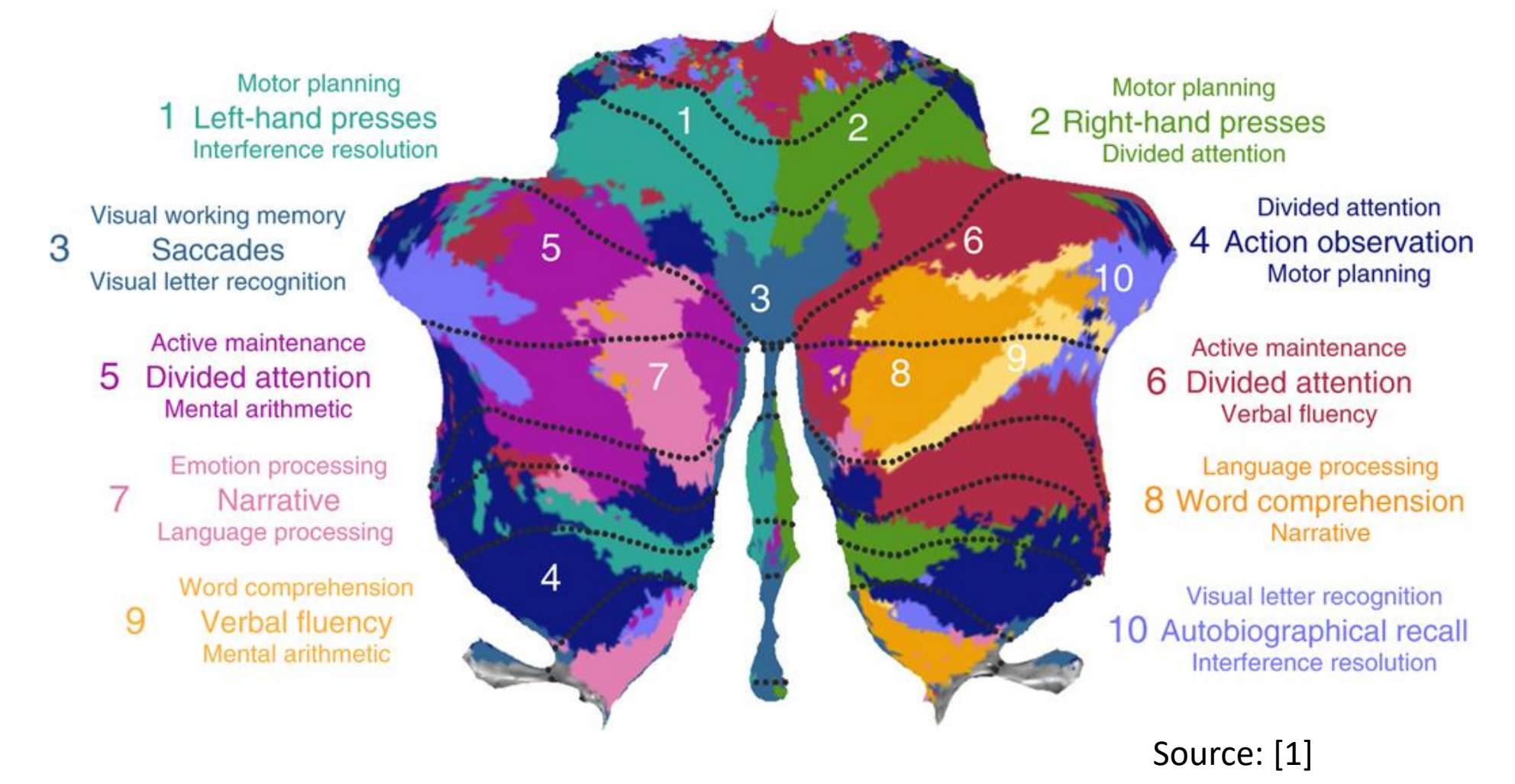
G. ROCCO¹, J. LEBRUN¹, O. MESTE¹, M.N. MAGNIÉ-MAURO^{2,3}

¹ I3S Laboratory, ² BCL Laboratory, ³ Centre Hospitalier Universitaire - Université Côte d'Azur, Nice, France

INTRODUCTION

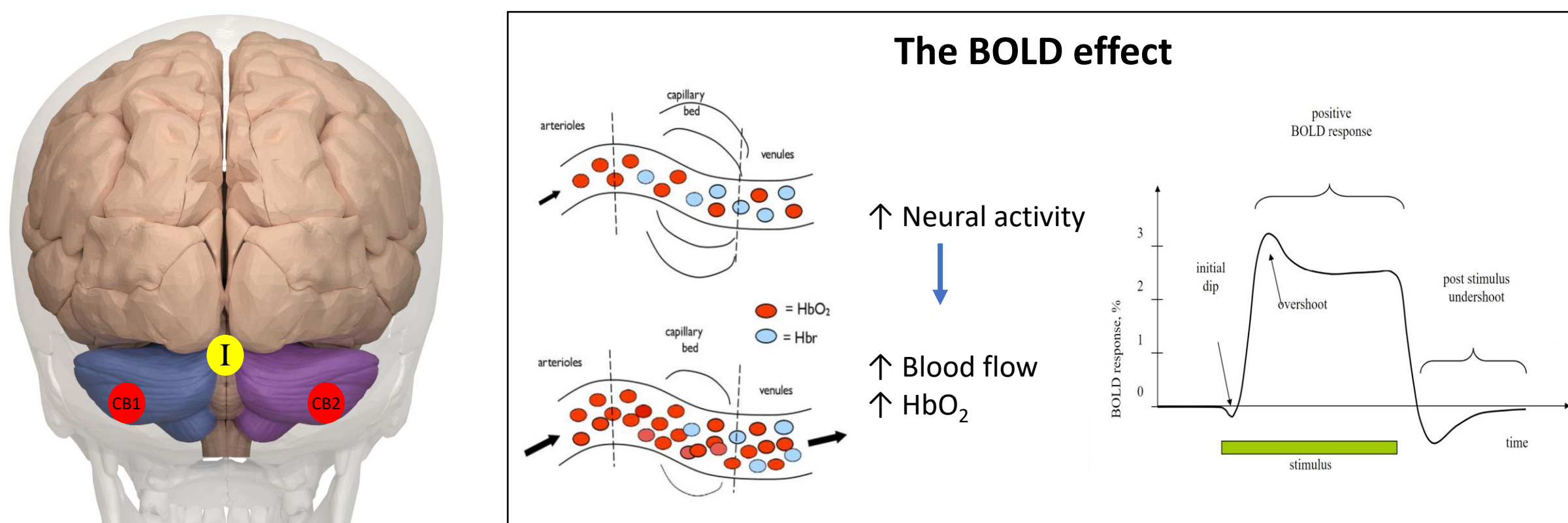
- Growing interest in unravelling cerebellar functions in the last decades
- Heterogeneous findings about cerebellar involvement in sensorimotor control
- Need for further analysis and new methods to investigate cerebellum with a focus on hemisphere specificity

→ investigation of which **cerebellar hemisphere** displays **activation** during finger movement of the dominant and sub-dominant hand using **functional Near-Infrared Spectroscopy (fNIRS)**.

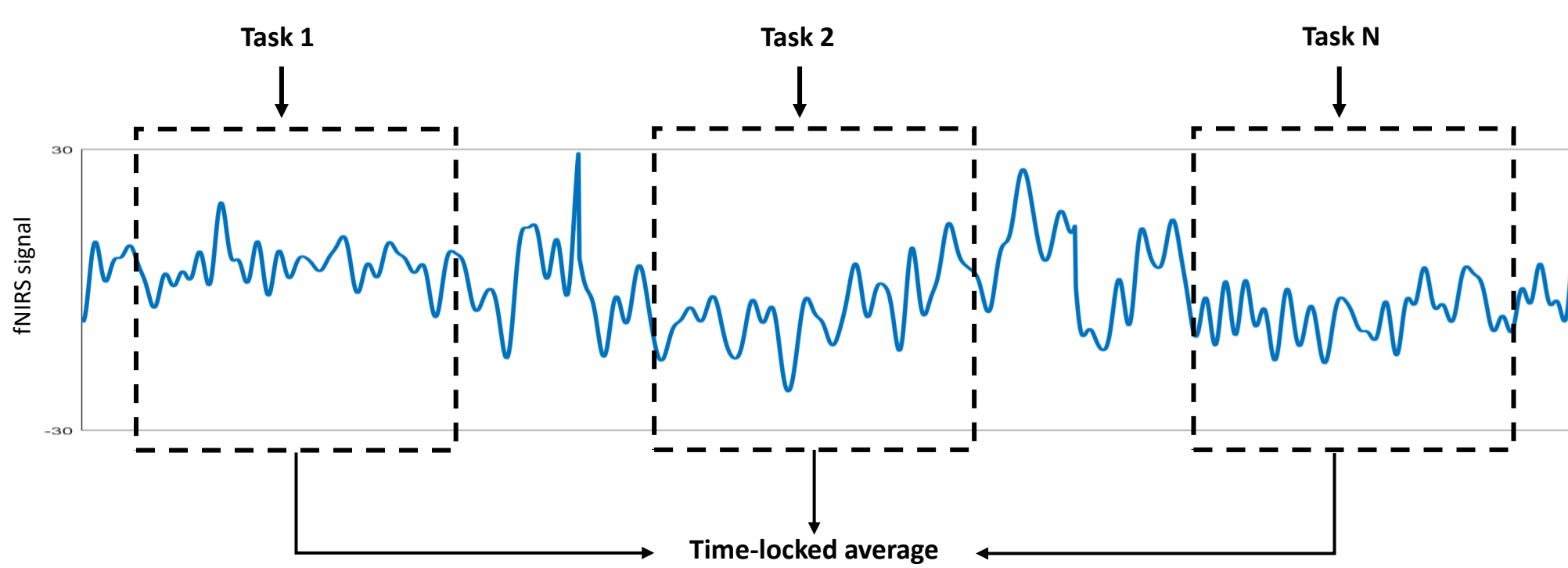


METHOD

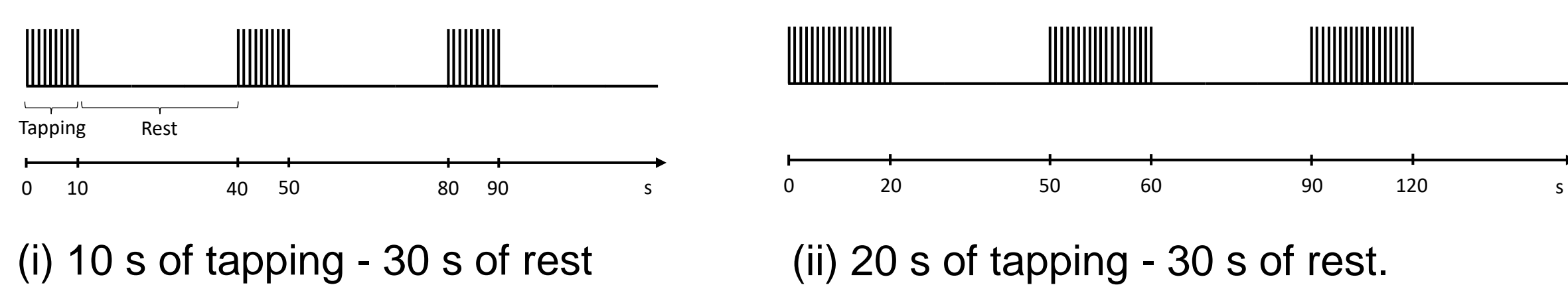
- fNIRS is an **optical technique** that allows to measure the changes in concentration of oxygenated (ΔHbO_2) and deoxygenated (ΔHbR) hemoglobin supposedly caused by neuronal activation.
- Two channels (source and detector) acquired, respectively on the left (CB1) and right (CB2) cerebellar hemisphere with source-detector distance at 3.5 cm to ensure an adequate depth to access the real cerebellar signal and to elude muscle and extracerebral activity.



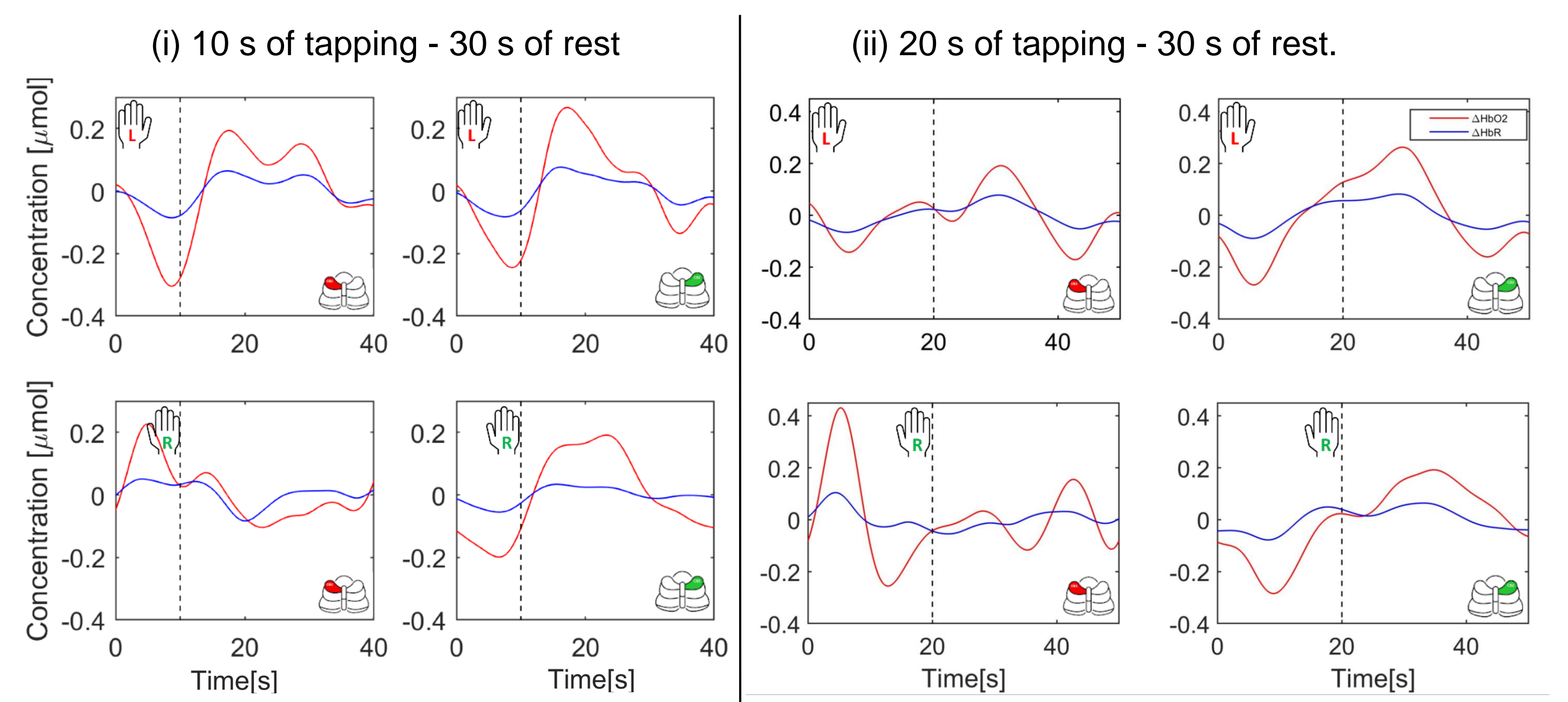
- Recording of the blood oxygenation level dependent (**BOLD**) effect: neural activation is associated with an increase in local arterial vasodilation, which leads in turn to a regional increase in cerebral blood flow and volume and thus oxygenation.
- One healthy subject performed a **finger tapping** task: 6 repetitive blocks (task + rest) respectively for the left and right hand.



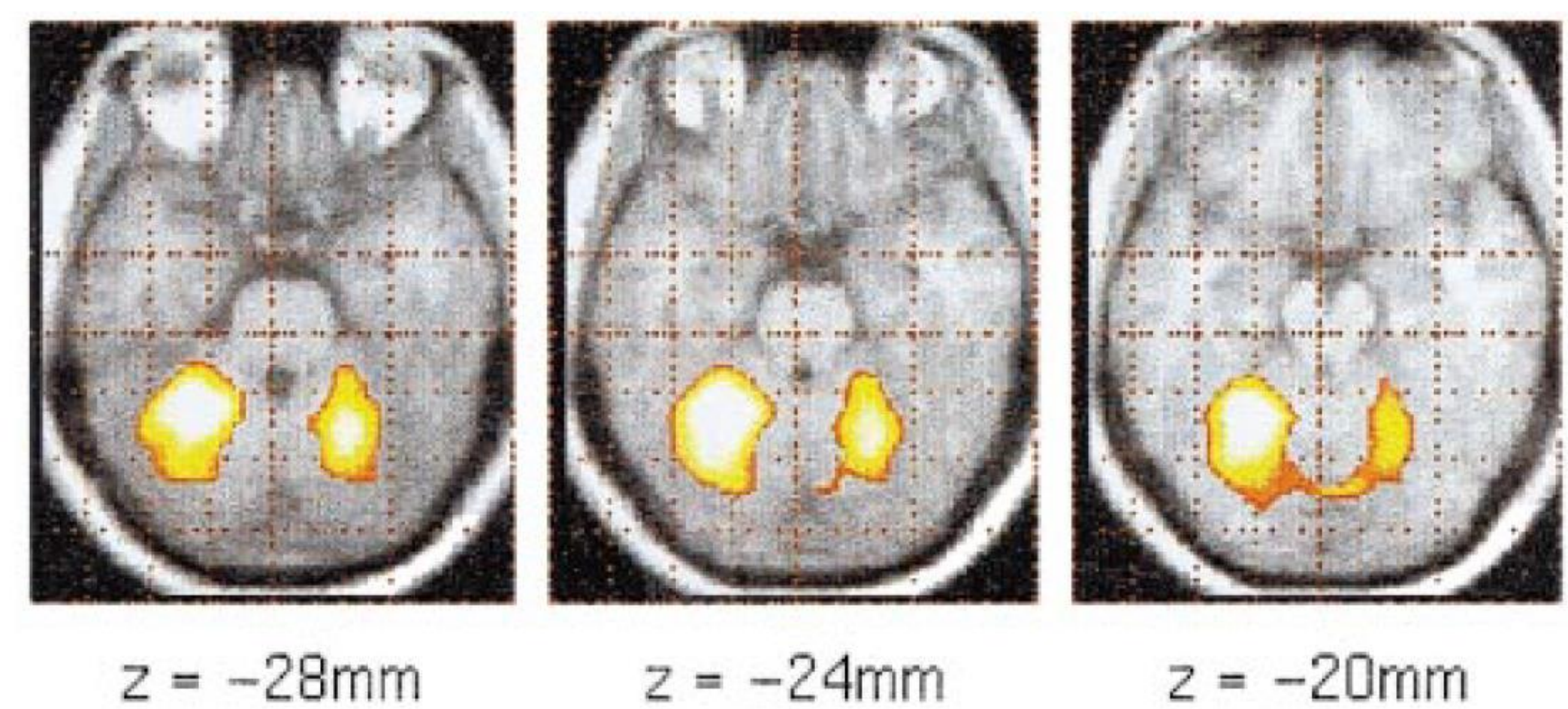
- The task was repeated twice for each hand changing the activity periods:



RESULTS



- Similar hemodynamic response observed ipsilaterally and contralaterally for both protocols (10 s vs 20 s activity).
- Involvement of the dominant hemisphere (right-handed subject) even during the sub-dominant hand movement (validated with a left-handed subject) [2].
- A finer analysis shows higher synchronization of the right hemisphere for left hand movement in according with previous fMRI studies [3]:
 - Ipsilateral activation with the dominant hand movement
 - With movements of the subdominant hand BOLD signal increases ipsilaterally and also contralaterally. This raised the hypothesis of a dual layer processing



CONCLUSIONS

- fNIRS proved to be a bona fide alternative technique to capture cerebellar hemodynamics in a non-clinical setting.
- The observed asymmetries in cerebellar activation agree with previous fMRI studies [3].
- They suggest the existence of different layer of controls from the cerebellum in the two hemispheres: one for precise movements and the other for repetitive ones.
- Extended experiments are planned in the future to study motor and cognitive functions in a multimodal setting with EEG recordings.
- This work paves the ground towards the implementation of a new diagnostic tool to interpret patterns of cerebellar activation.

REFERENCES

- [1] King, M., Hernandez-Castillo, C. R., Poldrack, R. A., Ivry, R. B., & Diedrichsen, J. (2019). Functional boundaries in the human cerebellum revealed by a multi-domain task battery. *Nature neuroscience*, 22(8), 1371-1378.
- [2] Rocco G., Lebrun J., Meste O., & Magnié-Mauro M. N. (2021). A Chiral fNIRS Spotlight on Cerebellar Activation in a Finger Tapping Task. *43rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*.
- [3] Jäncke, L., Specht, K., Mirzazade, S., & Peters, M. (1999). The effect of finger-movement speed of the dominant and the subdominant hand on cerebellar activation: a functional magnetic resonance imaging study. *Neuroimage*, 9(5), 497-507.

CONTACT: giulia.rocco@i3s.unice.fr