



Can a circular steering task quantify sensorimotor integration in persons with stroke?

Tifenn Fauviaux, Camille Muller, Germain Faity, Karima Bakhti, Isabelle Laffont, Jérôme Froger, Denis Mottet

► To cite this version:

Tifenn Fauviaux, Camille Muller, Germain Faity, Karima Bakhti, Isabelle Laffont, et al.. Can a circular steering task quantify sensorimotor integration in persons with stroke?. Congrès de la Société Française de Médecine Physique et de Réadaptation 2021, Oct 2021, Lille, France. 2021. hal-03834500

HAL Id: hal-03834500

<https://hal.science/hal-03834500v1>

Submitted on 30 Oct 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.

Can a circular steering task quantify sensorimotor integration in persons with stroke?

Tifenn Fauviaux¹, Camille Muller^{1,2}, Gemain Faity¹, Karima Bakhti^{1,2,4}, Isabelle Laffont^{1,2}, Jérôme Froger^{1,3}, Denis Mottet¹



- 1 — EuroMov Digital Health in Motion, Univ Montpellier, IMT Mines Alès, Montpellier, France
- 2 — Service de médecine physique et réadaptation, CHU Montpellier, Montpellier, France
- 3 — Service de médecine physique et réadaptation, CHU Nîmes, Le Grau Du Roi, France
- 4 — Direction des Soins, CHU Montpellier, Montpellier, France



Background

Stroke limits the capacity of the central nervous system to integrate sensory inputs for the execution of specific voluntary movement in response to task demands. Functional limitations are usually quantified with clinical evaluations, but it is unclear how these scores assess the effectiveness of visuomotor feedback in goal-oriented behaviors.

Objective : Quantify the effectiveness of visuomotor feedback in individuals with stroke, using a circular steering task.

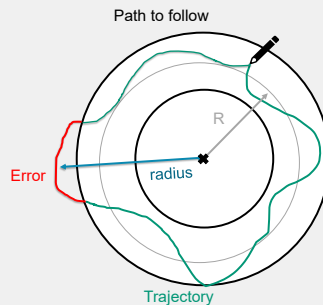
Methods

9 healthy volunteers and 9 stroke victims were recruited for a 30 minutes session.

Each participant performed a circular steering task with a total of 6 trials, organized into 2 hands x 3 repetitions.

The circular steering task :

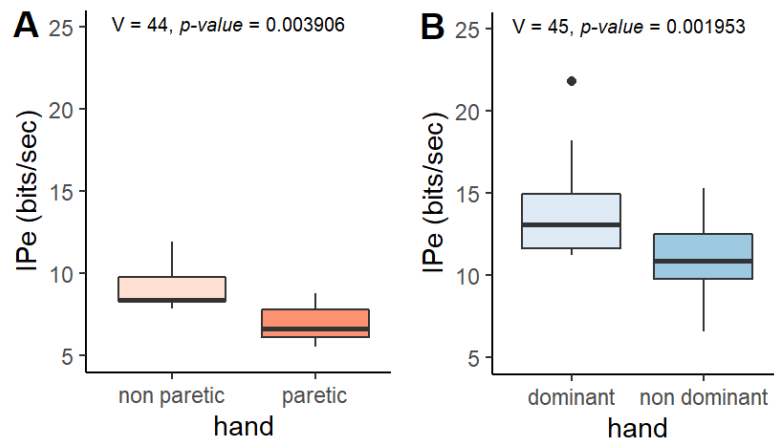
⇒ We measured the **Index of Effective Performance (I_{Pe}, in bit/s)**, which measure the effectiveness of visuomotor feedback.



$$I_{Pe} \text{ (bits/sec)} = \frac{\text{Index of Effective Difficulty (IDe)}}{\text{Movement Time (MT)}}$$

$$\Rightarrow IDe \text{ (bits)} = \frac{2\pi * R}{\text{Standard Deviation of the radius}}$$

Results



These results illustrates : **A)** The effect of stroke on the effectiveness of visuomotor feedback (through the I_{Pe} (bits/sec)) : the I_{Pe} measured with the non paretic hand is significantly better than the I_{Pe} measured with the paretic hand. **B)** The effect of hand (dominant vs non dominant) measured in the control group on the I_{Pe} (bits/sec) : the I_{Pe} of the non dominant hand is significantly reduced compared to the I_{Pe} of the dominant hand.

Conclusion

The circular steering task can quantify the quality of sensorimotor integration which reflects the effectiveness of sensory feedback. Finally, our preliminary results confirm a decrease of the effectiveness of sensorimotor feedback for the non dominant and for the paretic upper limb.

These results need to be supplemented with a larger number of participants. Age-specific norms might also help quantifying the possibilities of improvement for each patient, to guide therapists in the rehabilitation strategy of motor control of the upper limbs after stroke.

References

- Edwards, L. L., King, E. M., Buetefisch, C. M., & Borich, M. R. (2019). Putting the "Sensory" into Sensorimotor Control : The Role of Sensorimotor Integration in Goal-Directed Hand Movements After Stroke. *Frontiers in Integrative Neuroscience*, 13. <https://doi.org/10.3389/fnint.2019.00016>
- Fitts, P. M. (1954). The information capacity of the human motor system in controlling the amplitude of movement. *Journal of Experimental Psychology*, 47(6), 381-391. <https://doi.org/10.1037/h0055392>
- MacKenzie. (1992). Fitts' Law as a Research and Design Tool in Human-Computer Interaction. *Human-computer interaction*, 7(1), 91-139.

This study was supported by a grant from French Ministry of Solidarity and Health (ReArm, PHRIIP 2018-0731) and we thanks Dr Makii Muthalib for his contribution.