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

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Background

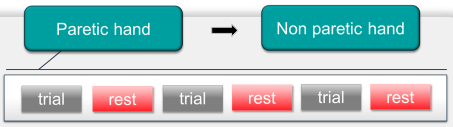
Stroke limits the capacity of the central nervous system to integrate sensory inputs for the execution of specific voluntary movement in response to task demands. Functional limitations are usually quantified with clinical evaluations, but it is unclear how these scores assess the effectiveness of visuomotor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

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

Methods

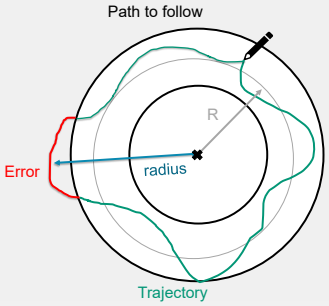
9 healthy volunteers and 9 stroke victims were recruited for a 30 minutes session.

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



The circular steering task :

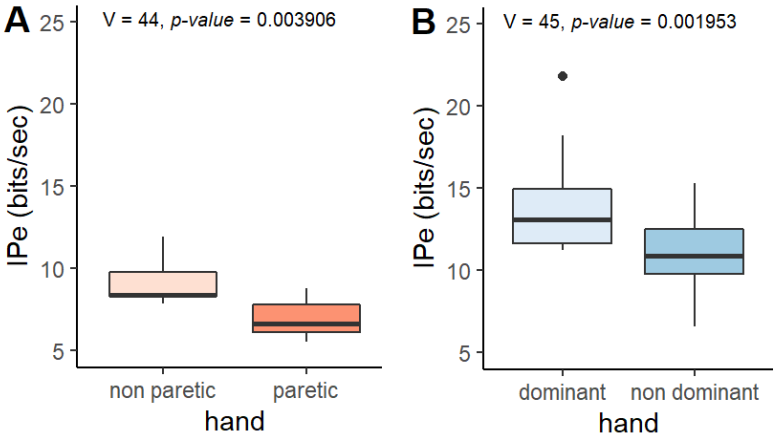
⇒ We measured the **Index of Effective Performance** (**IPe, in bit/s**), which measure the effectiveness of visuomotor feedback.



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

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

Results



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

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