Relationship between severity of post-concussive symptoms and motor learning in patients with mild traumatic brain injury

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BACKGROUND

Mild traumatic brain injury (mTBI) can lead to **persistent post-concussive symptoms** (PPCS) in ~30% of cases [1], affecting cognitive, emotional and somatic domains. Deleterious effects on **motor learning**, reflecting synaptic plasticity, have also been described. However, the interplay between these two components remains underexplored.

The **objective** of this study is to quantify the relationship between PPCS severity and motor learning impairments among patients with mTBI from a University Hospital care pathway

METHODS

- **32 patients** with PPCS (21 women, 40 y.±13)
  Time since injury: 116 ± 81 days
- **11 healthy controls** (8 women, 38 y. ± 14)

p >0.05

1) PPCS severity:

- Rivermead Post-concussion Questionnaire (RPQ)

Self-report symptom rating scale evaluating presence (cut-off score ≥16) and *severity* (total score 64) of PPCS

2) Motor learning:

- Serial Reaction Time Task (SRTT)

Computerized finger-tapping task using block sequences assessing implicit motor learning (Fig.1)

→ Total training-related learning = median response time (RT) across first and last sequence blocks (S1 vs. S10)

→ Sequence-specific learning = median RT across last sequence block and following last random block (S10 vs. R4)

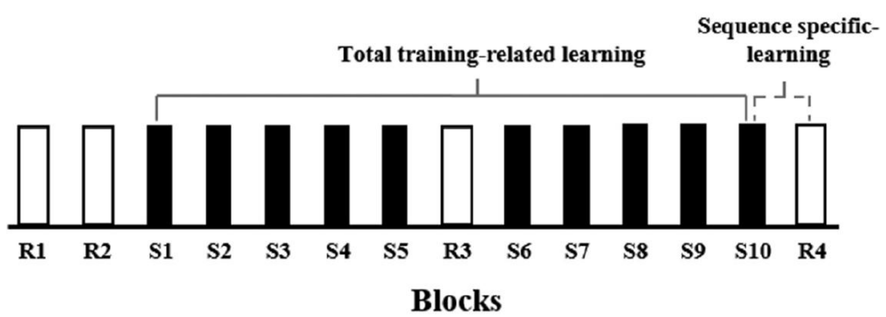

Fig.1 | SRTT structure. S blocks contained a repeating 12-item sequence whereas R blocks contained stimuli presented in random order

RESULTS

1) PPCS & motor learning: patients vs. controls

	Patients (n=32)	Controls (n=11)	p value [a]
PPCS severity			
RPQ score	34 [24, 44]	2 [0, 4]	<0.001 ***
Motor learning (SRTT)			
Task accuracy (%)	95 [92, 97]	98 [96, 98]	0.057
Response time (ms)	586 [546, 646]	573 [536, 598]	0.362
Total training-related learning	11 [7, 15]	4 [0, 6]	0.017 *
Sequence-specific learning	-9 [-15, -4]	-10 [-16, -3]	0.941

[a] : Wilcoxon rank sum test. RPQ = Rivermead Post-concussion Questionnaire

Patients show total training-related learning impairment but sequence-specific learning similar to controls

2) Correlation PPCS (RPQ) – motor learning (SRTT)

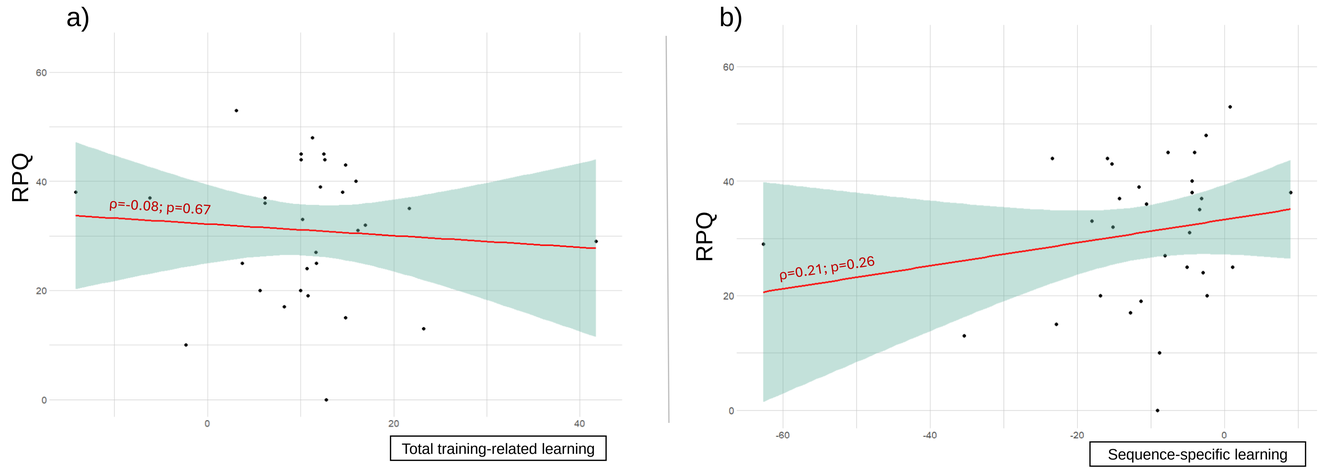

Fig.2 | **Scatterplots PPCS severity (RPQ) – motor learning indexes**
a) RPQ total score vs. Total training-related learning index (reflecting the cognitive load of the entire task).
b) RPQ total score vs. Sequence-specific learning (reflecting the cognitive load of getting back to a random sequence). ρ = Pearson's correlation

There is no significant relationship between persistent post-concussive symptoms severity and motor learning

CONCLUSIONS

- Patients with PPCS have impaired total training-related learning, demonstrating the potential added value of motor learning assessment in a diagnostic battery
- The sequence-specific learning component appears less discriminating, in agreement with previous findings on athletes [2]
- The motor learning indexes are not related to the severity of PPCS, underlining the specificity of neurocognitive alterations related to psychomotor speed against global functioning
- Future analyses will focus on the cognitive components of the Rivermead Post-concussion Questionnaire as well as neuroimaging correlates

References
1 Cancelliere et al., *J Neurotrauma*, 2023.
2 Bourassa et al., *J Clin and Exp Neuropsych*, 2021.

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