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P7

# Real-Time Functional MRI Neurofeedback in Functional Neurological Disorder

## A proof-of-concept study

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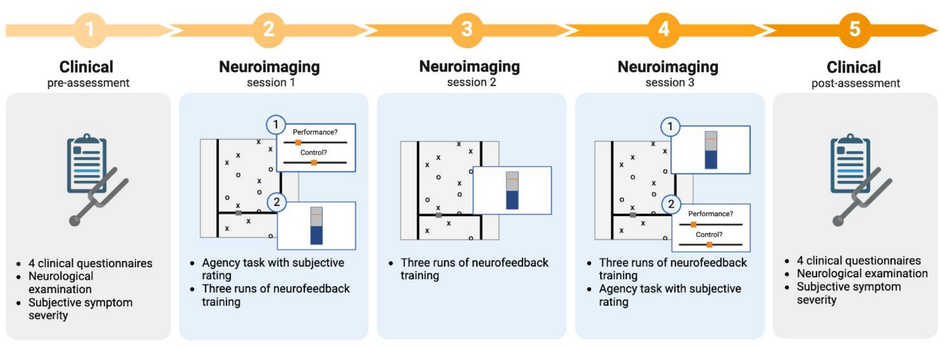
## BACKGROUND

Characteristics of **Functional Neurological Disorder (FND)**:

- FND is a neuropsychiatric condition [1].
- Patients report an impaired sense of agency, i.e., a lack of control over their movements [2].
- FND is associated with abnormal brain function and connectivity within the neurobiological network responsible for the sense of agency, particularly in the right temporoparietal junction (rTPJ) [3,4].

## METHODS



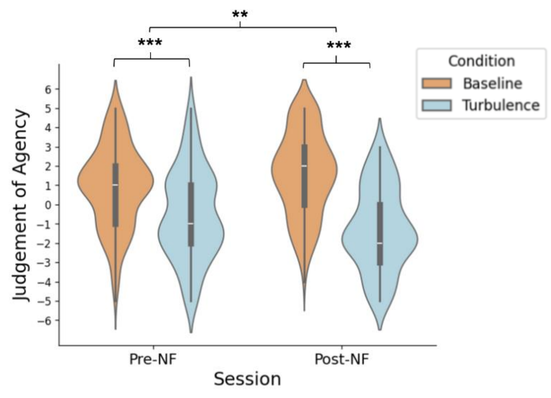

- 20 FND patients with mixed symptoms were enrolled in the study.
- The study used activity-based adaptive neurofeedback training with intermittent visual feedback reflecting activity within the rTPJ.
- The agency task used for neurofeedback training, as well as the baseline and outcome neuroimaging assessment, consisted of two conditions: **Baseline**, in which the cursor follows the exact movement, and **Turbulence**, in which the sense of control is reduced by artificially manipulating the movement of the cursor. Turbulence has been shown to activate the rTPJ in healthy subjects [6].

## AIMS

This proof-of-concept study aims to assess whether FND patients can learn to increase the activity within the rTPJ, a key region in the agency network, using real-time fMRI neurofeedback.

## RESULTS

**Fig. 1: Subjective ratings of agency during the agency task.**
Group-level results (n=18) of agency ratings before and after neurofeedback training. A Friedman test with post-hoc Dunn's test revealed a significant difference in agency ratings between the 'turbulence' and 'baseline' conditions ($p < 0.001$), with this difference increasing significantly after training ($p < 0.01$).



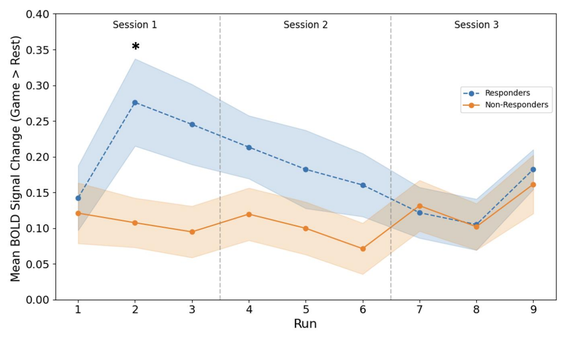
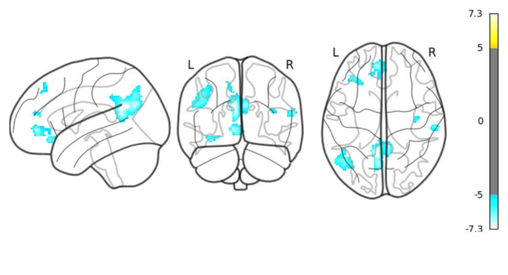




**Fig. 2: rTPJ activity during neurofeedback training.**
Mean BOLD signal change (± SEM) for the game vs. rest contrast within the rTPJ is plotted across runs and sessions for responders (n=8) and non-responders (n=10). Linear mixed model regression analysis revealed a significant difference in BOLD signal change during run 2 between responders and non-responders ($p = 0.01$, corrected for multiple comparisons).

**Fig. 3: Psychophysiological interaction (PPI) analysis during the neurofeedback training task at the group level (n=18).**
Regions showing reduced functional connectivity with the rTPJ during the task include key nodes of the default mode network (DMN), motor areas, and other task-relevant regions. Notable clusters include the precuneus, cingulate cortex, and paracingulate gyrus—regions frequently associated with self-referential thought and social cognition.




## CONCLUSION

The neurofeedback training protocol was feasible, with all 20 participants completing the study (2 excluded post hoc due to movement artefacts). Behavioural analysis showed significant group-level changes in agency perception, driven primarily by responders (n=8) who showed distinct BOLD signal patterns early in training. Psychophysiological interaction analysis revealed changes in functional connectivity from the rTPJ to regions of the DMN, indicating altered attentional focus and self-referential processing. These findings suggest that neurofeedback may have differential effects on individuals and warrant further investigation of neuroimaging and clinical characteristics of responders.

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References

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