

A swing between the inner and the outer worlds: Exploring the function of the frontal aslant tract with transcranial magnetic stimulation

ABSTRACT:

Background

Humans interacting with the world choose between two mutually incompatible strategies: either building an internal representation of the future temporal events and acting by predicting what will happen or waiting for external events to happen and then reacting to them. The two strategies could interact by means of the white matter bundle “frontal aslant tract” (FAT), connecting the superior frontal gyrus (SFG) to the inferior frontal gyrus (IFG)..

Aims

To understand the role of the IFG and SFG terminations of the FAT, in the light of their connectivity. To show homologies between the SFG and IFG regions connected by FAT fibers, with internally-driven actions in the SFG and externally-driven actions in the IFG.

Method

We used tractography-guided transcranial magnetic stimulation (TMS) to interfere transiently with local neural process in the SFG and IFG, at both terminations of the FAT, but at 3 different positions along the caudal-cranial axis, during different tasks: a) an implicit strategic choice between internally-timed and externally-driven action strategies and b) spontaneous production of rhythmic movements.

Results

Stimulation of the SFG produced biases towards internal strategies and stimulation of the IFG produced biases towards external strategies. SFG stimulation interfered also with internally-paced actions. The control of strategy was localized more anteriorly compared to the control of action timing.

Conclusions

Our data confirm that the FAT mediates the interaction between internally-driven actions, represented in the SFG and externally-driven actions represented in the IFG. The mid-portion of the FAT controls action selection. The posterior part produces action plans for action execution.

Keywords

Frontal aslant tract, Motor control, Action selection, Predictive, Proactive

Os textos são da exclusiva responsabilidade dos autores
All texts are of the exclusive responsibility of the authors

Published Work:

Tagliaferri, M., Giampiccolo, D., Parmigiani, S., Avesani, P., & Cattaneo, L. (2023). Connectivity by the Frontal Aslant Tract (FAT) explains local functional specialization of the superior and inferior frontal gyri in humans when choosing predictive over reactive strategies: a tractography-guided TMS study. *The Journal of Neuroscience*, 43(41), 6920–6929. doi: 10.1523/JNEUROSCI.0406-23.2023

Tagliaferri, M., Amorosino, G., Voltolini, L., Giampiccolo, D., Avesani, P., & Cattaneo, L. (2024). A revision of the dorsal origin of the frontal aslant tract (FAT) in the superior frontal gyrus: A DWI-tractographic study. *Brain Structure & Function*, 229(4), 987–999. doi: 10.1007/s00429-024-02778-4

Researcher's Contacts:

Luigi Cattaneo
Center for Mind/Brain Sciences
University of Trento
Via delle Regole, 101
38123, Trento
Italy

Phone: +39 0461 882745

Email: luigi.cattaneo@unitn.it