Project title: Temporal dynamics of task context representation in corticostriatal cognitive networks

Project leader: Peter Stiers

Function: Assistant professor

Collaborators: Alexandros Goulas

Proposal (250 words):

Introduction: Insight into the organization of the prefrontal cortex for cognitive performance has substantially increased during the last decade, and has led to extensive study of the distributed representations of task-relative information (task contexts) in lateral and medial prefrontal cortex regions. However the collaboration across these regions, and particularly with the basal ganglia, has received much less attention. Our own fMRI studies support the view that subpopulations of neurons underlying the imaging voxels assemble in task-context specific subnetworks across these regions. These interregional couplings are hardwired and traceable also in resting state data.
Hypothesis and Objectives: The current project investigates the dynamic formation of these assemblies over time. A crucial question at this point is whether the assemblies underlying specific task contexts are acquired specifically for each task or whether the tasks use wirings that existed before task learning. In addition, we will establish the contribution of basal ganglia, implicated in procedural/habit learning, to task learning and assembly formation.
Setting and Methods: We study task (feature) preferences and functional couplings of voxels before, during and after learning different cognitive tasks, in order to establish whether the connections underlying assemblies are already present before learning a new task or whether they are formed during acquisition of new tasks. In addition, we will investigate whether the acquisition of new tasks perturbates the spatial patterns of task-related activity and functional coupling that are characteristic of already acquired tasks.
Impact: These results will affect our views on brain-wide network functioning and task/function specific network motifs.

Requirements candidate: Highly motivated student with good English communication skills and proactive and resolute attitude. Experience with neuroimaging analysis and willingness to acquire programming skills are a plus.

Keywords: Multiple demand network, functional connectivity, striatum, decision making, stimulus response rules, neural plasticity.

Top 5 selected publications:

1. Samara, Z., Evers, E.A., **Goulas, A.**, Uylings, H.B., Rajkowska, G., Ramaekers, J.G., **Stiers, P.** (2017). Human orbital and anterior medial prefrontal cortex: Intrinsic connectivity parcellation and functional organization. *Brain Structure and Function*. Web published, doi: 10.1007/s00429-017-1378-2.
2. **Goulas, A., Stiers, P.**, Hutchison, R.M., Stefan Everling, S., Petrides, M., Daniel S. Margulies, D.S. (2017). Intrinsic functional architecture of the macaque dorsal and ventral lateral frontal cortex. *Journal of Neurophysiology, 117,* 1084-1099.
3. Evers, E.A., **Stiers P.**, Ramaekers, J.G. (2017). High Reward Expectancy During Methylphenidate Depresses the Dopaminergic Response to Gain and Loss. *Social, Cognitive, and Affective Neuroscience,* 12:311-318.
4. **Goulas, A.**, Uylings H.B.M., **Stiers, P.** (2012). Unravelling the intrinsic functional organization of the human lateral frontal cortex: a parcellation scheme based on resting-state fMRI. *Journal of Neuroscience, 32*, 10238-10252.
5. **Stiers, P.**, Mennes, M., & Sunaert, S. (2010). Distributed task coding throughout the multiple demand network of the human frontal-insular cortex*. NeuroImage, 52*, 252-262.