FRONTOSTRIATAL NEUROPHYSIOLOGICAL UNDERPINS OF DECISION-MAKING

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Background: Impulsivity is a central process in decision-making and is typically divided in action impulsivity and choice impulsivity/delay intolerance (preference for smaller but immediate outcomes). These two forms of impulsivity overlap in many aspects, notably at the network level but important differences have been described. For instance, in the variable delay-to-signal (VDS) a behavioral paradigm that captures these two types of impulsive behavior, a challenge with methamphetamine increased action impulsivity but decreased delay tolerance. Also, impulsive action and delay tolerance are mediated by distinct sub-regions of the nucleus accumbens (NAcc), shell and core, respectively.
The frontostriatal network is essential for different decision-making steps. It remains however largely unexplored different network nodes interact to compute a decision and what differs in their activity that eventually culminates in a favorable or unfavorable outcome. In this project we will explore these questions in rats by measuring local field potentials (LFPs) simultaneously in 8 regions – prelimbic cortex (Prl), orbitofrontal cortex (OFC), striatum (Str) and NAcc in both hemispheres – during the execution of the VDS paradigms.

Aims: register the activity of 8 nodes of the rat's frontostriatal network during decision-making; identify decision-specific (timed vs premature) network level signatures;

Method: Ni/Cr single-wire electrodes will be implanted bilaterally for LFP recordings in young adult 2-3 month-old male Wistar han rats in the Prl, OFC, NAcc (core division) and Str (dorsolateral). These areas have been implicated in impulsive decision-making. Regional evoked neuronal activity (LFPs) will be registered during the execution of the VDS task; power analysis and functional coherence between these areas will be analyzed off record. The VDS will be performed in an operant chambers and consists in 2 main phases: training and VDS proper. While in the former delays are fixed (3 seconds) and premature responses (i.e. prior to a light signal) are punished with a timeout period cancelling the ongoing trial, in the latter delays vary from 3 to 12 seconds and nose pokes are allowed during these periods; in this case prematurity rate is defined as the amount of premature responses per minute of total delay.

Results: Three to 2 s before a response, power in the entire left network and the right Nacc show different activation depending on the future response (timed or premature). Immediately after, left Prl- right Nacc coherence seems to play a role, after which left Prl-right Prl and right Prl- right OPFC associations lead to one of the outcomes. After the response, the entire network seems to encode rewarded/unrewarded trials

Conclusions: Activity in the network studied encondes future actions in an impulsivity task. The PrL is a good target for modulation in future studies.

Keywords: Behavior, Mesocorticolimbic network, Executive function, Impulsivity

Publications:

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