

Exploring the neural basis of motivation

ABSTRACT:

Background

Optimal decision-making requires that individuals evaluate the costs and benefits of potential choices and this is highly dependent on the value attributed to the outcome but also individual motivational status. Evidence in both animal models and humans has highlighted the nucleus accumbens (NAc) as a core brain region in the neural circuitry underlying motivation. One anatomical study has shown that the laterodorsal tegmentum (LDT) directly projects to the NAc, though the nature and biological role of such connections remains completely unknown.

Aims

Determine the role of the LDT-NAc network in the modulation of motivation.

Method

We performed a detailed characterization of the LDT-NAc rodent circuit using viral transsynaptic markers and in vivo electrophysiological recordings. We also used optogenetics to modulate LDT-NAc different types of projections and evaluate their impact in motivation in rodents.

Results

Our results show that the majority of LDT-NAc inputs are cholinergic, but there is also GABAergic and glutamatergic innervation; activation of LDT induces a predominantly excitatory response in the NAc. Specific activation of LDT-NAc cholinergic inputs (but not glutamatergic or GABAergic) is sufficient to shift preference, increase motivation, and drive positive reinforcement in different behavioral paradigms in rodents.

Conclusions

These results provide evidence that LDT-NAc projections play an important role in motivated behaviors and positive reinforcement, and that distinct neuronal populations differentially contribute for these behaviors.

Keywords

Motivation, Neuronal circuits, Nucleus accumbens, Laterodorsal tegmentum

Published Work:

Coimbra, B., Soares-Cunha, C., Borges, S., Vasconcelos, N. A., Sousa, N., & Rodrigues, A. J. (2017). Impairments in laterodorsal tegmentum to VTA projections underlie glucocorticoid-triggered reward deficits. *eLife*, *6*: e25843. doi: 10.7554/eLife.25843

Coimbra, B., Soares-Cunha, C., Vasconcelos, N. A. P., Domingues, A. V., Borges, S., Sousa, N., & Rodrigues, A. J. (2019). Role of laterodorsal tegmentum projections to nucleus accumbens in reward-related behaviors. *Nature Communications*, *10*: 4138. doi: 10.1038/s41467-019-11557-3

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Soares-Cunha, C., Coimbra, B., Borges, S., Domingues, A. V., Silva, D., Sousa, N., & Rodrigues, A. J. (2018). Mild prenatal stress causes emotional and brain structural modifications in rats of both sexes. *Frontiers in Behavioral Neuroscience*, *12*, 129. doi: 10.3389/fnbeh.2018.00129

Soares-Cunha, C., Coimbra, B., Domingues, A. V., Vasconcelos, N., Sousa, N., & Rodrigues, A. J. (2018). Nucleus accumbens microcircuit underlying D2-MSN-driven increase in motivation. *eNeuro*, *5*(2), e0386-18. doi: 10.1523/ENEURO.0386-18.2018

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