Differential contributions of the dorsal and ventral striatum during foraging in freely moving rats

Zelda Timmel*[1], Thomas Morvan[2], Christophe Eloy[3], and David Robbe[4]

[1]Institut de Neurobiologie de la Méditerranée [Aix-Marseille Université] – INMED UMR1249 – France
[2]Institut de Neurobiologie de la Méditerranée [Aix-Marseille Université] – Aix-Marseille Université, CNRS, IRPHE UMR7342, INMED UMR1249 – France
[3]Institut de Recherche sur les Phénomènes Hors Equilibre – Aix-Marseille Université, CNRS, IRPHE UMR7342 – France
[4]Institut de Neurobiologie de la Méditerranée [Aix-Marseille Université] – Institut National de la Santé et de la Recherche Médicale - INSERM – France

Résumé

During reward-oriented behaviors, animals –including humans– spontaneously adjust the speeds of their decisions and movements based on dynamically changing costs and benefits. The dorsal and ventral striatum are well known to modulate the vigor of reward-oriented behaviors and cost-benefit decision-making but their exact contribution(s) to the co-modulation of decision and movement speeds by costs (e.g., efforts) or benefits (e.g., reward opportunity) is still poorly understood. Here, to tackle these unresolved issues, we created a foraging task in which rats ran freely on a motorized treadmill between two platforms where they could collect single drops of water delivered according to probabilistic rules. Action cost was manipulated separately from reward by changing the treadmill's length, speed, or direction. Our experiments and model-based analyses revealed that, over the course of the sessions, as animals became progressively satiated, run and inter-run durations increased in a correlated manner, an effect that was independent of action cost conditions. On the other hand, rapid variations in the history of reward outcomes led to idiosyncratic modulations of inter-run and running duration. Finally, when action cost was increased the rats consistently and proportionally increased their running speed to save time, but inter-run duration was unaffected. Lesion of the dorsal striatum reduced the running speed of the animals in the most effortful conditions indicating a role of this brain region in controlling the effort versus time tradeoff. Preliminary experiments following lesion of the ventral striatum revealed a distinct pattern of behavioral alteration as both running speed and inter-run duration became insensitive to satiety. Altogether, our study describes how neuroeconomic constraints influence decision and movement speeds in foraging rats, and paves the way for a refined understanding of the role of the basal ganglia in motor control and decision-making.

*Intervenant