

Clarifying Dopaminergic Projections of the Ventral Tegmental Area and Substantia Nigra in Humans using Structural Magnetic Resonance Imaging

Background

Dopaminergic (DA) pathways from the human midbrain to the striatum mediate movement, decision making, learning, and reward processing. Classically, the scientific consensus has been that there are two main DA pathways: the nigrostriatal and the mesolimbic pathways. In the nigrostriatal pathway, the substantia nigra par compacta (SNc) sends DA to the dorsal striatum (DS), and in the mesolimbic pathway, the ventral tegmental area (VTA) sends DA to the ventral striatum (VS) as well as prefrontal and limbic cortices. Recent findings, however, cast doubt on the accuracy of this model. It seems likely these DA projections are more overlapping and dispersed. This study aims to re-evaluate this model using ultra-high field magnetic resonance imaging (MRI).

Methods

By scanning twenty-six healthy participants using 7T MRI, we aim to a) outline and distinguish the SNc and VTA and b) methodically track the projections from SNc and VTA to the striatum and cortex, and their secondary projections. The utilization of 7T over 3T will aid in distinguishing these small brain regions.

Results

We expect to discover patterns at odds with the current view that SNc versus VTA are entirely distinct DA pathways mediating movement and cognition respectively.

Discussion and Conclusion

This research will yield a greater understanding of the DA pathways of the human brain, which has applications for research uncovering the complex human functions that implicate and depend upon DA pathways.

Interdisciplinary Reflection

Exploring the midbrain DA pathways will help elucidate the role of DA pathways in movement and important cognitive functions.