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Review

Dopamine reward circuitry: Two projection systems from the ventral midbrain to the nucleus accumbens–olfactory tubercle complex

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ABSTRACT

Anatomical and functional refinements of the meso-limbic dopamine system of the rat are discussed. Present experiments suggest that dopaminergic neurons localized in the posteromedial ventral tegmental area (VTA) and central linear nucleus raphe selectively project to the ventromedial striatum (medial olfactory tubercle and medial nucleus accumbens shell), whereas the anteromedial VTA has few if any projections to the ventral striatum, and the lateral VTA largely projects to the ventrolateral striatum (accumbens core, lateral shell and lateral tubercle). These findings complement the recent behavioral findings that cocaine and amphetamine are more rewarding when administered into the ventromedial striatum than into the ventrolateral striatum. Drugs such as nicotine and opiates are more rewarding when administered into the posterior VTA or the central linear nucleus than into the anterior VTA. A review of the literature suggests that (1) the midbrain has corresponding zones for the accumbens core and medial shell; (2) the striatal portion of the olfactory tubercle is a ventral extension of the nucleus accumbens shell; and (3) a model of two dopamine projection systems from the ventral midbrain to the ventral striatum is useful for understanding reward function. The medial projection system is important in the regulation of arousal characterized by affect and drive and plays a different role in goal-directed learning than the lateral projection system, as described in the variation–selection hypothesis of striatal functional organization.

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Abbreviations: 6-OHDA, 6-hydroxydopamine; A, anterior to bregma; FG, Fluoro-Gold; L, lateral to the midline; PBp, parabrachial pigmented area; PBS, phosphate buffer solution; PHA-L, Phaseolus vulgaris leucoagglutinin; PN, paranigral nucleus; SNC, substantia nigra, compact part; TH, tyrosine hydroxylase; V, ventral to the skull surface; VTA, ventral tegmental area; VTT, ventral tegmental tail

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