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Transcriptome and functional characterization of nucleus accumbens neurons reveal *Tac2*$^{+}$ D1 neurons in regulating psychostimulant effect of cocaine

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As a key component of basal ganglion circuitry, the nucleus accumbens (NAc) plays a critical role in integrating information from cortical and limbic regions to direct behaviors and it has been intensively studied under different physiological and pathological conditions. In contrast to its functional and connective complexity, our understanding about the cellular composition of the NAc has only painted a relatively rough picture, which impedes a clear understanding of its circuit organization and how it participates in various neural functions. Here, we present a cell taxonomy of mouse NAc based on high-throughput single-cell transcriptomic profiling, which reveals not only a rich cellular heterogeneity of both interneuron and medium spiny neuron (MSN) populations in the NAc, but also a tight relationship between transcriptional features and spatial distribution of different neuron subtypes, suggesting functional heterogeneity of the NAc can arise from spatially and molecularly distinct neuronal subtypes. As proof-of-concept, we demonstrate that the tachykinin 2-positive neurons, a dopamine receptor D_1 (D1) MSN subtype located in the medial NAc, exhibit distinct neuronal connectivity and specifically regulate the psychomotor stimulant effects of cocaine. Collectively, our work bridges molecular, anatomical and functional features of novel NAc neuronal subtypes, supporting a notion that anatomical and functional complexity of this brain region stems from its rich neuronal diversity. By integrating existing and new anatomical and functional understanding into this molecularly defined neuronal taxonomy, a comprehensive molecular-anatomy-function architecture of the NAc and its involvement in various neural functions and dysfunctions will be understood.