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## Distinct limbic-hypothalamic circuits for the generation of social behaviors

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The main pillars of social behaviors involve (1) mating, where males copulate with female partners to reproduce, and (2) aggression, where males fight conspecific male competitors in territory guarding. Decades of study have identified two key regions in the hypothalamus, the medial preoptic nucleus (MPN) and the ventrolateral part of ventromedial hypothalamus (VMHvl) , that are essential for male sexual and aggressive behaviors, respectively. However, it remains ambiguous what area directs excitatory control of the hypothalamic activity and generates the initiation signal for social behaviors. Through neural tracing, in vivo optical recording and functional manipulations, we identified the estrogen receptor alpha (Esr1)-expressing cells in the posterior amygdala (PA) as a main source of excitatory inputs to the MPN and VMHvl, and key hubs in mating and fighting circuits in males. Importantly, two spatially-distinct populations in the PA regulate male sexual and aggressive behaviors, respectively. Moreover, these two subpopulations in the PA display differential molecular phenotypes, projection patterns and in vivo neural responses. Our work also observed the parallels between these social behavior circuits and basal ganglia circuits to control motivated behaviors, which Larry Swanson (2000) originally proposed based on extensive developmental and anatomical evidence.

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