

Effect of social isolation stress on the response of mesocortical dopaminergic neurons to pleasurable stimuli

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The mesocortical dopaminergic system has been the subject of extensive biochemical and functional research because of its unique response to stress and its involvement in the coping response to environmental stimuli. Accordingly, both stressful and pleasurable stimuli can induce an increase in the extracellular concentration of dopamine (DA) in the medial prefrontal cortex of rats. In our experiments we investigated the effect of anticipation and consumption of food on extracellular dopamine concentration in freely moving rats by microdialysis. Rats were trained to consume their daily meal only two hours a day and after four weeks of training dopamine was measured from 9 A.M. to 3 P.M., thus including the 2 h before food presentation (anticipatory phase), the 2 h during food consumption (consummatory phase), and the following 2 h (satiety). In these rats dopamine extracellular concentration significantly increased (+180% over basal values) as soon as 80 min before food presentation, reached a maximum during food consumption (+350%) and returned to basal values when food was taken away.

Social isolation (SI), a widely used animal model of depression, is able to induce anhedonia in rats, reducing the consume of sucrose. In SI rats the food restriction-induced increase in dopamine output was almost completely abolished with respect to control, group housed (GH) animals, both in the anticipatory and consummatory phase. In order to restore the response of mesocortical DAergic neurons to food, we administered the antidepressant drug imipramine (IMI, 20 mg/kg/day for 21 days) in a chocolate (CH) pellet that was presented to the animals one hour before food. This way of administration was chosen to avoid to handle the animals as handling has been shown to abolish the effect of SI. Control animals received only the CH pellet. Our results showed that in SI rats neither CH or IMI were able to restore the food-induced increase in DA extracellular concentration. In GH rats the anticipatory increase in DA output was shifted before CH presentation, while food consumption still induced an increase in DA output similar to that observed in control rats. In these rats, IMI administered with CH was able to enhance the increase in DA output observed both in the anticipatory and consummatory phase.

Our data confirm the crucial role of mesocortical dopaminergic neurons in the regulation of emotion and suggest that the alterations in mood state induced by SI are able to blunt the response of cortical dopaminergic neurons to pleasurable stimuli.