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Modeling Drug Reward in Invertebrates

Conditioned place preference (CPP) continues to be one of the most popular models to study the motivational effects of drugs and non-drug treatments in experimental animals. With the underlying mechanisms strongly conserved in evolution, invertebrates have recently emerged as a powerful new model in addiction research. Indeed, as early as 1990, Huber et al. reported cockroaches as good candidates for neurobiology with relevant applications in biomedical research. Cockroaches represent an excellent model organism for a variety of biological and biomedical studies, including development, behavior, and neural responses. Because we can study behavioral mechanisms in cockroaches, we can study neuromodulation in a variety of different experimental paradigms. Early cockroach work focused on octopamine (OA) and serotonin response in the nervous system. OA is a neuromodulator, neurotransmitter and neurohormone in insect nervous systems prompting the organism for "dynamic action." We use two species of cockroach (*Periplaneta Americana* and *Blattella germanica*). A total of 20 cockroaches, 10 of each species, were placed one at a time in a single lane of a Plexiglas apparatus with vanilla and peppermint. Each session was recorded from a top and side view for three minutes; video sessions were analyzed at a later time for the amount of time spent on each compartment X of the apparatus (X= Intermediate, Vanilla, or Peppermint). Our results show a strong Vanilla preference and peppermint avoidance for both South American and North American roaches. We also examined grooming behavior and found Vanilla to increase exploration and grooming whereas Peppermint had little effect on behavior. In a separate experiment, we show how OA alone increases exploratory behavior and neural excitability of the giant interneurons in the North American cockroach. The neuropil of the thoracic ganglia contains many catecholamine-histofluorescent processes bearing varicosities, providing a possible anatomical substrate for dopamine release sites. It is proposed that release of these biogenic amines may contribute to the modulation of the cockroach place preference behavior. Collectively, these findings suggest that the cockroach model is a useful approach to examine basic mechanistic questions in drug addiction.