

OADES, R. D., SIMON, H., LE MOAL, M., (1985). Modulation by dopaminergic neurons of neurobiological systems processing strategies in adaptive behaviour and learning. Behavioural Processes., 10, 180-181.

Introduction:

Critical in behavioural neurobiology are questions of what to measure and how to do it. These are questions of concept and task. In neurobiology the development of concepts has benefited from cognitive psychology and the attention paid to the organization of problem-solving strategies, from system theory and the integration of structures into sets that act in an inter-related fashion on the processes in the brain and hence their function.

Recently many studies have focussed on dopaminergic (DA) neuronal systems. These neurons have many branches, large dendritic trees and provide the same level of modulation to a number of structures in different neuronal systems. Interventions on DA neurons allow us to study the role of these systems.

The second question deals with the need to investigate the plans and strategies used in learning.

Experiment 1:

In a 2-compartment exploration task rats gained experience of one chamber over 3 days; a door to an adjacent box opened on days 4-6; on days 7-9 a novel object was placed in a second box.

In experimental animals the DA terminal region in the mesolimbic N. accumbens was lesioned with 6-hydroxydopamine (6-OHDA).

Results:

1/ The activity of lesioned and control animals was similar on days 1-3.

2/ On days 4-6, the exploration strategy changed. Controls decreased the frequency and increased the duration of visits to the second compartment. Lesioned animals showed little change of their pattern of behaviour.

3/ On days 7-8 - although there was no difference between groups in the latency to contact or the number of contacts made with the novel object, - controls remained longer in the second compartment and on the square containing the novel object.

4/ When the object was removed, controls avoided this area, whereas the lesioned animals did not change their behaviour.

Experiment 2:

In a 16-hole-board food-deprived rats learn to search for food and find 4 pellets that are consistently placed in the same 4 holes. After 8 sessions (10 trials/session) the same food-hole visiting sequence is usually repeated on successive trials. Controls develop such an individually specific sequence (visiting strategy). as an aid to eliminate empty-hole visits (errors).

Results:

1/ The neuroleptic spiroperidol was injected into the DA A-10 cell body region of the ventral tegmental area (VTA) to disinhibit the ascending mesolimbic DA systems during learning [DA utilization increased in the N. accumbens]. This led to changes of the animals' strategy of hole-selection more frequently and they visited more empty holes.

Conclusions:

Demodulation of ascending DA systems profoundly impairs the development of strategies and the capability to shift from one referential behaviour to another.

Such neurobehavioural studies lead us to differentiate two types of neuronal systems: those that mediate the signal, and others (e.g. mesolimbic DA systems) that modulate the function.