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Abstract:

Dependence of a cognitive task on acetylcholine

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Information about a stimulus is transmitted within the nervous system by the electrical discharges of neurons. Several different encoding methods have been proposed including a rate-code, synchrony code and other temporal codes. We have applied information theory to describe the contribution of the different encoding systems in object recognition.

The nervous system not only transmits information but is adaptive so that its neuronal properties can be modified by learning to respond to new categories of stimuli. This is a crucial function of the nervous system not only in children but also in adults and its malfunction can lead to a severely disabling mental disease known as Alzheimer's or senile dementia. Acetylcholine is thought to be a chemical transmitter implicated in learning, attention and in Alzheimer's disease.

In a recent experiment, a macaque monkey was taught a categorization task, in which appropriate behavioral responses assigned stimuli presented on a computer screen to different categories. Performance was disrupted following injections of scopolamine, an antagonist of muscarinic acetylcholine receptors. When presented with stimuli that belonged to one of these categories but had not been seen before, scopolamine significantly impaired performance in the categorization task. The monkey was still able to carry out the task with a set of familiar stimuli, ie. stimuli that it had previously categorized successfully.

The site of the effect has not been established but it is likely to depend on forebrain mechanisms. An analogue of scopolamine that cannot cross the blood brain barrier mimicked the peripheral actions of scopolamine but caused no cognitive deficit.