Dopamine observed in the arcade

The role of dopamine neurotransmission in human cognition has been inferred from experiments in animals, which have suggested that dopamine is involved in aspects of learning, reinforcement of behaviour, attention and integration of sensorimotor behaviour. Koepp *et al.*[1] have now begun to extend these findings by providing evidence for dopamine release in man during the performance of a behavioural task. Dopamine release was measured indirectly by monitoring the change in the binding of radiolabelled Raclopride to dopamine D2 receptors using positron emission tomography (PET). Raclopride binds to D2 receptors in the brain and is displaced by endogenous dopamine released during task performance. Therefore, a measure of endogenous dopamine release can be calculated from the strength of the PET signal, contrasted during two experimental conditions: a baseline control condition in which subjects observed a blank screen and an experimental condition in which subjects performed a goal-directed motor task. The goal-directed motor task was a video game in which the subjects moved a 'tank' through a 'battlefield' collecting 'flags' and destroying 'enemy tanks' to progress to a higher, more difficult level of the same basic game. A financial reward was provided upon completion of each level of the game. The results showed that the binding of Raclopride to dopamine receptors in the dorsal and ventral striatum was reduced during performance of the game relative to the control condition, a finding consistent with an increase in the levels of endogenous dopamine during task performance. The increased levels of dopamine in the striatum was positively correlated with performance and was largest in the ventral striatal areas. The authors speculate that these changes might represent the influence of the dorsal striatal dopamine system in response selection and sensorimotor coordination and the ventral striatal system in the affective aspects of task performance. Although future work will evaluate these predictions in more detail, the current study does provide a novel instrument for investigating the conditions in which dopamine is released during behaviour and thereby provides a new window for the study of the cognitive neurochemistry of human performance.

Reference

1 Koepp, M.J. *et al.* (1998) Evidence for striatal dopamine release during a video game *Nature* 393, 266–268

Stimulating thoughts about heading perception

When we move through the world it appears to expand, a phenomenon which is used to great effect in the Star Trek television series. We know where we are heading based on the pattern of expansion we see. This even holds when we make pursuit eye movements that add a motion component to the retinal image. But is there a correlate for heading perception in the brain? Some neurons in cortical area MSTd (the dorsal portion of the middle superior temporal region) of the macaque respond to expanding visual stimuli, and hence MSTd seems to be involved in the heading calculation. So far no evidence linking monkeys' heading perception and neural activity has been demonstrated. Now Britten and van Wezel show that activity in MSTd is correlated with the performance of monkeys in a heading task[1]. Neural activity in MSTd was recorded when monkeys saw expansion patterns. Based on this a prediction was made about the preferred heading of the particular electrode site. Next, the monkey had to indicate the perceived heading in a series of trials. On some trials a stimulation current was passed through the electrode. Thus, two psychometric functions were collected: for stimulated and unstimulated trials. For a large number of MSTd sites stimulation shifted the psychometric function, indicating that stimulation in MSTd affected the monkeys' response. About half of these sites showed the effect as predicted from the recordings. In additional experiments monkeys pursued the fixation point with their eyes during a trial. Strikingly, a majority of sites showed the expected effect of stimulation. While this difference between pursuit and non-pursuit trials is puzzling, these experiments are important because they provide the first evidence that MSTd activity is related to heading perception.

Reference

1 Britten, K.H. and van Wezel, R.J.A. (1998) Electrical microstimulation of cortical area MST biases heading perception in monkeys *Nature Neurosci.* 1, 59–63

Working memory in dorsolateral frontal cortex

It is widely held that the frontal cortex plays a critical role in certain aspects of both spatial and non-spatial working memory. The prevailing view in recent years has been that there are domain-specific subdivisions within dorsal and ventral regions of the prefrontal cortex, which subserve working memory for spatial and non-spatial information, respectively. However, Owen *et al.* have now used functional magnetic resonance imaging to demonstrate that performance of such tasks involves identical regions of the lateral prefrontal cortex when all factors unrelated to the type of stimulus material are appropriately controlled[1]. Two similar tasks, one involving the short-term retention and manipulation of spatial information and the other involving non-spatial visual patterns both activated the mid-dorsolateral frontal cortex in six subjects. These data provide evidence that spatial and non-spatial working memory might not be mediated by dorsal and ventral regions, respectively, of the frontal lobe, as widely assumed, and support the alternative notion that specific regions of the lateral frontal cortex make identical executive functional contributions to working memory.

Reference

1 Owen A.M. *et al.* (1998) Functional organization of spatial and nonspatial memory processing within the human lateral frontal cortex *Proc. Natl. Acad. Sci. U. S. A.* 95, 7721–7726

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