

Neurobiology and Human Behaviour
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Lent term problems

What does it mean for a molecule to be amphipathic, and why is this property important in determining a CNS drug's bioavailability?

What does it mean for binding to be allosteric, and how is this property significant in the case of the benzodiazepines?

What's a therapeutic index?

How does valproate act to increase seizure threshold?

If the goal in patients with Parkinsonism is to increase dopamine, why administer the dopamine precursor L-DOPA? Why not just give dopamine?

What is excitotoxicity, and how is it related to (1) epilepsy and (2) ischaemia and stroke?

ESSAY: In what ways does pharmacologic evidence support the association of specific disorders of behaviour (e.g. schizophrenia, depression, Parkinsonism) with specific disorders of neurotransmission?

The essay must be emailed or postmarked by Friday 14 February. (Happy Valentine's Day.)

What techniques exist for examining brain function, and what are their spatial and temporal specificities?

What general features are common to the organisation of all regions of the cerebral cortex?

What is the phenomenon of blindsight, and what physiological mechanisms might explain it?

Lesions in what areas can produce neglect?

With what sorts of behavioural tests might you evaluate a patient who showed signs of neglect?

What sorts of lesions can produce amnesia?

What kinds of memory are there?

A cardiac bypass patient presents, three months postoperatively, with complaints of forgetfulness. He has difficulty remembering telephone numbers and shopping lists. Though he has trouble remembering directions to unfamiliar places, he reports that when he's driving to his house or to his office 'his hands know where to go.' The anaesthetist in surgery noted that during transfer to the heart-lung machine, pO₂ fell to a borderline-hypoxic level. Where might the pathology be localised, and how would systemic hypoxia produce anatomically localised damage?

In the Delayed Non-matching to Sample Task, a monkey is presented with an object, then the object is removed, and after a delay the monkey must select from a pair of objects the one that it was not presented initially. Although both electrode lesions of the hippocampus and conventional surgical lesions of the hippocampus impair performance on this task, the impairment is much more severe in the case of the conventional surgery. Given your knowledge of the anatomy of the medial temporal lobe, why might this be? (What surgical approach might you use for the lesion?)

A patient presents with an inability to recognise faces; he can identify people by their voices or clothing. In addition, the patient is a gardener, and suddenly has had difficulty identifying many species of plants that previously were familiar to him. What is the diagnosis, and in what cerebral lobe do you suspect a lesion?

Place the following structures in the order of propagation of signals: dentate gyrus, entorhinal cortex, subiculum, CA1, CA3, mossy fibres, Schaffer collaterals, perforant path.

What regions of the hippocampal formation project directly to neocortex?

What regions of the hippocampal formation project directly to subcortical structures?

What evidence exists for the involvement of the hippocampus in tasks of spatial memory in particular?

What's the difference between supervised learning and unsupervised learning?

What evidence supports the involvement of NMDA receptors in learning?

Describe the symptoms of the various categories of aphasia.

A patient presents awake and alert, but with extreme difficulty articulating words. Although his speech is telegraphic and full of paraphasias, this impairment disappears when you ask him to repeat sentences that you speak. In addition to the speech deficit, when you ask him to imitate a complex series of fist-to-palm movements he's slow and makes some errors. His motor ability seems otherwise unimpaired. Where do you suspect a lesion?

A monkey is trained to fixate its eyes at the centre of a screen while a dot is displayed peripherally. The dot then disappears, and after a delay, the monkey must make a saccade to the location of the dot. Single-neuron recordings from dorsolateral prefrontal cortex show continuous activity from the time at which the dot appears to the time at which the saccade is initiated, while similar recordings from posterior parietal cortex show activity only just before the initiation of the saccade. What do these facts seem to say about the nature of the spatial processing implemented by frontal and parietal cortices? How might this hypothesis be explored using other methods (*e.g.* lesion studies, functional imaging)?

Six months following an automobile accident, a patient presents at your psychiatric practice at the urging of her husband. Her complaint is a fairly nonspecific one of difficulty in relationships; her husband tells her that she's lost her warmth. A physiological examination reveals abnormal galvanic skin response to affectively laden stimuli. In what region do you suspect a lesion? Why might you expect this region to be particularly susceptible to damage from the rapid deceleration common in automobile accidents?

ESSAY (due by Wednesday 5 March) CHOOSE ONE:

(1) Long-term potentiation has been described as a physiological mechanism in search of a behavioural function. Explain.

(2) In what ways can prefrontal cortex be said to subserve a general function, and in what ways can it be said to subserve a collection of specific functions?