Neuroscience HMB 200S
Midterm Test
February 13, 2009

Total score for this test 25%
Short answers (1 point each) :

Name:
Student #:

22.50

(7.5)

1. Taste information is relayed to the brain from taste bud receptors in the tongue by way of cranial nerves IX (Glosso) and VII (Facial) (Roman numerals).

2. The large neurons in the olfactory bulb that send their axons into the brain are called mitral cells, which receive their olfactory inputs in synaptic zones called glomeruli.

3. The cause of narcolepsy/cataplexy in humans appears to be the loss of orexin/hypocretin neurons.

4. Circadian rhythms in mammals are controlled by a negative feedback loop in which two proteins Per and Cery combine to inhibit the gene transcription factors clock and cycle.

5. Amphetamine acts on dopamine neurons in two ways: acting as a dopamine reuptake inhibitor and facilitate releases of dopamine.

6. List 3 ways of treating Parkinson's disease" L-Dopa

1.0

0.75 dopamine agonist

Transplantation of dopamine neurons

1.0

7. Mauthner Cells are found in the medulla of fish and tadpoles (insert 2 animal groups here) and serve to evoke a C-shape escape response. 0.5 OK

8. The rubrospinal tract begins in the red nucleus, which responds to ascending pathways coming mainly from the cerebellum and descending pathways coming from the motor cortex.

Definitions (3 points each–Use back of page if necessary):

7 - 0.5 for pt form = 6.5

melanopsin (Explain precisely where it is found in the nervous system and what functions it serves)

- found in retinal ganglion cells (the first layers of a retina)
- it acts as a light meter for the eye ⇒ i.e. whether the environment is light or dark
- also used in pupillary light reflex ⇒ helps control the amount of light that goes into the eye via control of the pupil

2

delta-waves in sleep

- occurs during deep sleep, stage 3+4 (larger amplitude in stage 4)
- 1-4 Hz
- onset of deep sleep triggered by characteristic sleep spindles in α waves in stage 2 sleep
- can be detected by EEG in brain by electrodes on the scalp of head

2.5

endocannabinoids (also give one example)

Ex. anandamide

- wide spread throughout the brain
- it act on cannabinoid receptors
- analgesic effects / calming effects

3.5

i) defensive threat
ii) flight
iii) freezing
} PAG dl l vl

Essay (8 points): Describe how unlearned defensive responses of different sorts are organized in brain stem nuclei. Include output systems for the startle reflex, for avoidance eye and head turns, and for complex coping responses of different sorts. Describe how these responses have been mapped by stimulation studies, and discuss the possible functional value of these responses for animals that are attacked by predators.

diff. layers of S. colliculus

5

There are four major defensive responses in a mammal and they include flight, freezing, defensive threat, and startle reflex. These are all used for survival in mammalian organism, such as a rat. The responses in which the rat sees its predator (i.e. flight, freezing, defensive threat) has been carefully mapped by glutamate stimulation studies in the PAG, while startle reflex, which occurs when the rat does not see its predator, has been extensively studied as well.

The defensive responses – flight, freezing, and defensive threat has been mapped in the PAG. It has been shown that flight is activated by glutamate stimulation of the dorsolateral PAG. The flight response is activated when the predator is farthest from the rat, and involves the fast escape back to safe territory (e.g. burrow). The freezing effect occurs when a predator is near the rat and running is not feasible anymore. Thus, the rat freezes hoping the predator won't notice. This also has some non-opiate mediated analgesic effect on the SC. Finally, the defensive threat is the desperate attempt to fight the predator and is activated by the stimulation of the ventrolateral PAG by glu. All of the above are attempts to escape from the predator

and is activated by glu excitation to the lateral PAG

Also, there are some opiate mediated analgesics

However, when the predator is not in sight, the rat can only exhibit the most desperate response – startle reflex. This is a protective response, activated by three stimuli – auditory, tactile, and vestibular – by a "head-blow" on the rat's neck. All of these pathways are mediated by their corresponding nuclei in the pons (i.e. auditory → cochlear n., tactile → trigeminal n., and vestibular → vestibular n.). This is then relay to the PnC (pontine caudal giant neuron), which ultimately relays the three different signals from each nuclei to the SC. The effect of the startle reflex in a rat is that it shortens the length of the body, eyes close to protect the body. This is all carried in descending pathways.

reticulospinal and vestibulospinal

- Another area of particular interest are approach and avoidance turns. This is generally activated in the middle and deep layers of the s. colliculus. The approach turn is activated in the middle layer by crossed tectospinal pathways down to the SC. The avoidance turn is activated in the deep layers by uncrossed TS pathways. Combined, the s. colliculus facilitates w/ the approach of an interesting object and the avoidance of a threatening object, like a predator. These turns are those integration from the retinotopic map on the outer layer of the s. colliculus.

These defensive responses have been shown to be crucial in survival and has a huge role in the evolution of organism. These complex responses has been integrated system to protect an organism. From the head, the avoidance and approach turns allow them the animal to analyze and saccade on objects of interest. Other stimuli, like touch, hearing, and vestibular, can influence the animal by way of the startle reflex. This then leads to motor outputs to the neck by CN XI and cervical ganglions. Finally, it reaches the SC and influences the movement of the whole body. One can easily see that this complexity evolved as a fast coping response to threatening objects or stimuli for survival purposes.