P.G Department of Psychology

NEURO-PHYSIOLOGY OF PERCEPTUAL LEARNING

Course-CC-6 (Neuropsychology) Unit 3; Sem 2

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Psychophysical sensitivity during the performance of sensory discrimination or detection tasks can improve with training, even in adults well beyond critical developmental periods. This is known as perceptual learning. Perceptual learning involves changes in neural circuits in the sensory association cortex because visual learning has received more attention than any other form of perceptual learning.

The sub regions of the cortex send the results of their analysis to the inferior temporal cortex where the information is combined production neural activity that corresponds to the perception of particular three dimensional objects

- Inferior temporal cortex
- Prestriate cortex
- Striate cortex

Neurophysiology of perceptual learning in the visual cortex

LESION STUDIES

Kluver and Bucy (1939) discovered the monkey with bilateral lesions of the temporal lobes had difficulty perceiving visual stimuli. They referred to the phenomenon as "Psychic Blindness". The animals could move around in their environment and could see well enough to pick up small objects. They had great difficult recognizing what they saw. They would pick up item from is tray containing small edible and inedible objects, bring them to their mouth and them eat the pieces of food and drop the pieces of hardware. They also showed no sign of year to visual stimuli that normal monkeys avoid, such as snakes.

Mishkin (1966) showed that when visual information was prevented from reaching this region, monkeys lost the ability to distinguish between different visual patterns. First he removed the striate cortex on one side of the brain and tested the animal's ability to discriminate between visual patterns, they performed well. Next, he removed the contralateral inferior temporal cortex, again no deficit. Finally he cut the corpus callosum, which isolated the remaining inferior temporal cortex. Now the animals could no longer perform the visual discrimination task.

Thus we can conclude that the inferior temporal cortex is necessary for visual pattern discrimination and that it must receive information from the primary visual cortex.

Blake, James and Miskin (1977) have shown that the two major regions of the inferior temporal cortex perform different functions. The region barbering the prestriate cortex is necessary for perception of simple shapes; its destruction impairs monkey's ability to discriminate among different two dimensional patterns.

RECORDING STUDIES

The conclusion from the lesion studies are supported by an electro physiological study by **Fuster and Jervey (1981)**, who obtained evidence that neurons in the inferior temporal cortex retain information about a just perceived stimulus. They turned on a coloured light (yellow, green, blue) behind a translucent disk, turned it off and after a delay interval, turned on yellow, green, red and blue lights behind four other disks. If the monkey pressed the disk whose colour matched the one it had just seen it, receives a piece of food. While the monkey performed the task, the experimenters recorded the activity of single neurons in the inferior temporal cortex. Some neurons responded selectively to colour, maintaining a high response role during the delay interval. When the sample stimulus consisted of a red light, the neuron because active and remaining active even, after the sample stimulus went off. Under normal conditions a stimulus causes a neuron to respond briefly.

Desimone, Albright, Cross and Bruca (1989) found neurons in the inferior temporal cortex responded to such stimuli as hands and faces. Roll and his colleagues (1989) studied the responses of neurons in the inferior temporal cortex of monkey to the right of monkey's faces. Neurons that specifically respond to the right of faces are not scattered throughout the visual association cortex. The responses of neurons that respond to the right of faces remain constant even if the picture is blurred or changed in colour, size and distance (Rolls and Bayles 1986).

Bayles and Leonard (1985) found that most of these neurons are sensitive to differentiate between faces, which suggest that the circuits of which they are a part are responsible for a monkey's ability to recognize particular individuals.

Rolls, Bayles, Haselmo and Nateva (1989) found that as monkeys become familiar with particular faces the response characteristics of some face, sensitive neurons in the inferior temporal cortex changed. The presented monkey with pictures of human and monkey faces on the screen of a video monitor. They found that many cells showed changes in their response characteristics when new faces were shown to the monkey. The finding suggests that learning caused a rewiring of the neural circuits.

Changes in the read-out of sensory neurons during learning

Several psychophysical and modelling studies have proposed that perceptual learning can be explained by an adjustment of weights through which basic sensory channels affect decision making. Thus, perceptual learning can occur via improvements in how sensory signals are decoded or read out by decision-making mechanisms. This type of model can also account for the location specificity of perceptual learning because training strengthens sensory channels that are relevant to the task, including spatial location.

Law and Gold found that LIP responses substantially change with training. Early in training, LIP responses depend only on the monkey's subsequent choice and not on the strength of motion stimuli. With extended training, LIP responses gradually become dependent on motion strength and the rate of build-up activity increases during training. These characteristics of LIP neurons are consistent with an increasingly selective read-out from sensitive MT neurons.

MODELLING OF BRAIN'S ABILITY TO LEARN

The results of the electrical recording study by Rolls and his colleagues strongly suggest that the inferior temporal cortex is an important site of visual perceptual learning and that perception is not simply a result of analysis of circuits. These wiring changes represent what is learned.

Investigators have discovered that when they contract a network of simple elements interconnected in certain ways, the network does some surprising things. The elements are given properties like those of neurons. They are connected to each other through junctions similar to synapses. When an element receives a critical amount of excitation, it find a message to the element with which it communicates, some of the elements of network have inputs lines that can receive signals from the outside which could represent as sensory organ. Neural network can be tough to recognize particular stimuli. The characteristics of neural network are similar to many of those exhibited by real nervous systems which makes them exciting to scientists interested in the neural basis of learning, because the brain is made of networks of neurons, learning occurs in neural network.

Investigator studying the properties of neural networks emphasize that their models deal with the micro structure of the brain. The brain contains a large number of networks. Probably many thousands of them each devoted to performing individual functions. The network probably exits in a sort of hierarchy with some controlling the functions of others and regulating the exchange of information between them.