P.G Department of Psychology

NEUROPHYSIOLOGICAL BASE OF MOTIVATION

Course-CC-6 (Neuropsychology)
Unit 3; Sem 2
By
Dr. Priyanka Kumari
Assistant Professor
Institute of Psychological Research and Service
Patna University
Contact No-7654991023, E-mail- drpriyankakumari1483@gmail.com

NEUROPHYSIOLOGICAL BASE OF MOTIVATION

Motivated behaviour is any behaviour or action performed to obtain rewards or avoid punishments. Motives or motivation is directly related to the motor area of the cortex. When any stimulus is driven and pulled towards a particular goal or which result in persistent behaviour directed towards particular goal, it is termed as motivation.

Hypothalamus play a vital role in the origin of motivation. Its biological base is very high. The biological motives are to a large extent, rooted in the physiological state of the body. Many biological motives are triggered, in part, by departures from balanced physiological conditions of the body. The body tends to maintain a state of equilibrium called homeostasis in many of its internal physiological processes.

Certain hormones or "chemical messengers" circulating in the blood are also important in the arousal of some biological motives.

Nature of Motivation and its Neurological base

The brain and the hunger motivation

The classic work of the 1940s and 1950s of Hetherington and Ranson 1940, and Brobeck, 1951 emphasized the contributions of two regions of the hypothalamus-the lateral hypothalamus and the ventromedial hypothalamus in the regulation of hunger motivation. The LH was considered to be an excitory region for hunger motivation and VMH was said to be involved in the cessation of eating-that is, in satiety.

These ideas was based on animal experiments by the methods of lesions.

Neuro-physiology of Motivation in Thirst

The body's water level is maintained by physiological events in which several hormones play a vital role. ADH (antidiuretic hormone) regulate water loss through the kidney. In the anterior, or front of the hypothalamus are nerve cells called osmoreceptors, which generates nerve impulses when they are dehydrated.

Neural Control of Sexual Motivation

Hypothalamus of the brain regulates the hormones release which affects the sexual motivation in an organism. Estrogen hormones direct further sexual development of the body and brain. As the Sex organs grow rapidly, the hormones release increases markedly secondary sexual characteristics-breast development, body shape, pitch of voice and amount of facial hair development under the influence of estrogens or androgens at puberty.

Apart from these biological bases, in motivation glands and muscles also play an important role.

Orbitofrontal cortex and motivated decision making

The Iowa gambling task is probably the most widely used neuropsychological test of motivational function. Bechara et al. (1994) demonstrated significant impairments in patients with orbitofrontal lesions, with patients continuing to opt for high-risk decks. Strikingly, patients understood and could explain the contingencies. They had understanding of the task but did not use this to guide behaviour. Bechara et al. interpreted this as suggesting that orbitofrontal patients are insensitive to future consequences of behaviour, an explanation consistent with their observed everyday behaviour.

Maia and McLelland (2004) have suggested that reversal learning impairments could explain Bechara's findings and this would be consistent with other reports of reversal learning deficits following orbitofrontal damage.

Bechara et al. (2005) cite the abnormal skin conductance responses (SCRs) observed in patients. Control participants showed elevated SCRs when they were about to make a high-risk choice. Patients with orbitofrontal lesions did not. Interestingly, they *did* show normal raised SCRs to receiving rewards and punishments.

Gambling impairments in orbitofrontal patients have also been reported by Rogers et al. (1999). Their participants were less able to make accurate judgements and more willing to take risks. Patients with bilateral amygdala lesions were also impaired on the Iowa task (Bechara et al., 1999) and failed to show anticipatory SCRs to risky choices. However, these patients also failed to show the normal elevation of SCRs in response to receiving rewards and punishments.

NEUROIMAGING OF MOTIVATION

Imaging primary reinforcers: Taste and smell

An fMRI study of taste and smell stimuli (Francis et al., 1999) demonstrated neuronal responses in the medial OFC in response to the taste of glucose and to the smell of vanilla. The OFC is known to contain taste and smell receptors and it is possible that this is simply an effect of sensory stimulation.

O'Doherty et al. scanned participants before and after eating a large meal and then presented smells of foods that were part of the meal and foods that were not. The OFC response was significantly reduced for foods that were part of the meal. This is evidence that the OFC codes motivational as well as sensory properties.

Small et al. (2001) studied a similar phenomenon in people eating chocolate during PET scanning. Participants were fed large amounts of chocolate and asked to rate how pleasant it was at regular intervals. As expected, it became steadily less pleasant and, as the ratings decreased, activation in medial OFC diminished.
Recently a study of five food flavours (O'Doherty et al., 2006) demonstrated differential responses in human ventral striatum that directly reflected subjective preferences for the flavours.

Imaging studies of financial reward and loss

In the neuroimaging context, most studies of reinforcement have used financial rewards. Money is not a primary reinforcer in the classic sense; it has no intrinsic physiological value, but it does have enormous social value, and is a strong behavioural motivator in most modern societies. From an empirical viewpoint, money is a very useful reinforcer, as various parameters (size of reward, probability of reward, etc.) can be systematically and objectively varied.

One of the first studies of financial reward was a PET study (Thut et al., 1997) in which participants performed a simple cognitive task under the two conditions. In one they were simply told "OK" while in the other they received money for accurate performance. Financial reward was associated with activation in regions of an extended reward system, including midbrain, thalamus, dorsolateral PFC, and OFC.

In a more sophisticated study, Delgado et al. (2000) examined neuronal responses to receiving financial rewards and punishments. Participants were presented with a series of computerised cards on which they knew a number from 1 to 9 would appear, and had to guess whether the number would be greater or less than 5. They won money for correct guesses and lost money for incorrect guesses.

Increased responses were seen in the dorsal and ventral striatum after a reward, while decreased responses were seen after a punishment. A similar study also assessed responses to winning and losing money and reported striatal responses to winning.
Imaging has also been used to look at important variables that affect motivation. One such variable is anticipation of financial reward.

Breiter et al. (2001) compared anticipation and outcome on a rewarded task and found that neural responses in regions including the extended amygdala, ventral striatum, and OFC were seen for anticipation as well as outcome.

The most recent imaging studies of financial reward have used increasingly complex mathematical modelling to look at reward prediction. These studies are predicated on the fact that reinforcement is critically dependent on the extent to which outcomes match expectations.

Thus reward and punishment responses in the brain are extensively modulated by expectations, and new modelling and analysis techniques in functional imaging are allowing these relationships to be explored.