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EMOTION PROCESSING NETWORK OF THE BRAIN

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Abstract:-Our daily life is filled with so many emotions, both positive and negative. Positive emotions include happiness and love and the negative emotions include worry, frustration, sorrow, and anger. Complexity of our social life has made us to experience range of emotions. In our life, emotions serve many functions. They arouse our interest and tell us what to pay attention to. They motivate approach strategies through pleasant feelings and motivate avoidance or attack strategies through unpleasant ones.

Keywords:Emotion Processing , social life , Brain , techniques.

INTRODUCTION :

The ability to regulate one's emotions is important to lead a healthy and productive life. But, failure to regulate our emotion, affect our psychological well being as well as the normal part of development for children and adolescents. It is essential that we understand how we can lay the foundation for efforts to improve emotion regulation skills. Affective neuroscience uses various techniques to better understand emotion and mood at the neurobiological and psychological levels and their interface. This paper discusses about various neuro-anatomical theories of emotions and brain regions involved in emotion regulation.

EARLY NEUROANATOMICAL THEORIES:

The Cannon–Bard theory:

Cannon and Bard proposed the first theory of the brain mechanisms of emotion. They argued that the hypothalamus is the brain region that is involved in the emotional response to stimuli and that such responses are inhibited by neocortical regions. Removal of the cortex frees the hypothalamic circuit from top–down control, allowing uncontrolled emotion displays.

The Papez circuit:

In 1937, James Papez introduced a new central neural circuitry of emotion, known as the 'Papez circuit' (Papez,1937). Papez proposed that sensory input into the thalamus diverged into upstream and downstream - the separate streams of 'thoughtand 'feeling'. The thought stream was transmitted from the thalamus to the sensory cortices, especially the cingulated region. The feeling stream, on the other hand, was transmitted from the thalamus directly to the mammillary bodies which allows the generation of emotions, and so via the anterior thalamus, upwards to the cingulate cortex. According to Papez, emotional experiences were a function of activity in the cingulate cortex and could be generated through either stream.

MacLean's limbic system:

In 1949, Paul MacLean proposed an anatomical model of the brain regions that are involved in emotion. MacLean's model elaborated on Papez's and Cannon and Bard's original ideas and integrated them with the knowledge provided by the seminal work of Kluver and Bucy. MacLean viewed the brain as a triune architecture. The first part is the evolutionarily ancient reptilian brain which is the seat of primitive emotions such as fear and aggression. The second part is the 'old' mammalian brain which augments primitive reptilian emotional responses such as fear and also elaborates the social emotions. Finally, the 'new' mammalian brain consists mostly of the neocortex, which exerts top–down control over the emotional responses that are driven by other systems.

According to MacLean, events in the world lead to bodily changes. Messages about these changes return to the brain where they are integrated with ongoing perception of the outside world. It is this integration that generates emotional experience. MacLean proposed that such integration was the function of the visceral brain, in particular the hippocampus, and later he introduced the term 'limbic system' for the visceral brain (MacLean, 1952). Nevertheless, other brain regions such as the 'reptilian brain' (the ventral striatum and the basal ganglia) and the limbic structures of the amygdala, hypothalamus, cingulate cortex and PFC as identified by Cannon and Bard, Papez and MacLean are integral to emotional life.

LIMBIC SYSTEM AND EMOTION CONTROL:

MacLean's limbic system concept is still considered as the dominant conceptualization of the 'emotional brain', and the structures that he identified as important have been the focus of much of the research in affective neuroscience.

I. The amygdale:

Connected to the hippocampus by the neural ways, amygdale is particularly involved in the processing of information about threats. When it perceives a threat the amygdala sends an alarm to the hypothalamus and other brain regions. It also triggers the ventral tegmentum, in the brain stem, to send dopamine to the nucleus accumbens (and other brain regions) in order to sensitize them all to the information now streaming through the brain as a whole. Recent studies have established that amygdala is one of the most important brain regions for emotion, with a key role in processing social signals of emotion (particularly involving fear), in emotional conditioning and in the consolidation of emotional memories.

Fear conditioning:

Recent researches have highlighted the roles of two afferent routes involving the amygdala that can mediate fear conditioning. The first is the thalamo–amygdala route that can process crude sensory aspects of incoming stimuli and directly relay this information to the amygdala, allowing an early conditioned fear response. The second route is a thalamo–cortico–amygdala pathway that allows more complex analysis of the incoming stimulus which results in conditioned emotional response. In a study, by Bechara and colleagues (Bechara, A., Tranel, D., Damasio, H. & Adolphs, R., 1995), a patient with bilateral amygdala damage failed to fear-condition to aversive stimuli indicating that fear conditioning depends on the amygdala.

Memory consolidation:

It is reported in a study that a patient with amygdale damage did not show the usual enhanced memory for emotional aspects of stories (Cahill, L., Babinsky, R., Markowitsch, H. J. & McGaugh, J. L.,1995). This and similar other studies indicate that the amygdala is involved in the consolidation of long-term emotional memories.

Learning social signals:

Studies of human amygdale lesions show that amygdale damage impairs the processing of faces and other social signals(Jacobon.R, 1986). It is also proved that emotional facial expressions, especially fear, was impaired in humans with amygdala lesions(Calder.A.J.et al,1996).

II. The PFC:

The PFC is centrally involved in performing executive functions like anticipating things, making plans, organizing action, monitoring results, changing plans, and settling conflicts between different goals. PFC helps to foresee the emotional rewards of different courses of action and also inhibits emotional reactions. Many more nerve fibers head down from the PFC to the limbic circuitry than in the other direction.

Reward processing:

PFC regions work together with the amygdala to learn and represent relationships between new stimuli (secondary reinforcers) and primary reinforcers such as food, drink and sex. Importantly, according to Rolls, neurons in the PFC can detect changes or reversals in the reward value of learned stimuli and change their responses accordingly.

Bodily signals:

Damasio and colleagues presented the somatic marker hypothesis which stresses the role of bodily feedback in emotion. Damasio argues that these somatic codes are processed in the ventromedial PFC, thereby enabling individuals to navigate themselves through situations of uncertainty where decisions need to be made on the basis of the emotional properties of the present stimuli.

'Top-down' regulation:

Davidson and colleagues argue that prefrontal regions send 'bias signals' to other parts of the brain to guide behaviour towards the most adaptive current goals. Davidson and colleagues suggest that the PFC promotes adaptive goals in the face of strong competition from behavioural alternatives that are linked to immediate emotional consequences (Ochsner, K. N., Bunge, S. A., Gross, J. J. & Gabrieli, J. D. E.,2002).

III. The ACC:

This is in the middle of the brain, centrally located for communication with the PFC and the limbic system. It monitors conflicts between different objects of attention. It lights up when we attend to emotionally relevant stimuli, or sustain our attention to important feelings – inside ourselves and other people – in the face of competing stimuli.

Affective neuroscientists view the ACC as a point of integration of visceral, attentional and emotional information that is crucially involved in the regulation of affect and other forms of top–down control (Davidson, R. J. et al.,2002). It has also been suggested that the ACC is a key substrate of conscious emotion experience and of the central representation of autonomic arousal. The ACC has generally been conceptualized in terms of a dorsal 'cognitive' subdivision and a more rostral, ventral 'affective' subdivision. Current thinking suggests that it monitors conflict between the functional state of the organism and any new information that has potential affective or motivational consequences. When such conflicts are detected, the ACC projects information about the conflict to areas of the PFC where adjudications among response options can occur.

CONCLUSION:

Our social relationship is primarily determined by our emotional experiences. Hence, it is important to understand emotional experiences and the underlying processes that lead to emotional experiences. Studies of the neural basis of emotion and emotional learning have focused on how emotional responses are produced. The amygdala was found to play a major role in the evaluation process. At the same time it is important to understand the network between amygdala and the prefrontal cortex. Since amygdale is connected with prefrontal cortex activities triggering prefrontal cortex will be producing more results in controlling and regulating emotions.

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