Emotion and Stress
Classification of Emotion

Emotions are subjective, conscious experiences characterized primarily by psychophysiological expressions, biological reactions and mental states.

Studies have shown that people of different cultures make similar facial expressions in similar circumstances. Analysis of these expressions suggests that there are six basic human emotions: anger, happiness, surprise, disgust, sadness and fear.

It is thought that primary emotions blend to form the full spectrum of human emotional experience.
Functions of Emotions

It is believed that expressions of emotion, like other behaviors, are products of evolution.

Functional roles:
- anger – attack
- happiness, sadness – social
- surprise – startle
- disgust – avoid
- fear – escape

Opposite messages are often signaled by opposite movements and postures, an idea called the principal of antithesis.
Theories of Emotion

Psychologists define emotion in terms of three components: perception, feelings and actions.

James-Lange Theory (1884)
Stimulus triggers autonomic and somatic response which triggers emotion. Physiological reaction is thus necessary to feel an emotion.

Cannon-Bard (1915)
Stimulus triggers both autonomic & somatic responses and emotion. Physiological responses and emotion are independent.

Modern view
All factors influence one another
Physiological Reactions and Emotion

Are physiological reactions **necessary** for emotion?
- Individuals lacking somatic feedback feel emotions.
- Individuals lacking autonomic inputs report decreased emotional intensity.

Are autonomic physiological reactions **sufficient** for emotion?
- Rapid breathing or accelerated heart rate for unknown reasons can cause a panic attack.
Limbic System and Emotion

In 1937, Papez proposed that emotional expression is controlled by the limbic system, including the cingulate gyrus, amygdala and hypothalamus.

Modern imaging techniques also point to this system and these particular areas as important for emotions.

The data suggest, however, that additional areas are involved and that individual emotions are processed in an overlapping, distributed manner.
The Anterior Cingular Cortex

The anterior division of the cingulate cortex (ACC) participates in a variety of functions.

The dorsal part of the ACC is connected with the dorsolateral prefrontal cortex (DLPFC) and posterior parietal cortex (PPC). Within this circuit, the PPC directs attention to the task at hand, the DLPFC creates the appropriate rules for the brain to accomplish its current goal, and the dACC monitors performance and signals when adjustments in control are needed.

The ventral part of the ACC is connected with the amygdala and hypothalamus, and is involved in assessing the salience of emotion. Lesions of the ACC are associated with fear, irritability and depression. Like above, the vACC might detect shortfalls from some optimal emotion and signal the DLPFC to implement behavioral changes.
The Amygdala

Research has demonstrated in many species that the amygdala is important for the experience and expression of emotion.
- lesions of the amygdala profoundly reduce fear and aggression
- stimulation elicits fear, anxiety and aggression

The amygdala is a complex of nuclei commonly divided into three groups: the corticomedial nuclei receive olfactory inputs; the basolateral nuclei receive non-olfactory sensory inputs; and the central nucleus is the major output.
The Amygdala and Fear

Fear: emotional reaction to threat

Fear Conditioning
• Pair a neutral stimulus (e.g., a tone) with an aversive stimulus (e.g., a shock).
• Present the tone later and the animal will show a conditioned fear response (i.e., a defensive behavior – fight or flight)

Lesions of the medial geniculate body and the amygdala block fear conditioning to simple tones.

The amygdala assesses the emotional significance of the sound on the basis of previous encounters (memory stored elsewhere) and activates the appropriate response circuits – here, the behavioral circuits in the periaqueductal gray and the sympathetic circuits in the hypothalamus.
Aggression is an overt, often harmful, social interaction with the intention of inflicting or threatening damage upon another individual.

Two broad categories of aggression are commonly distinguished.

- Predatory aggression involves attacks against a member of another species for the purposes of obtaining food.
- Affective aggression is for show rather to kill for food (e.g., establishing a defensive posture or dominance in a social hierarchy).

In monkeys, lesions of the amygdala cause loss of aggression and social position. Electrical stimulation increases aggression.
In addition to the amygdala, the medial prefrontal cortex and hypothalamus affect aggression. Sham rage (affective aggression) to the slightest provocation (including light touch) can be elicited in cats whose cerebral hemispheres have been removed down to, but not including, the posterior hypothalamus. Thus, the posterior hypothalamus elicits aggression, whereas the cortex inhibits/directs this response.
Serotonin and Aggression

Studies indicate that the neurotransmitter serotonin may be involved in regulating aggression. Serotonin-containing neurons are located in the raphe nuclei of the brainstem, and their axons ascend in the medial forebrain bundle and project to many structures involved in controlling aggression including the amygdala, hypothalamus and medial prefrontal cortex.

Evidence indicates that drugs that block the synthesis or release of serotonin (antagonists) increase aggressive behavior (i.e., lower serotonin levels = higher aggression). Conversely, agonists of serotonin receptors are known to decrease anxiety and aggressiveness in mice.
A variety of studies have found that emotional functions are lateralized (like language). fMRI and lesion studies have shown asymmetrical activation of brain regions when thinking of emotions, responding to emotional stimuli, and viewing emotional situations. In particular, production and processing of facial expressions appears to be processed predominantly in the right hemisphere.
The stress response (or just stress) is a cluster of physiological changes in the response of the body to any demand upon it, particularly harm or threat of aggression. All stressors produce the same core pattern of changes.

General adaptation syndrome:
- **Alarm** – increased activity of the sympathetic nervous system (and the adrenal medulla) readying the body for brief emergency activity (fight or flight).
- **Resistance** – activation of the anterior pituitary-adrenal cortex system to release glucocorticoids that enable the body to maintain prolonged alertness, fight infections and heal wounds.
- **Exhaustion** – nervous and immune systems no longer have the energy to sustain their heightened activity.
Stress and the Immune System

The immune system consists of cells that protect the body against infection. In addition to infection, stress can activate the immune system.

In response to activation, immune cells produce small proteins called cytokines, which combat infections and communicate with the brain (in particular the hypothalamus) to elicit appropriate behaviors (fever, lack of appetite, sleepiness).

The effects of stress on immune function depends on duration:
- acute stressors improve immune function.
- chronic stressors impair immune function.
Chronic Stress and (Emotional) Health

Physical Symptoms
- Aches and pains
- Diarrhea or constipation
- Nausea, dizziness
- Chest pain, rapid heartbeat
- Frequent colds (immune system)

Cognitive Symptoms
- Memory problems (hippocampus)
- Inability to concentrate
- Poor judgment
- Seeing only the negative
- Anxiety (amygdala)
- Constant worrying

Behavioral Symptoms
- Eating more or less (cytokines)
- Sleeping too much or too little
- Isolating yourself from others
- Procrastinating or neglecting responsibilities
- Using alcohol, cigarettes, or drugs to relax
- Nervous habits (e.g. nail biting, pacing)

Emotional Symptoms
- Moodiness (amygdala)
- Irritability or short temper (amygdala)
- Agitation, inability to relax
- Feeling overwhelmed
- Sense of loneliness and isolation
- Depression or general unhappiness