Secret Intelligence Service

BASIC NOTES DISCUSSION

ROOM 15

FEAR

OR R15300316fwp

For the discussion see the pdfs

(I) FEAR DOCUMENT pdf
(II) FEAR GENDER STUDY pdf
(III) EMOTION AND STRESS pdf

A Useful Definition of Fear

Fear is the emotional response to the perception of an alternating loss of control and regaining of control. By 'control' is meant any conscious act of mind and body. The alternation between control and lack of it must occur in varying degrees of intensity and inconsistent periods of time. This alternation insures an element of surprise and keeps the perceiver off balance emotionally so that she/he cannot construct a set of mental expectations and thereby re-impose control.

Ref(i) and (ii) below: David R. Saliba, *A Psychology of Fear: The Nightmare Formula of Edgar Allan Poe*. 1980.

Psycho-analytic perspectives - I

Fear

In a biological sense fear is related to death. For the human organism all emotions can be said to be reactions to what Jeffrey Gray calls "reinforcing events," i.e., rewards and punishments, or the removal of such rewards and punishment. Fear, as all emotions, depend on what our perception is in relation to these reinforcing events. A fearful response is an indication that the perceiver believes that her/his well-being

is in danger, and that she/he is threatened by death or injury, which can lead to death indirectly.

Biologically fear is a warning signal that death, injury or destruction is imminent, and it is designed to cause the perceiver to avoid the dangerous situation. Fear, psychologically, is also a warning, and it basically functions to prevent the possibility of personality disintegration. A victim of fear perceives a threat to her/his identity which she/he experiences as a loss of control. According to Arno Karlen it is "a traditional Western fear that any loss of individual or social control will start a snowballing loss of controls in general, and such an effect in itself is sufficient to arouse more fear and complicate the situation for the victim. That is, fear is capable of generating more fear, and a victim of fear can find her/himself in a nightmare of her/his own making if she/he allows her/his imagination to get out of hand and does not successfully re-impose control on the situation. Once the victim perceives her/himself in control, she/he must maintain that control until the situation stabilizes. If her/his control falters, she/he will enter a vicious cycle of control and loss of control, and thereby initiate a panic reaction.

There are two basic kinds of fear stimuli. The first is environmental and poses a direct physical threat to the perceiver. The second is strictly psychological and poses no direct physical threat. For obvious reasons the first is a rational fear and the second is an irrational fear. Rational fears can be overcome by physical retaliation or escape, whereas irrational fears such as those aroused by horror stories, can be successfully overcome only by conscious and rational control. Carl Jung; "it is just man's turning away from instinct—her/his opposing her/himself to instinct--that creates consciousness." Consequently, the method for controlling irrational fear is to avoid further instinctual reactions and to concentrate on rationalizing. However, in a panic situation the victim automatically acts instinctually rather than rationally, and instead of remedying her/his problem and dispelling her/his fear she/he acts in a non-rational way that is likely to end catastrophically.

Though the principle of rational control is sufficiently plausible, the fact that the type of fear aroused by a horror story [or horror film] is irrational fear makes the victim's task difficult. The conscious-rational side of the human mind is diametrically opposed to, and inconsistent with, the unconscious-irrational. The unconscious influences the behavior

of the conscious, but a person cannot directly understand her/his unconscious mind. Sigmund Freud and Carl Jung; an integrated personality depends on a balanced interaction between the conscious and the unconscious sides of the mind. Jung's analytical theory - two parts of the unconscious which he refers to as "personal" and "collective.” Irrational fear, which is the type of fear has its source in both of Jung's portions of the unconscious mind.

Fear is an intense form of anxiety. Anxiety can come from threatening situations perceived in a person's surroundings, as well as from what Freud refers to as the id (instincts) and the superego (conscience). Once anxiety is experienced the ego, or conscious part of the mind moves quickly to protect itself through defense mechanisms, which are unconscious reactions that essentially distort reality. Since fear is an intense anxiety it, too, causes the ego to set up defenses to protect itself. Because of the greater intensity of fear over anxiety the threat perceived by the ego is identity dissolution. Consequently, the defenses in response to fear are often desperate and aimed at self-preservation--which in certain cases is perceived as both psychological and physical self-preservation, even though the fear is irrationally based.

During a highly fearful reaction the ego may see its loss of control in terms of mind disintegration, which is the inability to distinguish between reality and fantasy - the inability of the conscious mind to keep the unconscious mind under control. Mind disintegration is simply another form of identity dissolution.

In whatever form a victim of irrational fear perceives her/his control loss, her/his response will always be one of self-preservation. She/he will either meet the threat head-on, or she/he will attempt to escape it. Low level fears, or anxieties, will produce what Freud referred to as ego-defense mechanisms, which include both direct and indirect responses. Defense mechanisms are unconscious compulsions that function to save the conscious mind from unwanted shock or pain. The five basic mechanisms that Freud described are; regression, reaction-formation, repression, projection, and fixation. There is also the possibility of reduction in intensity of a fear-producing stimulus through adaptation or habituation, "It is in the nature of an intense stimulus that, with repetition, it becomes less intense (a phenomenon known as 'adaptation'); and in the nature of a novel stimulus that it becomes familiar with repetition (a

phenomenon known as 'habituation'). Both phenomena have been used with great success in curing phobic fears.

The complexity of the relations between the emergence and the decline of a fear can be seen from the fact that repeated exposures to the fear-evoking object or situation are said to sometimes increase the fear (sensitization) and at other times to decrease it (habituation). In other words, it is that fears exist in a state of balance. Furthermore, this balance will tilt in the direction of increased or decreased fear depending on the type of exposure, intensity of the stimulation, the person's state of alertness and other factors.

During a nightmare the balance tilts in the direction of increased fear, and it is through an understanding of the nightmare as a paradigm of irrational fear that the relationships among literary art, dreams, fear, and the gothic will become apparent.

On Combat: The Psychology and Physiology of Deadly Conflict in War and Peace

(USA) David Grossman, a former United States Army Ranger and West Point psychology professor, wrote *On Combat: The Psychology and Physiology of Deadly Conflict in War and in Peace* with former police officer Loren Christensen. The book is based on interviews and debriefs of soldiers and police, the authors' own personal experience, and research by others in the field. While Grossman presents the book as a work for military and law enforcement, he does make mention of traditional peace workers in saying, "I hope this book will be of use to the gentle, decent and discerning spirits in the peace movement." The author includes military, police, development, relief, and medical personnel under the umbrella term "peace warriors", and believes that all peace warriors "must study and master combat as the firefighter would study and master fire." It is my hope in writing this summary that I can extract and clearly present the information that is most important for peace warriors in the conflict resolution community.

There is a great deal of information in *On Combat* that pertains more specifically to the training and philosophy of the soldier.

Modern conflict zones frequently have no front line, and so anyone working in one would do well to understand the consequences of extreme high stress on most humans. Similarly, an understanding of the lasting effects of combat on those who fight can aid in the process of reintegrating soldiers post-conflict, and can help peace workers sympathize with allied military and civilians in combat zones with whom they may be working closely. A general understanding of emotional trauma is useful for anyone within any conflict related field.

Summary

Physiological Responses to Extreme High Stress

There is a wide range of possible responses and experiences during extreme high stress events. Sharper focus, visual clarity, slow-motion time, temporary paralysis, dissociation, and intrusive thoughts can all occur. When dissociation (a detachment from physical and emotional reality) occurs, it may be a red flag for the onset of post-traumatic stress disorder (PTSD). Loss of bladder and bowel control during moments of intensity is a common occurrence that is rarely discussed. Grossman uses it as an example of the hesitancy people have in discussing natural responses to combat.

Studies of World War II indicate that there were more psychiatric causalities than physical ones.

Among individuals participating in combat for longer than 60 consecutive days, 98 percent of them would begin to breakdown emotionally. This can have long term effects.

The range in responses to high stress result from changes in the autonomic nervous system, the part of human physiology responsible for automatic response to stimulus (the sympathetic nervous system) and basic bodily maintenance (the parasympathetic nervous system). When one's "fight or flight" response is triggered, the sympathetic nervous system begins shutting down things like salivation and digestion while increasing the production of epinephrine (adrenaline). Once the action is over it is followed by a parasympathetic backlash, the body attempting to calm down. Responses to this can vary depending on how prolonged the violence or stress has lasted. Soldiers fighting for hours find themselves exhausted and falling asleep because they have burned all their adrenaline. People who have experienced only a brief violent instance may find themselves unable to sleep for some time.

Heart rate increase in response to fear is correlated with a deterioration of motor skills and senses such as vision and hearing. Eventually cognitive abilities degrade to a point which has been referred to as ‘condition black’ (based on work by Siddle and Cooper). He describes conditions; white, yellow, red, gray, and black, with white being unconcerned and black being overwhelmed. He postulates high pressure situations call for condition yellow in which motor and cognitive skills are functioning at peak performance. Condition black is when the heart rate gets above 175 beats per minute because of the influx of adrenaline via stress. At this point vasoconstriction, the tightening of the blood vessels, allows less oxygen to the brain. The mid-brain, the part humans share with animals such as dogs and bears, takes over. Rational thought disappears.

During combat situations there are a variety of perceptual distortions caused by biomechanical changes in the body. "Auditory exclusion" - sounds such as gunfire cease being heard or are muted. "Tunnel vision" - the field of view becomes narrowed, cutting out the periphery. Depending on the environment the body may focus its attention almost entirely on either audio or visual stimulus, as is the case when hearing becomes sharper in low light situations. “Sensory exclusion” - adrenaline masks the pain due to injury until after the stress has passed.

Other experiences can present themselves; loss of memory and "tactical fixation", during when a person may attempt the same thing over and over expecting a different result each time. There are also memory distortions. People who have participated in extreme high stress situations may remember events incorrectly, believing them to be more negative than they actually were. There can also be an "autopilot effect" during which a person may engage in actions without thought. Distance and depth perception can also distort.

A natural response to prolonged stress is the desire to eat, though at times of high stress, when one is in condition red or higher, the desire to eat is extremely unlikely. Similarly, stress may cause either a pronounced increase or decrease in sexual desires. It is also possible that women will stop menstruating after a particularly stressful incident.

Psychology of Combat

The act of killing is normally a difficult thing to bring someone to do. By and large people do not like killing, however

joy can come from the act. The following presents the stages a person will go through after they have killed someone in a combat situation.

The first stage is "*survivor euphoria*", - a result of the realization that the life taker is still alive. This is followed by a sense of remorse (and possible vomiting). The happiness the survivor feels at being alive is difficult to separate from the death of the other party. This can lead to questions of morality and mental health ("I just killed someone and I am happy about it. Does that mean I enjoy the act?").

The final stage is the prolonged process of rationalization, which becomes necessary when actions (in this case killing) do not match personal belief systems, ie. killing is wrong. When this process fails PTSD can be the result. Killers can have different reactions depending on their levels of emotional preparedness and the context of the situation.

Resistance to killing inside one's own species is present in many animals. It has been argued that no other species kills its own with the frequency of humanity because humans have spent centuries developing better methods so to train killers and better killing implements. Weapons have been developed, based on inherent physical weaknesses of human beings, so to increase the force, mobility, distance and protection of the combatant.

Physical distance and mobility enable killing. However, killing from a distance also lessens the psychological impact on the target, thus the compliance of an enemy is most difficult to gain through long range assaults like air strikes or artillery, though it should be noted that, research has shown the accuracy of a weapon directly influences its psychological potency. Crew served weapons such machine guns and cannons, and proximate leaders also enable killing by serving to diffuse the responsibility for the death through the social group.

Posturing as a component of combat; The ornamentation, battle cries, and weapons of a military all serve in an effort to convince the other side that confrontation is foolish. Guns are noted as being particularly effective due to the loud sound produced versus a bow and arrow. This posturing is meant to destabilize the opponent emotionally, possibly ending the fight before it begins. However, historically much of the killing that happens on the battlefield occurs as one side is fleeing. This perhaps for two reasons; the victims human quality is lessened

when the eyes and face are not visible, and that there is a deep seated urge to pursue when a target flees.

PTSD

Individuals have different responses to extreme high stress events. What might be traumatic to one person may not affect another. The susceptibility to trauma can be influenced by other prior factors such as the state of physical health or interpersonal relationship related. The onset of PTSD can follow the experience of a perceived life or death event that prompted feelings of fear and vulnerability. The symptoms are recurrent (lasting for at least a month), and can include; resentment, anxiety, avoidance, alienation, sleeplessness, increased arousal, hallucinations, and hypervigilance and so on.

A typical response to a post-traumatic event; "immediately following, an individual might well experience trembling, sweating, chills, nausea, hyperventilation, dizziness, thirst, an urge to urinate, diarrhea, upset stomach, and agitation. Later, during the night, the individual might experience sleep disturbances and nightmares. Some do not suffer any of these symptoms, some experience several of them and some experience all. Subsequently, the individual might be preoccupied with/dote on what happened, reliving it over and over in the mind. The individual might be annoyed, sad, irritable, hyper-sensitive, vulnerable, anxious, frightened, self-conscious, paranoid, be afraid of being judged by others, and so on. The individual might feel numb, zombie-like, unnaturally calm, and estranged from others. The individual’s thinking might be confused, experiencing difficulty concentrating, and experience impaired memory.

The sympathetic nervous system bears responsibility for symptoms of PTSD. It is normal for sufferers to try and avoid the stimulus that causes the anxiety. Some suggest that it can be important not to run from the stimulus, assuming it is no longer presenting a situation of possible death. For example; the backfire of a car being mistaken for a gunshot. If the backfire causes anxiety, the subject should listen to many backfires so to become de-conditioned from the response. This can have the effect of de-linking emotion and memory.

Debriefing

In order to fight the possible onset of PTSD, "Critical Incident Debriefings" should be conducted after traumatic events. There

are two fundamental reasons for these debriefings. The first reason is to replay the incident and analyze what went wrong and what worked. The second reason is to attempt to deal with the possible memory loss and cognitive distortion that participants and witnesses might have experienced. >>Pain shared is pain divided, and joy shared is joy multiplied<<.

A summary of guidelines for critical incident debriefings:

- No one should be forced to participate.
- It should be told that stress is the primary problem, and that while not everyone will have a problem with stress, those who are mentally healthy can help those with problems recover.
- The debriefings should take place as soon as possible and be conducted by someone from a similar background, or even better, someone who has been with the group before.
- The debriefing should be included as part of a larger program of recovery.
- Focus should be placed on de-linking emotions from memories, not simply exposing emotional trauma.

Debriefing should be done soon after the incident, though allowing participants to sleep before may help their long term memory. "Memory contamination" can result from exposure to new stimulus prior to debriefing. "Memory reconstruction" can happen when groups debrief together; one participant may use information provided by another participant to fill in the blanks in their own memory.

Breathing is presented as a way to control the autonomic nervous system during times of increased stress. This can be used during debriefs to de-link memories and emotions, and during traumatic incidents to lessen the impact of the fight or flight response and decrease heart rate. Some advocate autogenic breathing, which is also known as combat or tactical breathing. This process entails inhaling through the nose for four seconds, holding the breath for four seconds, exhaling for four seconds, and once again holding for four seconds. This is repeated until the heart rate begins to decrease.

It is important to be ready to respond to a survivor of a high stress incident, including soldiers returning to a domestic setting. Understanding, affirmation, and especially statements of support and caring are crucial to a trauma victim's recovery. Initiate contact and offer support to the victim without demanding information about the event, listen non-judgmentally

(being careful of facial expressions), stay away from alcohol or coffee and avoid making jokes about the incident, and provide encouragement as they try to return to normal life.

PTSD rates may be higher than previous wars because we are catching more sufferers, and that we are doing a better job of treatment. Further, he says that recovering from PTSD can make a person stronger as it provides stress inoculation, admitting that one prefers to emphasize positive expectations, positive self-fulfilling prophecies.

Training and Preparation

In recounting a few stories of remarkable individual actions in war, a single person can have a disproportionate effect on a situation, and goes on to discuss what it means to be a warrior. To her/him it comes down to a mentality that is prepared and even eager to confront instances of interpersonal conflict. It is necessary to avoid the denial that bad things do happen, and instead think clearly with regard to what actions should be taken in high intensity situations.

Training as realistically as possible is important. Repeated actions allow the soldier to act without thinking, as though they were on autopilot. It is actually possible to be scared speechless. Rehearsing the appropriate words can prevent this from happening. Good training can increase confidence and make people less susceptible to the effects of extreme stress and the anxiety that comes with performance.

Regarding who are referred to as "pre-battle veterans", meaning individuals who have gone through training that was sufficiently stressful to prepare them for real life engagements. During military and police training an individual should not be allowed to lose. In life or death encounters losing equates to death, so training should not be over until the trainee has completed whatever goals indicate survival in the test.

A person entering a high stress situation must also be physically prepared. In this regard, sleep is discussed as a primary cause of psychological stress.

Conclusion

Interpersonal human violence has been cited as the universal human phobia, and points out that the DSM – of mental disorders notes that violence from other people is more traumatizing than

violence from nature. The physiological and psychological responses a person will have to violence, or an extremely high stress experience, have a wide range of possibilities. One can really be scared speechless, or have the shit scared out of them. Cognitive impairments, both immediate and long term, are not uncommon. Witnesses may find themselves unable to act. Survivors may experience guilt.

Psychologically one must not be in denial about atrocious possibilities. Physically one must be free from stressors such as dehydration, hunger, and especially lack of sleep to be able to function effectively. Repetitive training, stress inoculation, and tactical breathing can help avoid being entirely overtaken by the stimulus of the moment. After incident debriefings can help survivors, witnesses, and victims process the event and de-link emotions from actions. >>Exercise can be used to burn off stress hormones.<<

Dealing with the effect of fear, anxieties:

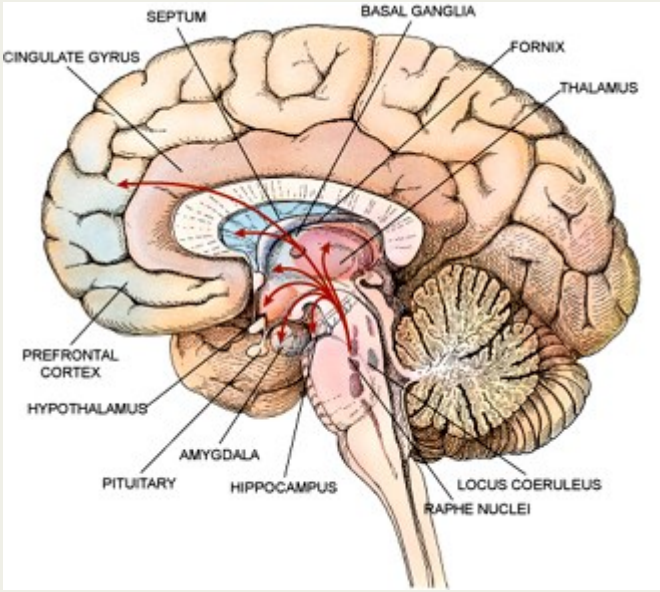
This is a US newspaper article from *The Appalachian* regarding the subject of the psychology of fear. The article was published on October 31, 2006.

Fear: Physiology

The physiological response to a fear stimulus begins in the brain. The brain triggers the release of certain chemicals that cause the fight or flight response in human beings. This response is characterized by rapid heart rate, rapid breathing, flexed muscles, and an automatic focus on reacting physically. Once the chemicals released in the blood stream begin to work, one is hardly aware of what is happening physically. One is simply in a reactive state controlled by the autonomic nervous system. All one wants to do is run away from the fear agent or attack it directly.

Specific regions of the brain work together so to trigger reactions to fear stimuli, these include the:

- Amygdala
- Hippocampus
- Hypothalamus
- Sensory cortex
- Thalamus



The process generally begins in the thalamus - which collects sensory data coming from the five senses during the intrusion of the fear stimulus. The sensory cortex receives the data from the thalamus and interprets it; stages it for processing by the amygdala, the hippocampus, and the hypothalamus. It is the task of the hippocampus to store and download memories that help it analyze the context of the situation. The amygdala has a store of fear memories and begins interpreting emotions and evaluating the threat level. Finally, the hypothalamus is responsible for ordering the response; to either run, or attack.

The reaction to a fear stimulus is completely unconscious. And there are two recognized paths through the brain that eventually lead to the fight or flight response. Both of these paths occur simultaneously, but reveal very different behaviors. One path leads to an immediate and completely unconscious response, while the other takes just a little time to evaluate the situation before causing us to revert to our animal instincts.

Fear: Neurobiology

Studies of neuronal activity in the brain have suggested that the prefrontal cortex, a cognitive and emotional learning center that helps interpret sensory stimuli, is responsible for the conscious assessment of danger. After passing through the amygdala, sensory information is directed to the cortex. There, the frightening stimulus is examined in detail to determine whether or not a real threat exists. Based on this information, the amygdala will be signaled either to perpetuate the physical response, or to abort it. Because the amygdala is aroused before

the cortex can accurately assess the situation, an individual will experience the physical effects of fear even in the case of a false alarm.

An Extract from Howard Phillips-Lovecraft, *Supernatural Horror in Literature* (1973)

"The oldest and strongest emotion of mankind is fear, and the oldest and strongest kind of fear is fear of the unknown. These facts few psychologists will dispute, and their admitted truth must establish for all time the genuineness and dignity of the weirdly horrible tales as a literary form."

The Mechanics of Fear in Screenplay Development

Good screenwriters know that fear generates a core emotional response that actually changes the body's chemical response for a small period in time. This shift inside an audience, in turn, creates thrilling moments in which their participation actually engages them physically with the stories on the screen. This is because horror films are emotion-based experiences.

Because horror movies rely specifically on eliciting fearful emotions, the most successful horror movies are constructed using tested and proven techniques that elicit this desired fear response in their audiences. 3 techniques employed in this classic screenplay formula:

- Set-up and Payoff-the character is set up for the inevitable fear surprise
- Sense of Predation-the innate fear of being devoured kicks in our resistance to becoming prey
- The Antagonist-the main villain who we know is reputed to be the primary fear agent and who we have paid to view

4 distinct categories of horror film:

- Creature Feature
- Slasher Flicks
- Supernatural Horror
- Psychological Horror

Fear Research in Neuroscience

There is recent research in neuroscience on the chemical interactions possibly related to learned behavior; particularly in relation to the learning of fear. In the abstract to an

article titled, "Synaptically released zinc gates long-term potentiation in fear conditioning pathways," the researchers submit that

"Using whole-cell recordings from amygdala slices, we demonstrated that activity-dependent release of chelatable Zn2+ is required for the induction of spike timing-dependent long-term potentiation in cortical input to the amygdala implicated in fear learning."

Fear Reaction

According to the dental Fear Central (USA) website, a fear response is characterized by some or all of the following:

- Heart Palpitations
- Sweating
- Trembling/shaking
- Sensations of shortness of breath
- Feeling of choking
- Chest pain
- Nausea or abdominal discomfort
- Feeling dizzy, unsteady, lightheaded or faint
- Chills or hot flushes
- Paresthesia (numbness or tingling)
- Feeling of de-realization (world's not real) or de-personalization (being outside one's body)
- Fear of losing control or going crazy
- Fear of dying

Phobia

A phobia is an irrational fear of anything: objects, people, situations, activities that the experiencer of the phobia feels compelled to avoid. Someone can be afraid of something without it controlling their entire life and reactions, and it wouldn't be a phobia. For example, if a person is afraid of flying, they may still be able to book cheap flights, but they may just need to take some medication to help them sleep through the flight itself once they are on board. However, if someone suffers from aviophobia, they would never even book cheap flights.

>>A phobia is a disabling, irrational fear that controls a person more than would normal fear. Boarding a flight to Europe and anywhere in between would be completely out of the question for someone with a phobia when it comes to flying. This holds true for all phobias, these fears are a form of psychological

disorder that takes a hold of a person in a way normal fear does not. It's important to know the difference between having a phobia and being fearful to a lesser degree, in order to know how to handle the condition, the symptoms of phobias include:

- Feeling of panic, dread, horror, or terror
- Recognition that the fear goes beyond normal boundaries and the actual threat of danger
- Reactions that are automatic and uncontrollable, practically taking over the person’s thoughts
- Rapid heartbeat, shortness of breath, trembling, and an overwhelming desire to flee the situation – all the physical reactions associated with extreme fear.

Physiological Responses to Pain

Physiological responses to pain are mainly aspects of the body's integrated defence response including fight or flight. The two main systems are (1) the Sympatho-Adrenal system and (2) the Hypothalamic-Pituitary-Adrenal system

Physiological signs of pain may include:

- dilatation of the pupils and/or wide opening of the eyelids
- changes in blood pressure and heart rate
- increased respiration rate and/or depth
- pilo-erection
- changes in skin and body temperature
- increased muscle tone
- perspiration
- increased defecation and urination

Psychological Effects of Combat

Physiological Arousal and Fear

The soldier in combat endures many indignities. Among these can be endless months and years of exposure to desert heat, sweltering jungle, torrential rains, or frozen mountains and tundra. Usually the soldier lives amidst swarming vermin. Very often there is lack of food, lack of sleep, and the constant uncertainty that eats away at the combatant’s sense of control over their lives and their environment. But, bad as they are, all of these stressors can be found in many cultural, geographic, or social circumstances,

and when the ingredient of war is removed individuals exposed to these circumstances do not suffer mass psychiatric casualties.

To fully comprehend the intensity of the stress of combat, we must keep these other stressors in mind while understanding the body's physiological response to combat, as manifested in the sympathetic nervous system's mobilization of resources. And then we must understand the impact of the parasympathetic nervous system backlash that occurs as a result of the demands placed upon it. The sympathetic nervous system mobilizes and directs the body's energy resources for action. It is the physiological equivalent of the body's front-line soldiers who actually do the fighting in a military unit. The parasympathetic nervous system is responsible for the body's digestive and recuperative processes. It is the physiological equivalent of the body's cooks, mechanics, and clerks who sustain a military unit over an extended period of time.

Usually the body maintains itself in a state of homeostasis, which ensures that these two nervous systems maintain a balance between their demands upon the body's resources. But during extremely stressful circumstances the fight-or-flight response kicks in and the SNS mobilizes all available energy for survival. This is the physiological equivalent of throwing the cooks, mechanics, and clerks into the battle. This process is so intense that soldiers very often suffer stress diarrhea due to redirecting of energies from nonessential parasympathetic processes, and it is not at all uncommon to lose control of urination and defecation as the body literally blows its ballast and redirects all available energy in an attempt to provide the resources required to ensure survival. This is reflected in World War II surveys in which a quarter of combat veterans admitted that they urinated in their pants in combat, and a quarter admitted that they defecated in their pants in combat.

A combatant must pay a physiological price for an enervating process so intense. The price that the body pays is an equally powerful "backlash when the neglected demands of the parasympathetic nervous system become ascendant. This parasympathetic backlash occurs as soon as the danger and the excitement is over, and it takes the form of an incredibly powerful weariness and sleepiness on the part of the soldier.

Napoleon stated that the moment of greatest danger was the instant immediately after victory, and in saying so he demonstrated a powerful understanding of the way in which soldiers become physiologically and psychologically incapacitated by the parasympathetic backlash that occurs as soon as the momentum of the attack has halted and the soldier briefly believes himself to be safe. During this period of vulnerability a counterattack by fresh troops can have an effect completely out of proportion to the number of troops attacking.

It is basically for this reason that the maintenance of an unblown reserve has historically been essential in combat, with battles often revolving around which side can hold out and deploy their reserves last. Clausewitz understood the danger of reserve forces becoming prematurely enervated and exhausted (and he provides insight into the root cause of the enervation) when he cautioned that the reserves should always be maintained out of sight of the battle.

In continuous combat the soldier roller-coasters through a seemingly endless series of these surges of adrenaline and their subsequent backlashes, and the body's natural, useful, and appropriate response to danger ultimately becomes extremely counterproductive. Unable to flee and unable to overcome the danger through a brief burst of fighting, posturing, or submission, the bodies of modern soldiers in sustained combat exhaust their capacity to enervate. They slide into a state of profound physical and emotional exhaustion of such a magnitude that it appears to be almost impossible to communicate it to those who have not experienced it.

Most observers of combat lump the impact of this physiological arousal process under the general heading of fear, but fear is really a cognitive or emotional label for nonspecific physiological arousal in response to a threat. The impact of fear and its attendant physiological arousal is significant, but it must be understood that fear is just a symptom and not the disease, it is an effect but not the cause. To truly understand the psychological effects of combat, we must understand exactly what it is that causes this intense fear response in individuals. It has become increasingly clear that there are two key, core stressors causing the psychological toll associated with combat. These stressors are: the trauma associated with being the victim of close-range, interpersonal aggression and the trauma associated with the responsibility to kill a fellow human being at close range.

Aggression and Violence

To understand the nature of aggression and violence on the battlefield, it must first be recognized that most participants in close combat are literally frightened out of their wits. Once the bullets start flying, most combatants stop thinking with the forebrain (that portion of the brain that makes us human) and start thinking with the midbrain (the primitive portion of our brain, which is indistinguishable from that of an animal).

In conflict situations, this primitive, midbrain processing can be observed in the existence of a powerful resistance to killing one's own kind. Animals with antlers and horns slam together in a relatively harmless head-to-head fashion, and piranha fish fight their own kind with flicks of the tail, but against any other species these creatures unleash their horns and teeth without restraint. This is an essential survival mechanism that prevents a species from destroying itself during territorial and mating rituals.

One major modern revelation in the field of military psychology is the observation that such resistance to killing one's own species is also a key factor in human combat. Only 15 to 20 percent of the individual riflemen in World War II fired their own weapons at an exposed enemy soldier. Key weapons, such as flame-throwers, were usually fired. Crew-served weapons, such as machine guns, almost always were fired. And action would increase greatly if a nearby leader demanded that the soldier fire. But when left on their own, the great majority of individual combatants appear to have been unable or unwilling to kill.

Ardant du Picq's survey of French officers in the Korean War when the rate of psychiatric casualties was almost seven times higher than the average for World War II. Only after the war settled down, lines stabilized, and the

threat of having enemy in rear areas decreased did the average rate go down to that of World War II. Again, just the potential for close-up, inescapable, interpersonal confrontation is more effective and has greater impact on human behavior than the actual presence of inescapable, impersonal death and destruction.

Ardant du Picq's surveys of French officers in the 1860s and his observations about ancient battles (*Battle Studies*, 1946), John Keegan and Richard Holmes' numerous accounts of ineffectual firing throughout history (*Soldiers*, 1985), Holmes' assessment of Argentine firing rates in the Falklands War (*Acts of War*, 1985), Paddy Griffith's data on the extraordinarily low firing rate among Napoleonic and American *Civil War regiments (*Battle Tactics of the American Civil War*, 1989), the British army's laser reenactments of historical battles, the FBI's studies of nonfiring rates among law enforcement officers in the 1950s and 1960s, and countless other individual and anecdotal observations, all confirm one conclusion that human beings are not, by nature, killers. Indeed, from a psychological perspective, the history of warfare can be viewed as a series of successively more effective tactical and mechanical mechanisms to enable or force combatants to overcome their resistance to killing other human beings, even when defined as the enemy.

NB. The modern day terrorists of Islamic State, et al, confuse the above conclusion.

By 1946, the US Army had accepted Marshall's conclusions, and the Human Resources Research Office of the US Army subsequently pioneered a revolution in combat training, which eventually replaced firing at targets with deeply ingrained conditioning, using realistic, man-shaped pop-up targets that fall when hit. Psychologists assert that this kind of powerful operant conditioning is the only technique that will reliably influence the primitive, midbrain processing of a frightened human being. Fire drills condition schoolchildren to respond properly even when terrified during a fire. Conditioning in flight simulators enables pilots to respond reflexively to emergency situations even when frightened. And similar application and perfection of basic conditioning techniques increased the rate of fire to approximately 55 percent in Korea and around 95 percent in Vietnam.

Equally high rates of fire resulting from modern conditioning techniques can be seen in Holmes' observation of British firing rates in the Falklands and FBI data on law enforcement firing rates since the nationwide introduction of modern conditioning techniques in the late 1960s.

The extraordinarily high firing rate resulting from these processes was a key factor in the American ability to claim that the United States never lost a major engagement in Vietnam. But conditioning that overrides such a powerful, innate resistance has enormous potential for psychological backlash. Every warrior society has a purification ritual to help the returning warrior deal with his blood guilt and to reassure him that what he did in combat was good. In primitive tribes, this generally involves ritual bathing, ritual separation (which serves as a cooling-off and group therapy session), and a ceremony embracing the veteran back into the tribe. Modern Western rituals traditionally involve long separation while marching or sailing home, parades, monuments, and unconditional acceptance from society and family.

During the *Vietnam War, this purification ritual was turned on its head. The returning American veteran was attacked and condemned in an unprecedented manner. The traditional horrors of combat were magnified by modern conditioning techniques, and this combined with societal condemnation to create a circumstance that resulted in 0.5 to 1.5 million cases of Post-Traumatic Stress Disorder (PTSD) in Vietnam veterans. The mass incidence of psychiatric disorders among Vietnam veterans resulted in the "discovery" of PTSD, a condition that we now know traditionally occurred as a result of warfare, but never in such quantity.

PTSD seldom results in violent criminal acts, and upon returning to society, the recipient of modern military conditioning is statistically no more likely to engage in violent crime than a nonveteran of the same age. The key safeguard in this process appears to be the deeply ingrained discipline that the combat soldier internalizes with his military training. However, with the advent of interactive "point-and-shoot" arcade and video games, there is significant concern that society is aping military conditioning, but without the vital safeguard of discipline. There is strong evidence to indicate that the indiscriminate civilian application of combat conditioning techniques as entertainment may be a factor in worldwide, skyrocketing violent crime rates, including a sevenfold increase in per capita aggravated assaults in America since 1956. Thus, the latest chapter in American military history may be occurring in the city streets.

>Again, PTSD is a psychological disorder resulting from a traumatic event. PTSD manifests itself in persistent re-experiencing of the traumatic event, numbing of emotional responsiveness, and persistent symptoms of increased arousal, resulting in clinically significant distress or impairment in social and occupational functioning. There is often a long delay between the traumatic event and the manifestation of PTSD.

Emotion definition

A conscious mental reaction (as anger or fear) subjectively experienced as strong feeling usually directed toward a specific object and typically accompanied by physiological and behavioral changes in the body

Alternative word discussion: emotion

Feeling, emotion, affectation, sentiment, passion - mean a subjective response to a person, a thing, or a situation. Feeling denotes any partly mental, partly physical response marked by pleasure, pain, attraction, or disgust; it may suggest the mere existence of a response but imply nothing regarding the nature or intensity of it *>the feelings that once moved me are gone<*.

Emotion carries a strong implication of excitement or agitation but, like feeling encompasses both positive and negative responses. *>the drama portrays the emotions of adolescence<*.

Affection applies to feelings that are also inclinations or likings *>a memoir of childhood filled with affection for her family<.*

Sentiment often implies an emotion inspired by an idea *>her feminist sentiments are well known<.*

Passion suggests a very powerful or controlling emotion *>revenge became his ruling passion<.*

The experience of emotion is associated with a variety of bodily changes, both obvious and covert. Obvious bodily manifestations of emotions are observable. But the covert organic changes are detected only by particular procedures, and modern recording devices including computers. Following obvious and covert changes occur in the body at the time of emotion:

- Face becomes red with excitement or anger
- Eyes are protruded
- The pupils of the eyes are dilated
- Respiration becomes more rapid
- The electrical resistance of the skin decreases
- The blood clots more quickly at the time of injury
- Blood sugar level increases to make the organism energetic
- Gastrointestinal activities decrease or even stop totally
- Blood is canalized from stomach and intestine to the motor organs and brain
- The hairs stand on their roots

All bodily changes during emotions are the result of a number of complex underlying processes originating in and integrated by the Autonomic Nervous System, the endocrine glands and the cerebrospinal system.

The outward bodily changes include changes in facial expression, vocal expression, perspiration on the surface of the body, accelerated motor activities, and so on. The internal physiological changes include changes in the electrical activities of the skin, respiratory activities, blood pressure, pulse rate, sweat glands, reactions of the endocrine glands, and the chemical activities of blood and so on.

The following instruments are used separately or in combination to measure organic changes during emotion: (I) the polygraph, (II) multichannel amplifier with associated ink writing, (III) optical oscillographs, (IV) pneumograph, (V) sphygmomanometer, (VI) psychogalvanometer, (VII) electroencephalogram.

In addition to these instruments, damages in the brain such as paralysis on any lobe of the cerebral cortex due to emotional shock can be diagnosed by modern computerized instruments such as CT scan, PET scan and MRI. The electrical activities of the body during emotion such as brain waves, muscle action potentials, galvanic skin responses, electro grams and eye blinks are studied through these aforestated instruments.

The following organic or physiological changes occur during emotion.

Electrical Phenomena of the Skin

One of the common measures of autonomic activities associated/affective and emotional state is the galvanic skin response. It also bears several names, such as psycho-galvanic reflex, skin resistance, electro-dermal response. The GSR is measured with an apparatus known as psycho-galvanometer. The changes in GSR called the electro-dermal changes result from the activity of the sweat glands. The GSR is associated with blood pressure and respiration, and indicates that an emotional reaction is taking place. The GSR is activated during emotion by the sympathetic nervous system and decreases during emotional stimulations. The latency, amplitude, and duration of the GSR provide indications of whether or not an emotional reaction is taking place.

Blood Pressure

Blood pressure and galvanic skin reflex have been used as indicators of emotional states. The level of blood pressure and GSR are considered be the best indications of facilitative, preparatory, and emergency functions during emotion activated by the sympathetic system.

There are two measures of blood pressure, - systolic and diastolic. The difference between these two measures is known as pulse pressure. >Systolic pressure is maximal pressure reached during the contraction of the heart< >diastolic pressure is the least pressure during expansion< Variations in pressure owing to emotion are recorded continuously. The significance of these changes is correlated with emotional manifestations of the individual.

Heart Rate

The electro-cardiogram (ECG) records the heart rate by means of attachment of electrodes to the two arms or to either of the arms and the left leg. The pattern recorded enables the cardiologist to analyze the performance of the heart during the emotional state. The cardio-tachometer is a useful device for counting the number of heartbeats. Cardio-chronograph is also another such device to study the heartbeats during emotion.

Respiration

The respiration pattern is very often disturbed by emotional conditions. The respiratory features, - the rate, depth, pattern, and inspiration and expiration ratio are measured in order to gauge the intensity of the emotional state. Respiration is mainly regulated reflexively through the respiratory center in the medulla. The medulla responds to changes in blood chemistry. Even if the respiration is interrupted by other reflexes, such as, coughing, sneezing, sighing, and yawning, it is a sensitive indicator of emotional responses such as the startle response, the conscious attempts at deception, and conflicts.

Skin Temperature

The common method to measure skin temperature in emotion is to apply thermocouple to the skin area concerned. Emotional stress produces a fall the skin temperatures. Conflict and altercations are associated with vasoconstriction and a fall in the skin temperature. On the other hand, uninhibited action and emotional security are said to result in vasodilation and crease in skin temperature.

Pupillary Response

The sympathetic and parasympathetic divisions of the Autonomic Nervous system never act together. Either of the two becomes active at one time spending on the situation. That means the two divisions are in active (position to each other while in action. Pupil of the eyes is the index of this. During emotion, dilation of the pupil occurs through the sympathetic system. Constriction of the pupil occurs by the parasympathetic system. Pupillary responses to pain and emotion-provoking stimuli have been studied by Bender (1933), Lindsley and Sassaman (1930). They recorded pupillary reaction during emotion, which are recorded through motion pictures. (This is the same modern video-tape recording).

Salivary Secretion

The secretion of the parotid gland has been studied by Pavlov and others in conditioning experiments. Wenger and Ellington (1943) described a method measuring salivary output as an index of autonomic activity. Others have tried to study the secretion of parotid gland in psychoneurotic patient's response auditory stimulation. The secretion resulting from parasympathetic stimulation is thin and watery. But owing to sympathetic stimulation the salivary secretion becomes thick and is filled with mucus. This leads to the general observation that emotional excitement, anticipation, fear and anger produce dryness the mouth due to predominance of sympathetic activity.

Pilomotor Response

During emotion, especially when one is afraid of, hairs stand on their root. This is due to the activities of the sympathetic nerves. The production of goose flesh while one is afraid is an emotional reflex.

Blood, Saliva and Urine Analysis

Chemical components of the blood have been found to be affected by emotional stimulation. Among them are blood sugar level, adrenaline content, acid balance (pH), red blood cells and many other constituents. Tests have been made to ascertain which organ of the body is activated when glucose and insulin are injected into the body. It was known that due to glucose and insulin intake, the sympathetic division becomes most active. Urine is analyzed for excess sugar secretion from samples taken at intervals before, during, and after emotional stimulation. The secretion of keto-steroids, a metabolic product resulting from steroid flow from adrenal cortex during stressful emotion, and the acid base balance (pH) have been found to vary with emotional state and stressful mental activities.

Gastro-intestinal Activities

Studies have been made on the activities of the stomach and the intestine in animals under emotional, electrical, and chemical stimulation. Cannon (1929) demonstrated that emotions of fear or anger inhibit activities in the gastro-intestinal tract. X-ray and fluoroscopic examination following barium milk, and by means of inflated stomach-balloon with a recording device a used to measure such gastro-intestinal activities.

Metabolic Rate

The amount of oxygen consumption or the basal metabolic rate (BMR) generally increases during emotions involving excitement and general body mobilizations. A standard BMR machine is used for the purpose.

Muscle Tension

A common symptom of emotional anxiety is bodily tension. These somatic reactions are caused by emotional reactions. Muscular tensions and visceral changes occur in emotion. Muscular tensions are recorded by means of muscle-action potential. Studies by Davis (1938) and Courts (1942) reveal relation of muscular tension to frustration and performance.

Tremor

The emotional excitements such as fear and anger give rise to tremors. Tremor is witnessed in conditions of tensions. Luria (1932) found that emotional conflict externalized in motor performance led to tremor and disorganization of motor responses. Berrien (1939) has described finger-tremors as indices of emotion.

Eye Blinking

The excessive eye blinking is associated with emotional tensions. Too much eye blinking seems to suggest a kind of "nervousness". The rate of eye blinking increases with emotional arousal and excitement. Records of eye blink shows there are different patterns of blinking in different people; in some, there may be continuous blinking; in others sporadic groups of rapid blinks; and in some others blinks may occur singly or doubly at irregular intervals.

Besides the aforesaid organic changes, which are associated with emotional sates, there are neural and hormonal mechanisms underlying emotional behavior. These can be understood by studying the activities of Autonomic Nervous System.

Emotion

Objectives

1. Discuss the behavioral, autonomic, and hormonal components of an emotional response and the role of the amygdala in controlling them.
2. Discuss the role of the orbitofrontal cortex in the analysis of social situations and the effects of damage to this region, including those produced by psycho-surgery.
3. Discuss cross-cultural studies on the expression and comprehension of emotions.
4. Discuss the neural control of the recognition of emotional expression and comprehension of emotions.
5. Discuss the neural control of emotional expression in normal people and people with brain damage.
6. Discuss the James-Lange theory of feelings of emotion and evaluate relevant research.
7. Discuss the nature, functions, and neural control of aggressive behavior.
8. Discuss the hormonal control of inter-male aggression, inter-female aggression, and maternal aggression.
9. Discuss the effects of androgens on human aggressive behavior.

The word *emotion* can mean several things. Most of the time, it refers to positive or negative feelings that are produced by particular situations. Emotions consist of patterns of physiological responses and species-typical behaviors. Most of us use the word *emotion* to refer to the feelings, not to the behaviors. It is behavior that has consequences for survival and reproduction.

Sections:

1. The patterns of behavioral and physiological responses that constitute emotions. The nature of the response patterns, their neural control, and the perception of situations that give rise to emotions; it includes a discussion of prefrontal lobotomy and other types of psychosurgery.
2. The communication of emotions-their expression and recognition
3. The nature of the feelings that accompany emotions.

4. The neural and hormonal control of aggressive and defensive behaviors.

Emotions as Response Patterns

An emotional response consists of three types of components: behavioral, autonomic, and hormonal. The *behavioral* component consists of muscular movements that are appropriate to the situation that elicits them. *Autonomic* responses facilitate the behaviors and provide quick mobilization of energy for vigorous movement. The activity of the sympathetic branch of the autonomic nervous system increases while that of the parasympathetic branch decreases. As a consequence, heart rate increases, and changes in the size of blood vessels shunt the circulation of blood away form the digestive organs toward the muscles. *Hormonal* responses reinforce the autonomic responses. The hormones secreted by the adrenal medulla-epinephrine and norepinephrine-further increase blood flow to the muscles and cause nutrients stored in the muscles to be converted into glucose. In addition, the adrenal cortex secretes steroid hormones, which also help to make glucose available to the muscles.

Special behaviors that serve to communicate emotional states to other animals, such as the threat gestures that precede an actual attack and the smiles and frowns used by humans. Negative emotions receive much more attention than positive ones. Most of the research on the physiology of emotions has been confined to fear and anxiety.

Neural Control of Emotional Response Patterns: Role of the Amygdala

Stimulation of various parts of the brain can induce an animal to attack another one or can cause it to make vigorous attempts to escape. In other words, the stimulation can produce the behaviors associated with anger or fear. The overt behaviors, the autonomic responses, and the hormonal secretions associated with these emotional reactions are controlled by separate neural systems. The *integration* of these responses appears to be controlled by the amygdala.

Anatomy of the Amygdala

Researchers in several different laboratories have shown that single neurons in various nuclei of the amygdala become active when emotionally relevant stimuli are presented. The amygdala is involved in the effects of pheromones on reproductive physiological and behavior.

The amygdala (or more precisely, the *amygdala complex*) is located within the temporal lobes. It consists of several groups of nuclei, each with different inputs and outputs-and with different functions. The major parts of the amygdala are the *medial nucleus*, the *lateral/basolateral nuclei*, the *central nucleus*, and the *basal nucleus*.

The **medial nucleus** consists of several subnuclei that receive sensory input (including information about the presence of odors and pheromones from the main and accessory olfactory bulbs) and relay the information to the medial basal forebrain and to the hypothalamus.

The **lateral/basolateral nuclei** receive sensory information from the primary sensory cortex, association cortex, thalamus, and hippocampal formation. Theses nuclei project to the ventral striatum (a region involved in the effects of reinforcing stimuli on learning) and to the dorsomedial nucleus of the thalamus, whose projection region is the prefrontal cortex. They also provide sensory input to the central nucleus, which is the part to the amygdala that will most concern us.

The **central nucleus** projects to regions of the hypothalamus, midbrain, pons, and medulla that are responsible for the expression of the various components of emotional responses.

The **basal nucleus** consists of several sub-nuclei that, like the central nucleus, receive sensory input form the lateral and basolateral nuclei and relay information to other amygdala nuclei and to the periaqueductal gray matter of the midbrain.

The central nucleus of the amygdala is the single most important part of the brain for the expression of emotional responses provoked by aversive stimuli. When threatening stimuli are presented, both the neural activity of the central nucleus and the production of Fos protein increase. Damage to the central nucleus (or to the lateral/basolateral nuclei, which provide it with sensory information) reduces or abolishes a wide range of emotional behaviors and physiological responses. After the central nucleus id destroyed, animals no longer show signs of fear when confronted with stimuli that have been paired with aversive events. The animal's blood levels of stress hormones are lower. In contrast, when the central amygdala is stimulated by means of electricity or by an injection of an excitatory amino acid, the animal shows physiological and behavioral signs of fear and agitation, and long –term stimulation of the central nucleus produces stress-induced illnesses such as gastric ulcers. These observations suggest that the autonomic and endocrine responses controlled by the central nucleus are among those responsible for the harmful effects of long-term stress.

Conditioned Emotional Responses

The central amygdala is particularly important for aversive emotional learning. A few stimuli automatically produce fear reactions-for example, loud unexpected noises, the approach of large animals, heights, or (for some species) specific sounds or odors. Even more important, however, is the fact that we can *learn* that a particular situation is dangerous or threatening.

A **conditioned emotional response** is produced by a neutral stimulus that has been paired with an emotion-producing stimulus.

Briefly, classical conditioning occurs when a neutral stimulus is regularly followed by a stimulus that automatically evokes a response.

If an organism learns to make a specific response that avoids contact with the aversive stimulus (or at least minimizes its painful effect), most of the nonspecific emotional responses will eventually disappear. If the organism learns a successful **coping response** - a response that terminates, avoids, or

minimizes an aversive stimulus-the emotional responses will no longer occur.

Behavioral arrest - a species-typical defensive response called freezing.

It has been found that lesions of the lateral hypothalamus interfered with the change in blood pressure, whereas lesions of the periaqueductal gray matter interfered with the freezing response. Thus, two different mechanisms, both under the control of the central nucleus of the amygdala, are responsible for the autonomic and behavioral components of conditioned emotional responses.

Some of the effects of anxiolytic (anxiety-reducing) drugs appear to be produced through the central nucleus. The amygdala contains a high concentration of benzodiazepine receptors-especially the basolateral nucleus, which projects to the central nucleus-and the central nucleus itself contains a high concentration of opiate receptors. The infusion of either opiates or benzodiazepine tranquilizers into the amygdala decreases both the learning and the expression of conditioned emotional responses (Kapp et al., 1982; Davis, 1992a). In addition , Sanders and Shekhar found that an injection of a benzodiazepine antagonist into the basolateral nucleus blocked the anxiolytic effects of an intraperitoneal injection of chlorodiazepoxide(Librium). Thus, tranquilizers appear to exert their anxiolytic effect in the basolateral amygdala. Even after their amygdala is destroyed, benzodiazepines still have some anxiolytic effect.

Some investigators have suggested that anxiety disorders are caused by hyperactivity of the central nucleus of the amygdala, perhaps as a result of increased secretion of endogenous anxiety-producing ligands for the GABA receptor, of which the benzodiazepine receptor is a part. Whether the primary cause of the increased anxiety lies within these circuits or elsewhere in the brain (or in people’s environments and past histories) has yet to be determined.

The amygdala is involved in behaviors associated with another negative emotion-disgust. When an animal becomes nauseated as a result of eating tainted food the animal develops an aversion to the flavor of the last thing it ate or drank before the nausea. This form of learning is abolished by lesions of the basolateral amygdala.

Research with Humans

A considerable amount of evidence indicates that the amygdala is involved in emotional responses in humans. These studies found that stimulation of parts of the brain produced autonomic responses that are often associated with fear and anxiety but that only when the amygdala was stimulated did people also report that they actually felt afraid (White, 1940; Halgren et al., 1978; Gloor et al., 1982).

Lesions of the amygdala decrease people's emotional responses. People with lesions of the amygdala showed impaired acquisition of a conditioned emotional response, just as rats do. Startle response of a man with a localized lesion of the right amygdala was not increased by the presence of an unpleasant emotion.

Damage to the amygdala interferes with the effects of emotions on memory. Normally, when people encounter events that produce a strong emotional response, they are more likely to remember these events. A patient with amygdala damage showed no such increase in memory.

Several imaging studies have shown that the human amygdala participates in emotional responses. The activity of the right amygdala increased while the subjects recalled the neutral ones. When well motivated people work on such tasks, they tend to become tense and unhappy and usually report feelings of frustration. A PET scanner showed that the blood flow in the amygdala increased while the subjects were working on the unsolvable anagrams but now when working on the solvable ones.

Social Judgments and Emotions: Role of the Orbito-frontal Cortex

The analysis of social situations involves much more than sensory analysis; it involves experiences and memories, inferences and judgments. But one region of the brain-the orbitofrontal cortex-plays a special role.

The **orbito-frontal cortex** is located at the base of the frontal lobes. It covers the part of the brain just above the orbits-the bones that form the eye sockets-hence the term *orbitofrontal*. The orbitofrontal cortex receives direct inputs from the dorsomedial thalamus, temporal cortex, ventral tegmental area,

olfactory system, and amygdala. Its outputs go to several brain regions, including the Cingulate cortex, hippocampal formation, temporal cortex, lateral hypothalamus, and amygdala. Finally, it communicates with other regions of the frontal cortex. Thus, its inputs provide it with information about what is happening in the environment and what plans are being made by the rest of the frontal lobes, and its outputs permit it to affect a variety of behaviors and physiological responses, including emotional responses organized by the amygdala.

The fact that the orbitofrontal cortex plays an important role in emotional behavior is shown by the effects of damage to this region. Before Phineas Gage's injury he was serious, industrious, and energetic. Afterward, he became childish, irresponsible, and thoughtless of others. He was unable to make or carry out plans, and his actions appeared to be capricious and whimsical. His accident largely destroyed the orbitofrontal cortex (Damasio et al., 1994).

In general, damage to the orbitofrontal cortex reduced people's inhibitions and self-concern; they became indifferent to the consequences or their actions. In addition, although they remained sensitive to noxious stimuli, the pain no longer bothered them-it no longer produced an emotional reaction.

Radical removal of the frontal loves in a human patient (performed because of a tumor) did not appear to produce intellectual impairment-thus, people could presumably get along without their frontal lobes. These two reports suggested to Moniz that "if frontal-love removal…eliminates frustrational behavior, why would it not be feasible to relieve anxiety states in man by surgical means?" in fact, Moniz persuaded a neurosurgeon to do so, and approximately one hundred operations were eventually performed under his supervision. (In 1949 Moniz received the Nobel Prize for the development of this procedure.)

Since that time, tens of thousands of people have received prefrontal lobotomies, primarily to reduce symptoms of emotional distress, and many of these people are still alive. Although patients did perform well on standard tests of intellectual ability, they showed serious changes in personality, becoming irresponsible and childish. They also lost the ability to carry out plans, and most were unemployable. And although pathological emotional reactions were eliminated, so were normal ones. Because of these findings, and because of the discovery of drugs and therapeutic methods that relieve the patient's symptoms without producing such drastic side effects, neurosurgeons

eventually abandoned the prefrontal lobotomy procedure (Valenstein, 1986).

A *trans-orbital leucotome*, shaped like an ice pick, was introduced into the brain by passing it beneath the upper eyelid until the point reached the orbital bone above the eye. The instrument was hit with a mallet, driving it through the bone into the brain. The end was then swept back and forth so that it cut through the white matter.

The fact that it was so easy and left no external signs other than a pair of black eyes may have tempted its practitioners to perform it too casually.

But the fact remains that the surgery did reduce people's emotional suffering, or it would never have become so popular. Primarily, the surgery reduced anxiety, observations, and compulsions. People's groundless fears disappeared, and they no longer felt compelled to perform rituals to ward off some (imaginary) disastrous events.

Some procedures approached the frontal lobes from the base of the brain, primarily cumin their connections with the diencephalon and temporal lobes. Other procedure approached the frontal lobes form above and disconnected the orbitofrontal cortex from the Cingulate gyrus. In either case the patients' emotional distress was usually reduced.

What, exactly, does the orbitofrontal cortex do? One possibility is that it is involved in assessing the personal consequences of what is currently happening. People whose orbitofrontal cortex has been damaged by disease or accident are still able to accurately assess the significance of particular situations, but only in a *theoretical* sense. For example, Eslinger became unable to distinguish between trivial decisions and important ones, spending hours trying to decide where to have dinner but failing to use good judgment in situations that concerned his occupation and family life. Thus, it appears that the orbitofrontal cortex is not directly involved in making judgments and conclusion about events but has a role in translating these judgments not appropriate feelings and behaviors.

SUMMARY

The word *emotion* refers to behaviors, physiological responses, and feelings. This section has discussed emotional response patterns, which consist of behaviors that deal with particular situations and physiological responses (both autonomic and hormonal) that support the behaviors. The amygdala organizes behavioral, autonomic, and hormonal responses to a variety of situations, including those that produce fear, anger, or disgust. In addition, it is involved in the effects of odors and pheromones on sexual and maternal behavior. It receives inputs from the olfactory system, the association cortex of the temporal lobe, the frontal cortex, and the rest of the limbic system. Its outputs go to the frontal cortex, hypothalamus, hippocampal formation, and brain stem nuclei that control autonomic functions and some species-typical behaviors. Damage to specific brain regions that receive these outputs will abolish particular components of emotional response patterns. Electrical recordings of single neurons in the amygdala indicate that some of them respond when the animal perceives particular stimuli with emotional significance. Stimulation of the amygdala leads to emotional responses, and it destruction disrupts them. Receptors in the amygdala are largely responsible for the anxiolytic effects of the benzodiaaepine tranquilizers and the opiates. Studies of people with amygdala lesions and PET and functional MRI studies with humans indicate that the amygdala is involved in emotional reactions in our species, too.

The orbitofrontal cortex plays an important role in emotional reactions. People with orbitofrontal lesions are able to explain the implications of complex social situations but are unable to respond appropriately when these situations concern *them*. Thus, this region does not appear to be necessary for making judgments about the personal significance of social situations, but it does appear to be necessary for transpersonal significance of social situations, but it does appear to be necessary for translating these judgments into actions and emotional responses. The orbitofrontal cortex, receives information from other regions of the frontal lobes, from the temporal pole, and form the amygdala and other parts of the limbic system via the medio-dorsal nucleus of the thalamus. It produces emotional reactions through its connections with the amygdala and the cingulate gyrus.

Between the late 1930’s and the late 1950’s many

people received prefrontal lobotomies, which involved cutting the white matter in the ventromedial frontal lobes. Although the operations affected many parts of the frontal lobes the most

important region was probably the orbitofrontal cortex. The surgery did often relieve emotional anguish and the suffering caused by pain, but it also mad people become largely indifferent to the social consequences of their own behavior and to the feelings of others, and it interfered with their ability to make and execute plans. Prefrontal lobotomies are not longer performed.

EXPRESSION AND ROCOGNITION OF EMOTIONS

Facial Expression of Emotions: Innate Responses

Charles Darwin (1872/1965) suggested that human expressions of emotion have evolved form similar expressions in other animals. He said that emotional expressions are innate, unlearned responses consisting of a complex set of movements, principally of the facial muscles. Thus, a human's sneer and a wolf's snarl are biologically determined response patterns, both controlled by innate brain mechanisms, just as coughing and sneezing are.

No matter how isolated people are, they show the same facial expressions of emotion, then these expressions must be inherited instead of learned.

Because the same facial expressions were used by people who had not previously been exposed to each other, Ekman and Friesen concluded that the expressions were unlearned behavior patterns. In contrast, different cultures use different words to express particular concepts; production of these words dos not involve innate responses but must be learned.

Thus, both the cross-cultural studies and the investigations with blind children confirm the naturalness of these expressions. Researchers have not yet determined whether other means of communicating emotions, such as tone of voice or changes in body posture, are learned or are at least partly innate.

Neural Basis of the Communication of Emotions: Recognition

- Effective communication is a two-way process. That is, the ability to display one's emotional state by changes in expression is useful only if other people are able to recognize them. They found that happy situations (such as making a strike while bowling, seeing the home team score, or experiencing a beautiful day) produced only small signs of happiness when the people were alone. However, when the people were interacting socially with other people, they were much more likely to smile.
- We recognize other people's feelings by means of vision and audition-seeing their facial expressions and hearing their tone of voice and choice of words. Many studies have found that the right hemisphere plays a more important role than the left hemisphere in comprehension of emotion. For example, many investigators have found a left-ear and a left-visual-field advantage in recognition of emotionally related stimuli.
- In studies of hemispherical differences in visual recognition, stimuli are usually presented to the left or right visual field so rapidly that the subject does not have time to move his or her eyes. Many studies have shown that the left hemisphere is better than the right at recognizing words or letter strings but that the right hemisphere is better at detecting differences in facial expressions of emotion. These results suggest that when a message is heard, the right hemisphere assesses the emotional expression of the voice while the left hemisphere assesses the meaning of the words.
- Patients with right hemisphere damage had difficulty producing or describing mental images of facial expressions of emotions.
- Subjects' regional cerebral blood flow with the PET scanner while they listed to some sentences and identified their emotional content. The investigators found that comprehension of emotion from word meaning increased the activity of both frontal lobes, the left more than the right.
- Observations of people with brain damage are consistent with the studies with normal subjects. Patients with right hemisphere damage judged the emotion being expressed less accurately.
- Damage to the visual association cortex can cause *prosopagnosia*- inability to recognize particular faces. Just as recognition of the meaning of words and the emotion expressed by tone of voice are accomplished by different brain functions, so are recognition of particular faces and facial expressions of emotions.

- The amygdala plays a special role in emotional responses. It may play a role in emotional recognition as well. Several studies have found that lesions of the amygdala (the result of degenerative diseases or surgery for sever seizure disorders) impairs people's ability to recognize facial expressions of emotion- especially expressions of fear report the case of a woman with bilateral amygdala lesions who had normal hearing but had difficulty recognizing emotions-particularly fear and anger- expressed in a person's tone of voice.

Neural Basis of the Communication of Emotions: Expression

- That genuinely happy smiles, in contrast to false smiles or smiles people make when they greet someone else, involve contraction of a muscle near the eyes, the lateral part of the orbicularis oculi-now sometimes referred to as Duchenne's muscle.
- **Volitional facial paresis**, is caused by damage to the face region of the primary motor cortex or to the fibers connecting this region with the motor nucleus of the facial nerve. The interesting thing about volitional facial paresis is that the patient cannot voluntarily move the facial muscles but will express a genuine emotion with those muscles.
- In contrast, **emotional facial paresis** is caused by damage to the insular region of the prefrontal cortex, to the white matter of the frontal lobe, or to parts of the thalamus.
- **Volitional facial paresis.** Difficulty in moving the facial muscles voluntarily; caused by damage to the face region of the primary motor cortex or its subcortical connections.
- **Emotional facial paresis.** Lack of movement of facial muscles in response to emotions in people who have no difficulty moving these muscles voluntarily; caused by damage to the insular prefrontal cortex, subcortical while matter of the frontal lobe, or parts of the thalamus.
- People with this disorder can move their face muscles voluntarily but do not express emotions on the affected side of the face. These two syndromes clearly indicate that different brain mechanisms are responsible for voluntary movements of the facial muscles and automatic, involuntary expression of emotions involving the same muscles.

- The right hemisphere plays a more significant role in recognizing emotions in the voice or facial expressions of other people- especially negative emotions. They found that the left halves were more expressive than the right ones. Because motor control is contralateral, the results suggest that the right hemisphere is more expressive than the left.
- The left side of their faces appeared to make stronger expressions of emotions. They confirmed these results in the laboratory by analyzing videotapes of people telling sad or humorous stories.
- Rhesus monkeys, like humans, express emotions more strongly in the left sides of their faces
- Left hemisphere lesions do not usually impair vocal expressions of emotion. For example, people with Wernicke's aphasia usually modulate their voice according to mood, even though the words they say make no sense. In contrast, right-hemisphere lesions do impair expression of emotion, both facially and by tone of voice.
- Interesting information about hemispherical specialization in the expression of emotion has been obtained during the Wada test. The **Wada test** (named after its developer) is performed before a person receives surgery for removal of a seizure focus. Ross, Homan, and Buck (1994) asked people who were about to be evaluated for seizure surgery about experiences they had had that caused an intense emotion. The subjects narrated their experiences and described their feelings at the time. Then, while the right hemisphere was anesthetized with a fast-acting barbiturate injected into the right carotid artery, the subjects were asked about these experiences again. This time, most of the subjects described less intense emotions. For example, one subject described an accident in which he had wrecked his car. Before the injection, he said, "I was scared, scared to death. I could have run off the road and killed myself or someone else….. I was really scared." During the right hemisphere anesthesia he said that after the accident he felt "silly…. silly." Another patient described an accident with a truck as the scariest situation he had ever experienced. While his right hemisphere was anesthetized, he said he was "sort of scared" but denied that the accident was the scariest event in his life. Another patient said he was very angry when he learned that his wife was having an affair and threw a phone across the room. During the anesthesia he said that he had become "a little angry" and "kind's tossed the phone."
- Colleagues suggest that the right hemisphere play a role in what the call *primary* emotions, most of which are negative.

The left hemisphere, they believe, is involved in modulating emotional displays controlled by the right hemisphere and organizing social displays of positive emotions, such as the quick smile we flash when we meet someone we know. Unfortunately, it is not possible to query people about their emotional responses while the left hemisphere is anesthetized, because the anesthesia of the speech mechanisms in the left hemisphere prevents them from speaking or understanding the speech of other people.

- **Wada test.** A test often performed before brain surgery; verifies the functions of one hemisphere by testing patients while the other hemisphere is anesthetized.

Summary

- We (and members of other species) communicate our emotions primarily through facial gestures. Darwin believed that such expressions of emotion were innate- that these muscular movements were inherited behavioral patterns. Ekman and his colleagues performed cross-cultural studies with members of an isolated tribe in New Guinea. Their results supported Darwin's hypothesis.
- Recognition of other people's emotional expressions involves the right hemisphere more than the left. Studies with normal people have shown that people can judge facial expressions or tone of voice better when the information is presented to the right hemisphere than when it is presented to the left hemisphere. PET scans made while people judge the emotions of voices show that such judgements activate the right hemisphere more than the left. Studies of people with left or right hemisphere brain damage corroborate these findings. In addition, they show that recognition of particular faces involves neural circuits different from those needed to recognize facial expressions of emotions. Finally, the amygdala plays a role in recognition in emotions; lesions of the amygdala disrupt this ability, and PET scans show increased activity of the amygdala while engaging in this task.
- Facial expressions of emotions (and other stereotypical behaviors such as laughing and crying) are almost impossible to stimulate. For example, only, a genuine smile of pleasure causes the contraction of the lateral part of the orbicularis oculi (Duchenne's muscle). Genuine

expressions of emotion are controlled by special neural circuits. The best evidence for this assertion comes from the complementary syndromes of emotional and volitional facial paresis. People with emotional facial paresis can move their facial muscles voluntarily but nut in response to an emotion, whereas people with volitional facial paresis show the opposite symptoms. In addition, the left halves of people's faces- and the faces of monkeys- tend to be more expressive than the right halves. While the right hemisphere is anesthetized during the Wada test, the emotional feelings that accompany people's recollection of memories generally become less intense.

Feelings of Emotions

- So far, we have examined two aspects of emotions: the organization of patterns of responses that deal with the situation that provokes the emotion, and the communication of emotional states with other members of the species. The final aspect of emotion to be examined, the subjective component: feelings of emotion.

The James-Lange Theory

- William James (1842-1910), an American psychologist, and Carl Lange (1834-1900), a Danish psychologist, independently suggested similar explanations for emotion, which most people refer to collectively as the **James-Lange Theory**. Basically, the theory states that emotion-producing situations elicit an appropriate set of physiological responses, such as trembling, sweating, and increased heart rate. The situations also elicit behaviors, such as clenching of the fists or fighting. The brain receives sensory feedback from the muscles and from the organs that produce these responses; it is this feedback that constitutes our feeling of emotion.

- **James-Lange theory.** A theory of emotion that suggests that behaviors and physiological responses are directly elicited by situations and that feelings of emotions are produced by feedback from these behaviors and responses.
- James says that our own emotional feelings are based on what we find ourselves doing and on the sensory feedback we receive from the activity of our muscles and internal organs. Thus, when we find ourselves trembling and fell queasy, we experience fear.
- James's description of the process of emotion might strike you as being at odds with your own experience. Many people think that they experience emotions directly, internally. Or did you ever find tears coming to your eyes while watching a film that you did not think was affecting you?
- A well-known physiologist, Walter Cannon, criticized James's theory. He said that the internal organs were relatively insensitive and that they could not respond very quickly, so feedback form them could not account for our feelings of emotions. He observed that cutting the nerves that provide feedback from the internal organs to the brain did not alter emotional behavior.

- Cannon cited the fact that cutting the sensory nerves between the internal organs and the central nervous system does not abolish emotional behavior in laboratory animals. However, this observation misses the point.
- James's theory is difficult to verify experimentally because it attempts to explain *feelings* of emotion. Some anecdotal evidence supports the theory. The man-a music lover-reported that the shivering sensation he felt while listening to music now occurred only on the unoperated side of his body. He still enjoyed listening to music, but the surgery altered his emotional reaction.
- In one of the few tests of James's theory, Hohman (1966) collected data from people with spinal cord damage. He asked people about the intensity of their emotional feelings. If feedback is important, one would expect that emotional feelings would be less intense if the injury were high (that is, close to the brain) than if it were low, because a high spinal cord injury would make the person become insensitive to a larger part of the body.

Summary

- From the earliest times, people recognized that emotions were accompanied by feelings that seemed to come from inside the body, which probably provided the impetus for developing physiological theories of emotion. James and Lange suggested that emotions were primarily responses to situations. Feedback from the physiological and behavioral reactions to emotion-producing situations gave rise to the feelings of emotion; thus, feeling are the *results,* not the *causes,* of emotional reactions. Hohman's study of people with spinal cord damage supported the James-Lange theory; people who could no longer feel the reactions from most of their body reported that they no longer experienced intense emotional states.

AGGRESSIVE BEHAVIOR

- Almost all species of animals engage in aggressive behaviors, which involve threatening gestures or actual attack directed toward another animal. Aggressive behaviors are species-typical; that is, the patterns of movements (for example, posturing, biting, striking, and hissing) are organized by neural circuits whose developmental is largely programmed by animal's genes. Many aggressive behaviors are related to reproduction. For example, aggressive behaviors that gain access to mates, defend territory needed to attract mates or to provide a site for building a nest, or defend offspring against intruders can all be regarded as reproductive behaviors. Other aggressive behaviors are related to self-defense, such as that of an animal threatened by a predator.
- Aggressive attacks can consist of actual attacks, or they may simply involve **threat behaviors**, which consist of postures or gestures that warn the adversary to leave or it will become the target of an attack. The threatened animal might show **defensive behaviors-**threat behaviors or an actual attack against the animal threatening it-or it might show **submissive behaviors-**behaviors that indicate that it accepts defeat and will not challenge the other animal. In the natural environment most animals display far more threats than actual attacks. Threat behaviors are useful in reinforcing social hierarchies in organized groups of

animals or in warning intruders away from an animal's territory. They have the advantage of not involving actual fighting, which can harm one or both of the combatants.

- **Predation** is the attack of a member of one species on that of another, usually because the latter serves as food for the former. While engaged in attacking a member of the same species or defending oneself against attack, an animal appears to be extremely aroused and excited, and the activity of the sympathetic branch of its autonomic nervous system is high. In contrast, the attack of a predator is much more "cold-blooded"; it is generally efficient and not accompanied by a high level of sympathetic activation.

Neural Control of Aggressive Behavior

- The neural control of aggressive behavior is hierarchical.
- Predation is not accompanied by a strong display of rage.
- Although a cat looks excited when it pounces on a rat and bites it, it does not show signs of "rage." The attack appears cold-blooded and ruthless.
- **Defensive behavior** A species-typical behavior by which an animal defends itself against the threat of another animal.
- **Threat behavior** A stereotypical species-typical behavior that warns another animal that it may be attacked if it does not flee or show a submissive behavior.
- **Submissive behavior** A stereotyped behavior shown by an animal in response to threat behavior by another animal; serves to prevent an attack.
- **Predation** Attack of one animal directed at an individual of another species on which the attacking animal normally preys.
- Panksepp observed a significant difference in rats' preference for receiving electrical brain stimulation that elicits predatory attack or defensive attack. If he turned on the stimulation that produced defensive attack but permitted the rats to press a lever to turn it off quickly learned to do so. Thus, brain stimulation that elicits defensive attack appears to be aversive. In contrast, rats quickly learned to press a lever that turned *on* stimulation that elicited predatory attack.
- Defensive behavior and Predation can be elicited by stimulation of different parts of the PAG and that the hypothalamus and the amygdala influence these behaviors through excitatory and inhibitory connections with the PAG. They found that the three principal regions of the amygdala

and two regions of the hypothalamus affect defensive rage and Predation, both of which appear to be organized by the PAG.

- Brain regions other than the amygdala, hypothalamus, and periaqueductal gray matter are involved in aggressive behavior. In general, increased activity of serotonergic synapses inhibits aggression. For this reason some clinicians have used serotonergic drugs to treat violent behavior in humans. Destruction of serotonergic axons in the forebrain facilitates aggressive attack, presumably by removing an inhibitory effect. (Vergnes et al., 1988).
- A group of researchers has studied the relation between serotonergic activity and aggressiveness in a free-ranging colony of rhesus monkeys. They assessed serotonergic activity by capturing the monkeys and removing a sample of cerebrospinal fluid and analyzing it for 5-HIAA, a metabolite of serotonin (5-HYT).
- The investigators found that young male monkeys with the lowest levels of 5-HIAA showed a pattern of risk-taking behavior, including high levels of aggression directed toward animals that were older and much larger than themselves. They were much more likely to take dangerous, unprovoked long leaps from tree to tree at a height of more than 7m (27.6ft.). they were also more likely to pick fights that they could not possibly win. Of 49 preadolescent male monkeys that the investigators followed for four years, 46 percent of those with the lowest 5-HIAA levels died, while all of the monkeys with the highest levels survived. Most of the monkeys were killed by other monkeys. In fact, the first monkey to be killed had the lowest level of 5-HIAA and was seen attacking two mature males the night before it death.
- It is clear that serotonin does no simply inhibit aggression; rather, it exerts a controlling influence on risky behavior, which includes aggression.
- The monkeys who received the serotonin agonist became dominant, while the status of those who received the antagonist declined.
- The monkeys with low levels of serotonergic activity showed the lowest levels of social competency.
- Several studies have found that serotonergic neurons play an inhibitory role in human aggression.
- A history of aggressiveness in psychological test scores indicating antisocial tendencies was related to low levels of CSF 5-HIAA in a group of naval recruits.

- They found that the men with the lowest serotonergic activity were more likely to have close relatives with a history of similar behavior problems.

Hormonal Control of Aggressive Behavior

- Many instances of aggressive behavior are in some way related to reproduction. For example, males of some species establish territories that attract females during the breeding season. To do so, they must defend them against the intrusion of other males. Even in species in which breeding does not depend on the establishment of a territory, males may compete for access to females, which also involves aggressive behavior. Females, too, often compete with other females for space in which to build nests or dens in which to rear their offspring.
- Many forms of aggressive behavior are, like mating, affected by hormones.

Aggression in Males

- Adult males of many species fight for territory or access to females. In laboratory rodents, androgen secretion occurs prenatally, decrease, and then increases again at the time of puberty. Inter-male aggressiveness also begins around the time of puberty, which suggests that the behavior is controlled by neural circuits that are stimulated by androgens. Indeed, many years ago, Beeman (1947) found that castration reduced aggressiveness and that injections of testosterone reinstated it.
- The secretion of androgens early in development modifies the developing brain, making neural circuits that control male sexual behavior become more responsive to testosterone. Similarly, early andro-genization has an organizational effect that stimulates the development of testosterone-sensitive neural circuits that facilitate Inter-male aggression.

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Physiological reactivity is the body’s response to a stressor. There are several different indicators of physiological reactivity such as changes from baseline in heart rate, heart

rate variability, systolic blood pressure, diastolic blood pressure, body temperature, and salivary cortisol levels (Hastings, Zahn-Waxler & Usher, 2007). The purpose of this paper is to examine whether or not physiological reactivity influences violent behavior. While physiological reactivity does coincide with aggression, it would be inappropriate to attribute it merely to reactivity because they naturally coexist. "Experiencing affective arousal within situations contributes to the assignment of meaning or relevance to the situation, primes the body for action and promotes behavioral reaction patterns that are effectively tailored to deal with the specific situation one is encountering" (Hastings, et al., 2007). Evolution has preserved certain physiological and behavioral patterns because they enable human beings to adapt in certain social and environmental situations. One example is the "fight or flight" response, which is a state of physiological reactivity that prepares an individual for possible aggressive behavior, or conversely, to direct the body's resources more appropriately to flee the stressor. An individual acting aggressively experiences some type of physiological reactivity, yet so does an individual trying to avoid violence (Rhodes, Harrison & Demaree, 2002). Some studies indicate that previous violent exposure experienced by an individual can influence basic physiological processes that may in turn influence emotions, behavior, and affect (Scarpa, Fikretoglu, & Luscher, 2000). Moreover, "emotional dysregulation has been suggested as an important cause of a wide range of problematic or disordered behavior patterns, including inhibition, social withdrawal and anxiety, and aggression and disruptiveness… Other disciplines also have recognized the contributions of emotion dysregulation to potentially maladaptive behaviors, such as the links drawn by health psychologists between highly assertive and competitive individuals and the experience of reactive hostility when challenged" (Hastings, et al., 2007).

Aggressive behavior can be correlated to not only increased physiological reactivity, but also decreased physiological reactivity depending on differing conditions such as emotions, personality traits or disorders, or previous exposure to violence. Male adolescents with oppositional defiant disorder (ODD), for instance, were found to have lower heart rates than male adolescents without psychopathology during and following competitive tasks. "Deficient somatic and emotional cues may facilitate an individual's ability to engage in dangerous and harmful acts, because they do not receive the normal signals that would indicate they should curtail such actions" (Hastings,

et al., 2007). An aggressive attitude can propagate violence in the presence of such reckless mindsets.

Interestingly, elevated arousal tends to have similar outcomes in certain individuals, as does underarousal in others. “The psychophysiological reactivity model links hostility to cardiovascular disease. According to this model, hostile persons are more likely to be vigilant for possible conflicts in their environment, and are more likely to respond in a physiologically exaggerated style to these stressors. Cardiovascular disease is thought to appear early in these individuals, as they ‘burn out’ from their chronic and exaggerated response style. Individuals rated high in hostility were found to be more physiologically reactive (e.g. blood pressure, heart rate, skin temperature, etc)” (Rhodes, et al., 2002). These contradictory findings among aggressive individuals can be explained by the “multidimensional nature of hostility.” According to this theory hostility is rooted in many different aspects of an individual’s physiology and personality; it cannot be universally explained by a single finding, hence the contradictory testing results (Rhodes, et al., 2002).

What do these findings suggest about physiological activity causing violent behavior? Physiological reactivity can act as a cue to the body to act, and in turn the individual’s behavioral patterns determine whether or not an aggressive or hostile response is appropriate. It is unclear how much physiological reactivity influences behavior as opposed to activating already held behavioral patterns. For susceptible individuals these issues can be addressed by “rechanneling risky behavior, cognitive restructuring of how situations are perceived, and practice of more-effective coping skills” (Scarpa, et al., 2000). If an individual can recognize a situation as one that may escalate to hostility and violence, then they can also work to avoid those situations with the understanding that it would be socially unacceptable to act out in a violent manner.

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