Chapter 10

Nervous System and Mental Health
## Related Combining Forms

<table>
<thead>
<tr>
<th>Structure</th>
<th>Related Combining Forms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brain</td>
<td>cerebr/o, encephal/o</td>
</tr>
<tr>
<td>Spinal cord</td>
<td>myel/o</td>
</tr>
<tr>
<td>Nerves</td>
<td>neur/i, neur/o</td>
</tr>
</tbody>
</table>
Functions of Nervous System

- Coordinates and controls all activities of the body
Structures of Nervous System

- Nerves
- Brain
- Spinal cord
- Sensory organs
  - Eyes, ears, nose, skin, tongue
Divisions of Nervous System

• Two primary parts
  – Central nervous system (CNS)
    • Includes brain and spinal cord
    • Receives and processes information
    • Regulates all activities of the body
  – Peripheral nervous system (PNS)
    • 12 pairs of cranial nerves
    • 31 pairs of spinal nerves
    • Transmits signals to and from CNS
Nerves

- **Nerve**
  - One or more bundles of neurons connecting brain and spinal cord with other parts of the body

- **Tract**
  - Bundle of nerve fibers located within the brain or spinal cord
Nerves

- **Ganglion**
  - Cluster of nerve cell bodies outside the CNS
- **Innervation**
  - Supply of nerves to specific body part
- **Plexus**
  - Network of intersecting spinal nerves
Nerves

• Receptors
  – Sites in sensory organs receiving external stimulation
  – Sensory neurons send stimulus to the brain for interpretation

• Stimulus
  – Anything that activates a nerve and causes an impulse
Reflexes

• Automatic, involuntary response to some change, either inside or outside the body
• Examples
  – Changes in heart rate, respiratory rate, and blood pressure
  – Responses to painful stimuli
Neurons

• Basic cells of nervous system
• Allow different parts of the body to communicate with each other
• Parts
  – Dendrites
    • Carry impulses toward the cell body
  – Axon
    • Carries impulses away from the cell body
Neurons

• Terminal end fibers
  – Branching fibers at the end of an axon that lead a nerve impulse from the axon to the synapse

• Synapse
  – Space between two neurons or between a neuron and a receptor organ
Neurotransmitters

- Chemical substances allowing messages to cross from synapse of a neuron to a target receptor
- Examples
  - Acetylcholine, dopamine, endorphins, norepinephrine
Glial Cells

• Four main functions
  – Surround neurons and hold them in place
  – Supply nutrients/oxygen to neurons
  – Insulate one neuron from another
  – Destroy and remove dead neurons
Myelin Sheath

- Protective covering made of glial cells
- Myelinated nerve fibers = white matter
  - (myelinated: having a myelin sheath)
- Unmyelinated nerve fibers = gray matter
  - (unmyelinated: lacking a myelin sheath)
Central Nervous System

- Brain and spinal cord
- Protected externally by bones of cranium and vertebrae of spinal column
Meninges

• Enclose brain and spinal cord
  – Three layers
    • Dura mater: outermost membrane
    • Arachnoid membrane: second layer; resembles spider web
    • Pia mater: inner layer; nearest to brain/spinal cord
Cerebrospinal Fluid

- Produced within the four ventricles in the middle region of cerebrum
- Clear, colorless, watery fluid
- Cools and cushions brain and spinal cord
- Nourishes brain and spinal cord by transporting nutrients/chemical messengers to these tissues
Parts of Brain

- Hypothalamus
- Thalamus
- Parietal lobe
- Occipital lobe
- Ventricles
- Frontal lobe
- Corpus callosum
- Temporal lobe
- Pituitary gland
- Midbrain
- Pons
- Medulla
- Cerebellum
- Spinal cord

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Parts of Brain

- Right cerebral hemisphere
- Left cerebral hemisphere
- Cerebellum
- Brainstem
- Spinal cord
• Largest and uppermost portion of brain
• Responsible for thought, judgment, memory, emotion, integration of motor and sensory functions

• Cerebral cortex (cerebr: brain; -al: pertaining to)
  – Outer layer of cerebrum; made of gray matter
  – Gyri: folds of gray matter in cerebral cortex
  – Sulci: fissures of cerebral cortex
Cerebral Hemispheres

- Two hemispheres
  - Left
    - Controls majority of functions on right side of the body
  - Right
    - Controls most of functions on left side of the body
- Connected at lowest midpoint by corpus callosum
Cerebral Lobes

- Divisions of cerebral hemispheres
- Frontal lobe
  - Controls skilled motor functions, memory, behavior
- Parietal lobe
  - Receives/interprets nerve impulses from sensory receptors in tongue, skin, and muscles
Cerebral Lobes

• Occipital lobe
  – Controls eyesight
• Temporal lobe
  – Controls senses of hearing and smell
  – Controls ability to create, store, and access a new information
Thalamus

- Located below the cerebrum
- Relays impulses to and from cerebrum and the sense organs
Hypothalamus

- Located below the thalamus
- Regulates
  - Autonomic nervous system
  - Emotional responses
  - Body temperature
  - Food intake and water balance
  - Sleep-wakefulness cycle
  - Pituitary gland/endocrine system activity
Cerebellum

• Second-largest part of the brain
• Located at the back of the head below the posterior portion of cerebrum
• Receives messages regarding movement within joints, muscle tone, and positions
• Produces coordinated movements, maintains equilibrium, sustains normal postures
Brainstem

- Stalk-like portion of brain that connects cerebral hemispheres with spinal cord
- Three parts
  - Midbrain
  - Pons
  - Medulla oblongata
Spinal Cord

- Tube-like structure that begins at the end of the brainstem and continues down to almost the bottom of the spinal cord
- Surrounded by cerebrospinal fluid and meninges
- Pathway for impulses to and from the brain
Peripheral Nervous System

- 12 pairs of cranial nerves extending from the brain
- 31 pairs of spinal nerves extending from the spinal cord
- Three specialized peripheral nerves
  - Autonomic nerve fibers
  - Sensory nerve fibers
  - Somatic nerve fibers
Cranial Nerves

- Originate from under surface of the brain
- Identified as Roman numerals
- Named for area or function
- Nerves of a pair are identical in function and structure
- Each nerve of a pair serves half of the body
Peripheral Spinal Nerves

- Named based on the region they innervate
- Referred to by numbers
  - Cervical (C1–C8)
  - Thoracic (T1–T12)
  - Lumbar (L1–L5)
  - Sacral (S1–S5)
Autonomic Nervous System

- Controls involuntary actions of the body
- Two divisions
  - Sympathetic nerves
    - Fight-or-flight (response to emergencies)
    - Increases respiratory rate, heart rate, blood flow
  - Parasympathetic nervous system
    - Returns body to normal after a response to stress
    - Maintains body functions when no emotional or physical stress occurs
Anesthesiologist
- (an-: without; esthesi: feeling; -ologist: specialist)
- Specializes in administering anesthetic agents before/during surgery

Anesthetist
- (esthet: feeling; -ist: specialist)
- Medical professional (not a physician) specializing in administering anesthesia
Medical Specialties Related to Nervous System

• Neurologist
  – (neur: nerve)
  – Specializes in diagnosing/treating diseases/disorders of nervous system

• Neurosurgeon
  – Specializes in surgery of nervous system
Medical Specialties Related to Nervous System

• Psychiatrist
  – (psych: mind)
  – Specializes in diagnosing/treating chemical dependencies, emotional problems, mental illness

• Psychologist
  – Specializes in evaluating/treating emotional problems and mental illness
  – Doctoral degree, but is not a medical doctor
Pathology of the Nervous System

• Head and Meninges
  – Cephalgia
    • Headache
      – (cephal: head; -algia: pain)
  – Migraine headache
    • Often accompanied by nausea, vomiting, and sensitivity to light; warning aura may be perceived
  – Cluster headaches
    • Repeatedly affect one side of the head
Conditions of Head and Meninges

• **Encephalocele** (encephala/o: brain; -cele: hernia)
  – Congenital herniation of brain tissue through gap in the skull

• **Meningocele** (mening/o: meninges)
  – Congenital herniation of meninges through defect in skull or spinal column

• **Hydrocephalus** (hydr/o: water; cephal: head)
  – Excess cerebrospinal fluid accumulates in the ventricles of the brain
Conditions of Head and Meninges

• **Meningioma** (mening/i: meninges; -oma: tumor)
  – Slow-growing, usually benign tumor of meninges

• **Meningitis** (mening: meninges; -itis: inflammation)
  – Inflammation of meninges of the brain and the spinal cord
  – May be bacterial or viral
Disorders of Brain

- **Dementia**
  - Progressive decline in mental abilities, often accompanied by personality changes

- **Vascular dementia**
  - Due to stroke or other restriction of blood flow to the brain

- **Encephalitis** (encephal: brain)
  - Inflammation of the brain
Disorders of Brain

- **Reye's syndrome**
  - May follow viral illness treated with aspirin
- **Tetanus**
  - Potentially fatal infection of CNS caused by toxin produced by tetanus bacteria
- **Tourette syndrome**
  - Neurological disorder characterized by involuntary movements and sounds
Neurodegenerative Diseases

- Alzheimer's disease
  - Progressive deterioration that affects memory and reasoning capabilities
- Parkinson's disease
  - Degenerative disorder leading to progressive loss of the control of movements
  - Due to inadequate level of dopamine
Neurodegenerative Diseases

• Amyotrophic lateral sclerosis
  – Rapidly progressive disease attacking nerve cells responsible for controlling voluntary muscles
Brain Injuries

- Amnesia
  - Total or partial inability to recall past experiences
- Concussion
  - (concuss: shaken together; -ion: condition or state of)
  - Violent shaking or jarring of the brain, which may result in temporary loss of awareness
Brain Injuries

- Cerebral contusion
  - Bruising of brain tissue due to brain bouncing against rigid bone of the skull
    - (contus: bruise; -ion: condition)

- Cranial hematoma
  - Collection of blood trapped in the tissues of the brain
    - (hemat: blood; -oma: tumor)
Traumatic Brain Injury

- Damage to the brain ranging from mild to severe
- Example
  - Shaken baby syndrome
  - Results from child being violently shaken
  - May result in brain injury, blindness, fractures, seizures, paralysis, and death
Levels of Consciousness

- Conscious
  - Awake, alert, aware, responding appropriately
- Unconscious
  - Unaware and unable to respond to stimuli
- Lethargy
  - Lowered level of consciousness marked by listlessness, drowsiness, and apathy
Levels of Consciousness

• **Stupor**
  – Unresponsive; arouses only briefly despite repeated attempts

• **Syncope**
  – Brief loss of consciousness due to decreased blood flow to the brain; fainting
Levels of Consciousness

- Coma
  - Deep state of unconsciousness; no spontaneous eye movements or response to painful stimuli or speech
- Persistent vegetative state
  - Alternating sleep/wake cycles, but person remains unconscious
Delirium

- Acute confusion, disorientation, disordered thinking/memory, agitation, and hallucinations
Brain Tumors

• Malignant brain tumor
  – Destroys brain tissue
  – May be primary or secondary
• Benign brain tumor
  – Does not invade brain tissue, but pressure may damage tissue
• Intracranial pressure (intra-: within; crani: cranium; -al: pertaining to)
  – Amount of pressure inside the skull
Strokes

- Cerebrovascular accident
- Damage to the brain due to disrupted blood flow
- FAST
  - Facial droop (one side of face droops)
  - Arm drift (arm drifts down when extended)
  - Speech abnormality (slurred speech)
  - Time (early emergency treatment)
Ischemic Stroke

- Due to blockage of the carotid artery
- Transient ischemic attack
  - Temporary interruption in blood flow to the brain
- Asphasia
  - (a-: without; -phasia: speech)
  - Loss of ability to speak, write, or comprehend written/spoken word
  - Often results from a stroke
Hemorrhagic Stroke

- Occurs due to leakage of blood vessel in the brain
- Arteriovenous malformation
  - (arteri/o: artery; ven: vein; -ous: pertaining to)
  - May cause hemorrhagic stroke
  - Abnormal connections between arteries and veins in the brain
Sleep Disorders

- Insomnia
  - (in-: without; somn: sleep; -ia: abnormal condition)
  - Prolonged or abnormal inability to sleep

- Narcolepsy
  - (narc/o: stupor; -lepsy: seizure)
  - Sudden uncontrollable brief episodes of falling asleep during the day
Sleep Disorders

• Sleep deprivation
  – Lack of restorative sleep resulting in physical or psychiatric symptoms; affects routine performance
• Somnambulism
  – Sleep walking
    • (somn: sleep; ambul: walk; -ism: condition of)
Spinal Cord

- Myelitis
  - Inflammation of the spinal cord
    - (myel: spinal cord or bone marrow)
- Myelosis
  - Tumor of the spinal cord
Spinal Cord

- Poliomyelitis
  - Contagious viral infection of brainstem and spinal cord
  - May lead to paralysis
    - (poli/o: gray matter; myel: spinal cord)
Pinched Nerves

- Radiculitis
  - Inflammation of the root of the spinal nerve causing pain and numbness radiating down the affected limb
    - (radicul: root or nerve root)
  - Named for the area affected
    - Cervical radiculopathy
    - Lumbar radiculopathy
Multiple Sclerosis

- Progressive autoimmune disorder
- Demyelination of myelin sheath due to inflammation that scars brain, spinal cord, optic nerves
- Scarring disrupts transmission of nerve impulses
Nerves

- Bell's palsy
  - Temporary paralysis of 17th cranial nerve
- Guillain–Barré syndrome
  - Inflammation of myelin sheath of the peripheral nerves
  - Muscle weakness leads to temporary paralysis
  - May occur after viral infection
• **Neuritis** *(neur: nerve)*
  – Inflammation of nerve accompanied by pain and/or loss of function

• **Sciatica**
  – Inflammation of sciatic nerve resulting in pain, burning, tingling along the course of nerve

• **Trigeminal neuralgia**
  – Pain due to inflammation of the fifth cranial nerve
Cerebral Palsy

• Poor muscle control, spasticity, speech defects due to damage of the cerebrum
• Occurs most frequently in premature or low-birth-weight infants
• Usually caused by injury during pregnancy, birth, or soon after birth
Epilepsy and Seizures

• Chronic neurological condition characterized by seizures of varying severity
• Seizure
  – Sudden surge of electrical activity in the brain affecting how person feels/acts for a short time
Epilepsy and Seizures

• Tonic–clonic seizure (grand mal seizure)
  – Involves entire body
  – Tonic phase: body becomes rigid
  – Clonic phase: uncontrolled jerking

• Absence seizure (petit mal seizure)
  – Brief disturbance in the brain leading to the loss of awareness
Abnormal Sensations

- **Causalgia**
  - Persistent, severe burning pain following injury to the sensory nerve
    - (caus: burning; -algia: pain)
- **Hyperesthesia**
  - (hyper-: excessive; -esthesia: sensation or feeling)
    - Abnormal/excessive sensitivity to touch, pain or other sensory stimuli
Abnormal Sensations

• Paresthesia
  – Burning, prickling sensation in hands, arms, legs, or feet
    • (par-: abnormal; -esthesia: sensation or feeling)

• Peripheral neuropathy
  • (neur/o: nerve; -pathy: disease)
  – Disorder of peripheral nerves
  – Produces pain, loss of sensation, and inability to control muscles, particularly in arms/legs
Abnormal Sensations

• Restless legs syndrome
  – Uncomfortable feelings in legs, producing strong urge to move them
  – Usually most noticeable at night or when trying to rest
Diagnostic Procedures of Nervous System

- Magnetic resonance imaging and computed tomography
  - Facilitate examination of soft tissues of the brain and the spinal cord
- Functional MRI
  - Detects changes in blood flow in the brain when patient is asked to perform a specific task
Diagnostic Procedures of Nervous System

- **Carotid ultrasonography**
  - Ultrasound study of the carotid artery to detect plaque buildup or to diagnose a stroke
    - (ultra-: beyond; son/o: sound; -graphy: the process of producing a picture or record)
- **Echoencephalography**
  - Use of ultrasound imaging to create visual image of the brain for diagnostic purposes
    - (ech/o: sound; encephal/o: brain)
Diagnostic Procedures of Nervous System

• Electroencephalography
  – Recording electrical activity of the brain through the use of electrodes attached to the scalp
    • (electr/o: electric)

• Myelography
  – Radiographic study of the spinal cord
  – Requires contrast medium through lumbar puncture
    • (myel/o: spinal cord)
Diagnostic Procedures of Nervous System

- Electromyography
  - Uses electrodes taped to skin to measure transfer of electrical signals in peripheral nerves to muscles

- Lumbar puncture
  - Insertion of needle into subarachnoid space of lumbar region to withdraw specimen of cerebrospinal fluid
Treatment Procedures of Nervous System

- Sedative and hypnotic medications
  - Hypnotic
    - Depresses CNS; produces sleep
  - Anticonvulsant
    - Prevents seizures
  - Barbiturates
    - Class of drugs producing calming or depressed effect on CNS
Treatment Procedures of Nervous System

- Sedative
  - Depresses CNS to produce calm and diminished responsiveness
  - Does not induce sleep
Anesthesia

- Absence of normal sensation, especially sensitivity to pain
  - Anesthetic
    - (an-: without; esthet: feeling; -ic: pertaining to)
    - Induces anesthesia
    - May be topical, local, regional, or general
  - Epidural anesthesia
    - Regional anesthesia produced by injecting medication into the epidural space of lumbar or sacral region of the spine
• Spinal anesthesia
  – Regional anesthesia produced by injecting medication into the subarachnoid space
  – Provides numbness from toes to waist or lower chest
  – Patient remains conscious
Brain

- Deep brain stimulation
  - Neurosurgical procedure for the treatment of dystonia, tremors, and Parkinson's disease
- Gamma knife surgery
  - Radiation treatment for brain tumors
  - Uses gamma radiation to destroy diseased tissue
Brain

• Electroconvulsive therapy
  – Small amounts of electric current are passed through brain, triggering brief seizure in an attempt to reverse the symptoms of certain mental illnesses

• Lobectomy
  – Surgical removal of portion of the brain
  – Treats brain cancer or seizure disorders that are not controlled with medication
• Thalamotomy
  – Surgical incision into thalamus
    • (thalam: thalamus; -otomy: surgical incision)
• Transcranial magnetic stimulation
  – Brief powerful electromagnetic pulses to alter electrical pathways in the brain
Nerves

• Neuroplasty
  • (neur/o: nerve; -plasty: surgical repair)
    – Surgical repair of nerves
• Neurorrhaphy (-rrhaphy: surgical suturing)
  – Surgically suturing together ends of a severed nerve
• Neurotomy (-otomy: surgical incision)
  – Surgical division/dissection of nerve
Mental Health

• Disorders may include congenital abnormalities, physical changes, substance abuse, or medications
• Diagnostic and statistical manual of mental disorders (DSM)
  – Assists in diagnosing mental disorders
Anxiety Disorders

- Generalized anxiety disorder
  - Chronic, excessive worrying
- Panic disorder
  - Fear of panic attacks
- Panic attack
  - Sudden experience of fear even in the absence of danger
• Post traumatic stress disorder
  – Develops after event involving actual or threatened death or injury to individual or someone else during which the person felt fear, helplessness, or horrified
  • (post-: after; trauma: injury; -tic: pertaining to)
Phobias

- **Acrophobia**
  - Excessive fear of heights
    - (acr/o: top; -phobia: abnormal fear)

- **Agoraphobia**
  - Excessive fear of environments outside the home
    - (agor/a: marketplace)
Phobias

- Claustrophobia
  - Abnormal fear of small, enclosed spaces
    - (claustr/o: barrier)
- Social anxiety disorder
  - Excessive fear of social situations where person feels negative evaluation by others or fears embarrassing himself in front of others
Obsessive–Compulsive and Related Disorders

- Obsessive–compulsive disorder
  - Recurrent obsessions (repetitive, distressing thoughts) and/or compulsions (repeatedly feeling compelled to do things)

- Hoarding disorder
  - Over accumulation of belongings in a way that interferes with daily living
  - Can create unsafe/unsanitary living conditions
Nondevelopmental Disorders

- Attention deficit/hyperactivity disorder
  - Short attention span and impulsive behavior inappropriate for developmental age

- Dyslexia
  - Substandard reading achievement due to inability of the brain to process symbols
Nondevelopmental Disorders

- Learning disabilities
  - Children of normal intelligence having difficulty learning specific skills
- Intellectual disability
  - Significant below-average intellectual and adaptive functioning present from birth or early infancy
Nondevelopmental Disorders

- Autistic spectrum disorder
  - Child has difficulty of developing normal social relationships and communication skills
Dissociative Disorders

• Dissociative identity disorder
  – Presence of two or more distinct personalities, each with its own characteristics within the same individual
Disruptive and Impulse Control Disorders

- Failure to resist impulse despite potential negative consequences
- Kleptomania (-mania: madness)
  - Repeated stealing
- Pyromania
  - Repeated arson
- Oppositional defiant disorder
  - Disruptive behavior toward authority figures
Bipolar and Depressive Disorders

- Bipolar disorder
  - Cycles of severe mood changes shifting from highs to severe lows
- Manic behavior
  - Elevated mood with increased irritability, insomnia, poor judgment, and inappropriate social behavior
Bipolar and Depressive Disorders

- **Depression**
  - Lethargy and sadness with the loss of interest or pleasure in normal activities

- **Persistent depressive disorder**
  - Low-grade chronic depression present on the majority of days for two or more years

- **Seasonal affective disorder**
  - Depression associated with winter months
Eating Disorders

• Anorexia nervosa
  – Voluntary starvation and excessive exercising related to false perception of body appearance

• Bulimia nervosa
  – Frequent episodes of binge eating followed by self-induced vomiting, excessive exercising, misuse of laxatives
Personality Disorders

- Antisocial personality disorder
  - Disregard for the rights of others
- Borderline personality disorder
  - Impulsive actions, mood instability, and chaotic relationships
- Narcissistic personality disorder
  - Preoccupation with self and lack of empathy for others
Psychotic Disorders

- Catatonic behavior
  - Lack of responsiveness, stupor, and tendency to remain in a fixed posture
- Delusion
  - False personal belief
- Hallucination
  - Sensory perception experienced in the absence of external stimulation
Psychotic Disorders

• Schizophrenia
  – Withdrawal from reality, with illogical patterns of thinking, delusions, and hallucinations
  – May be accompanied by other emotional, behavioral, or intellectual disturbances
Somatic Symptom Disorders

- Physical complaints or concerns about one's body that are out of proportion to physical findings or disease
- Factitious disorder
  - Person acts as if he/she has physical or mental illness although not really sick
Somatic Symptom Disorders

- Conversion disorder
  - Temporary or ongoing changes in function triggered by psychological factors
- Malingering
  - Intentional creation of false or exaggerated physical or psychological symptoms motivated by incentive such as avoiding work
Substance Related Disorders

- Substance abuse
  - Addictive use of tobacco, alcohol, medications, or illegal drugs
- Alcoholism
  - Chronic alcohol dependence
- Delirium tremens
  - Sudden, severe mental changes or seizures caused by abrupt withdrawal of alcohol
Substance Related Disorders

• Drug abuse
  – Excessive use of illegal or recreational drugs, or misuse of prescription drugs

• Drug overdose
  – Accidental or intentional use of illegal drug or prescription medication in amount higher than the safe or normal
Gender Identity

- Gender dysphoria
  - Person identifies himself/herself opposite to his/her biological sex
Medications to Treat Mental Disorders

• Psychotropic drug
  – Acts primarily on CNS by producing temporary changes affecting mind, emotions, and behavior
    • (psych/o: mind; -tropic: having an affinity for)

• Antidepressant
  – Prevents or relieves depression
Medications to Treat Mental Disorders

- **Antipsychotic drug**
  - Treats symptoms of severe disorders of thinking and mood associated with neurological and psychiatric illness
    - (anti-: against; psych/o: mind; -tic: pertaining to)

- **Anxiolytic drug**
  - Temporarily relieves anxiety and reduces tension
    - (anxi/o: anxiety; -lytic: to destroy)
Medications to Treat Mental Disorders

• Mood-stabilizing drugs
  – Treat mood instability and bipolar disorders
• Stimulant
  – Increases activity in certain areas of brain to increase concentration and wakefulness
  – Overuse can cause sleeplessness and palpitations
Psychological Therapies to Treat Mental Disorders

• Psychoanalysis
  – Determination of mental disorders stemming from childhood; gaining insight into one's feelings/behavior

• Behavioral therapy
  – Focuses on changing behavior by identifying problem behaviors, and using reward if appropriate behaviors are performed
Psychological Therapies to Treat Mental Disorders

• Cognitive behavioral therapy
  – Focuses on changing thoughts that affect person's emotions and actions
  – Attempts to change problematic beliefs

• Hypnotherapy
  – Producing altered state of focused attention by use of hypnosis, making person to be more willing to believe and to act on suggestions