

California State University, Fresno
Department of Communicative Disorders and Deaf Studies

CDDS 172

Neural Bases of Speech, Language and Hearing

Course Description and Primary Learning Objectives

This is an undergraduate course regarding the neuroanatomical and neurophysiological bases of speech, language and hearing. During this course, the student will:

1. Demonstrate an understanding of the rationale behind learning neuroscience and the clinical and academic benefit that such training provides.
2. Explain the basic principles that govern the functioning of the human brain.
3. Define the technical terms used for directional reference, planes of brain cross-section, and body movements.
4. Demonstrate an understanding of the neuron and its importance as the basic functional unit in the CNS.
5. Describe the embryological development of the CNS and the critical periods of susceptibility to teratogenesis for the CNS and other related organ systems.
6. Differentiate and describe the central, peripheral and autonomic nervous systems.
7. Identify gross anatomical structures of the brain and the spinal cord, describe their locations, and explain their functions.
8. Describe the connecting fibers of the brain.
9. Describe the structures and systems responsible for the protection and the nourishment of the brain and spinal cord.
10. List the cranial nerves, their anatomical locations, and describe their major sensory and motor functions.
11. Describe the neuromotor control of speech production and associated motor speech tasks. Describe the cerebral control of speech, language and associated disorders of cortical functions.
12. Demonstrate a basic understanding of the various neurologically based speech, language and cognitive disorders.

Required Text:

Webb, W.G., & Adler, R. (2007). Neurology for the speech-language pathologist (5th edition). Boston: Butterworth-Heinemann (ISBN: 0750675268)

Roberts, S.D. (2008) Course book – CDDS 172 Neural Bases of Speech, Language and Hearing, Fresno: Master Copy Center.

Recommended (Optional) Text:

Bhatnager, S.C., (2007). Neuroscience for the study of communicative disorders (3rd edition). Baltimore, MD: Lippincott Williams and Wilkins (ISBN: 9780781789905)

Test and Grading

There will be three 100-point examinations in this class - two regular examinations and one final examination. The tentative dates for these examinations are the following:

Exam #1 – _____

Exam #2 – _____

Final Exam – _____

The examinations will be objective in nature, and consist of short answer, multiple choice, and matching. The final course grade will be derived by adding the three test scores and dividing by three. The derived score will be translated into a letter grade for the course based on the following scale:

Derived Score	Letter Grade
90 – 100	A
80 – 89	B
70 – 79	C
60 – 69	D
Below 60	F

It is important that examinations be taken when scheduled. Make-up exams will only be administered under extraordinary circumstances, when there is a documented reason of a serious and compelling nature. Doctor's notes or supporting documentation is required. In the event that a make-up exam becomes necessary, it will not be the same test that was given on the scheduled exam date. Make-up exams will be based on the same general information, but will include not only objective questions, but also essays.

Small Group Discussion of Thought Provoking Questions (TPQs)

Students are expected to come prepared and actively participate in small group discussions of their completed TPQs for successful completion of this course. Groups will consist of 5-7 students and will be coordinated by one of the students in the class. The TPQ discussion groups will also serve to prepare students for the midterm and final examinations. The dates for small group discussions of TPQs are:

TPQ Set #1 – _____

TPQ Set #2 – _____

TPQ Set #3 – To be arranged outside of class

Attendance and Active Class Participation

Students are required to attend the entire class period and actively participate during class for successful completion of this course. Each student is requested to let the instructor know (in advance) if she/he is unable to attend class or stay for the duration of the class period. Should an absence become necessary, it is the student's responsibility to acquire the lecture notes from a peer student.

Course Policies & Safety Concerns

Cell phones must be deactivated, turned off, or set to the vibratory mode during this class. There are no visitors allowed in class. Use of tobacco products is prohibited on any California State University campus.

Statement on Cheating and Plagiarism

The University has a written policy on cheating and plagiarism that includes specific steps that will be taken in the event that an incident of cheating or plagiarism is suspected or alleged. The full text of the document is available in the office of the Vice President for Student Affairs in the Joyal Administration Building, room 262. University definitions of cheating and plagiarism may be found in the section on "Legal Notices" in the current "Schedule of Courses."

Statement on Services for Students with Disabilities

The University is committed to providing reasonable academic accommodation to students with disabilities. Services for Students with Disabilities provides university academic support services and specialized assistance to students with disabilities. Individuals with physical, perceptual, or learning disabilities as addressed by the American with Disabilities Act should contact Services for Students with Disabilities for information regarding accommodations. Please notify your instructor so that reasonable efforts can be made to accommodate you.

Primary Learning Outcomes

Following successful completion of this course, students will derive an understanding of the basic scientific principles of the neural basis for speech, language and hearing, and will gain the knowledge necessary to form the foundation for more advanced study in the field of Communication Disorders.

Course Outline

Section 1: Scope, Principles and Elements of Neuroscience

- Need for training and education in neuroscience
- Scope of Neuroscience
 - ❖ Neurology
 - ❖ Neurosurgery
 - ❖ Neuroanatomy
 - ❖ Neuroradiology
 - ❖ Neuroembryology
 - ❖ Neurophysiology
 - ❖ Neuropathology
- Pioneers study of neuroscience related to speech, language, and hearing
 - ❖ Historical roots
 - Paul Broca
 - William Ogle
 - Carl Wernicke
 - Joseph Dejerine
 - Hugo Liepmann
 - Sigmund Freud
 - ❖ Wernicke's Language Model
 - ❖ Other significant contributors
 - Jean Charcot
 - William Gowers
 - Korbinian Brodmann
 - ❖ Modern times
 - Wilder C. Penfield
 - Norman Geschwind
 - Noam Chomsky
 - Roger Sperry
- Tips on how to study for CDDS 172: Neural Basis for Speech, Language, and Hearing
- Eight principles for governing functional organization of the brain
 - ❖ Interconnectivity in the brain
 - ❖ Centrality of the central nervous system
 - ❖ Hierarchy of neuraxial organization
 - ❖ Laterality of brain organization
 - Bilateral anatomical symmetry
 - Unilateral Functional Difference
 - Contralateral Sensorimotor control
 - ❖ Structural and functional specialization
 - ❖ Topographical organization in cortical pathways
 - ❖ Placticity in the brain
 - ❖ Nonmythical brain
- Orientation to basic terminology

- Directional brain orientation
- Anatomical positions and planes of brain section
- Overview of the major structures of the central nervous system

Readings: Chapter 1

Section 2: Organization of the Nervous System I

- Central nervous system
- Cerebral hemispheres
 - ❖ Frontal lobe
 - ❖ Temporal lobe
 - ❖ Parietal lobe
 - ❖ Occipital lobe
 - ❖ Insular lobe
 - ❖ Fissures
 - ❖ Sulci
 - ❖ Gyri
 - ❖ Association cortex
 - ❖ Cerebral connections
 - ❖ Corpus callosum
 - ❖ Split-brain research
 - ❖ Cortical location maps
 - ❖ Specific cortical areas
 - ❖ Association area functions
 - ❖ Cortical motor functions
 - ❖ Cortical motor speech association areas
 - Primary somatosensory cortex
 - Primary auditory receptor cortex
 - Primary visual receptor cortex
 - Primary olfactory receptor cortex
 - ❖ Sensory association areas
 - ❖ Other cortical association areas
- Association pathways
 - ❖ Subcortical structures
 - ❖ Cerebellum and brainstem
 - Brainstem
 - Medulla oblongata
 - Pons
 - Mesencephalon (midbrain)
 - Diencephalon (thalamus)
 - Spinal cord
 - ❖ Reflexes

Readings: Chapter 2

Section 3: Organization of the Nervous System I

- Peripheral nervous system
 - ❖ Spinal nerves
 - ❖ Cranial nerves
 - ❖ Autonomic nervous system
- Protection and nourishment
 - ❖ Meninges
 - ❖ Ventricular system
 - ❖ Cerebral fluid
- Blood supply to the brain
 - ❖ Internal carotid arteries and their branches
 - ❖ Vertebral artery and Its branches
 - ❖ Circle of Willis
- General principles of neurologic organization
 - ❖ Contralateral motor control
 - ❖ Ipsilateral motor control
 - ❖ Bilateral speech motor control
 - ❖ Unilateral language mechanisms
 - ❖ Scheme of cortical organization

Readings: Chapter 3

Section 4: Neuronal Function in the Nervous System

- Neuronal physiology
 - ❖ Neuron
 - Cellular electrical potentials
 - action potential
 - ❖ Synapse
 - Chemical transmission
 - Transmission disorders
 - ❖ Synaptic excitation and inhibition
 - ❖ Principles of neuronal operation
 - ❖ Servomechanism theory in neuronal function
 - ❖ Myelin
 - Development of myelin
 - Myelin disorders
- Development of the Nervous System
 - ❖ Early development
 - ❖ Spinal cord
 - ❖ Brain

Readings: Chapter 4

Section 5: Neurosensory Organization of Speech and Hearing

- Bodily sensation
 - ❖ Sherrington's Scheme

- ❖ Anatomy of sensation
- ❖ Lateral spinothalamic tract
- ❖ Light touch
- ❖ Two-point discrimination
- ❖ Pain and temperature
- ❖ Dorsal column lesions
 - Inability to recognize limb position
 - Astereognosis
 - Two-point discrimination disorder
 - Vibratory sensibility disorder
 - Body sway test
- Anatomy of oral sensation
 - ❖ Sensory pathway of cranial nerve V
 - ❖ Sensory pathway of cranial nerve IV
- Oral sensation receptors
 - ❖ Oral proprioceptors
 - ❖ Studying oral sensation
 - ❖ Sensory control modalities
 - ❖ Speech proprioception
- Visual system
 - ❖ Retina
 - ❖ Path of the optic nerve
 - ❖ Primary visual cortex
 - ❖ Visual association cortex
 - ❖ Visual integration
- Central auditory nervous system
 - ❖ Receptor level
 - ❖ Cranial nerve level
 - ❖ Brainstem level
 - ❖ Auditory radiations and cortex
 - ❖ Auditory physiology
 - ❖ Lesions of the auditory system
 - ❖ Central auditory processing disorder

Readings: Chapter 5

Section 6: The Neuromotor Control of Speech

- Pyramidal system
 - ❖ Corticospinal tract
 - ❖ Descending motor pathways
 - ❖ Decussation
 - ❖ Paralysis, paresis and plegia
- Corticobulbar tracts
 - ❖ Bilateral symmetry
 - ❖ Contralateral and unilateral innervation
- Lower and upper motor neurons

- ❖ Lower motor neuron paralysis
- ❖ Upper motor neuron paralysis
 - Types of paralysis
 - Confirmatory signs
- Alpha and gamma motor neurons
 - ❖ Muscle spindles
 - ❖ Gamma motor neurons
 - ❖ Golgi tendon organs
- Extrapyrarnidal system
 - ❖ The Indirect Activation Pathway
 - ❖ Basal ganglia
 - ❖ Dyskinesias
 - ❖ Dyskinetic types
 - ❖ Tremors
 - Rest tremor
 - Physiologic or action tremor
 - Intention tremor
 - ❖ Chorea
 - ❖ Athetosis
 - ❖ Dystonia
 - ❖ Myoclonus
 - ❖ Orofacial dyskinesia or tardive dyskinesia
- Cerebellar system
 - ❖ Anatomy of the cerebellum
 - ❖ Three cerebellar lobes
 - Anterior lobe
 - Posterior lobe
 - Flocculonodular lobe
 - ❖ Synergy and asynergy
 - ❖ Cerebellar peduncles and pathways
 - ❖ Cerebellar role in speech
 - ❖ Clinical signs of cerebellar dysfunction
 - Ataxia
 - Decomposition of movement
 - Dysmetria
 - Adiadochokinesia or dysdiadochokinesia
 - Rebound
 - Hypotonia
 - Tremor
 - Nystagmus
 - Muscle stretch reflexes
 - Ataxic dysarthria
 - ❖ Cerebellar syndrome and dysarthria

Readings: Chapter 6

Section 7: The Cranial Nerves

- Origin of the cranial nerves
 - ❖ Names and numbers
 - ❖ Embryologic origin
 - ❖ Corticobulbar tract and the cranial nerves
- Cranial nerves for smell and vision
- Cranial nerves for speech and hearing
 - ❖ Cranial nerve V: Trigeminal
 - ❖ Cranial nerve VII: Facial
 - ❖ Cranial nerve VIII: Vestibular Acoustic or Vestibulocochlear
 - ❖ Cranial nerve IX: Glossopharyngeal
 - ❖ Cranial nerve X: Vagus
 - ❖ Cranial nerve XI: Spinal Accessory
 - ❖ Cranial nerve XII: Hypoglossal
- Cranial nerve cooperation: The Act of Swallowing

Readings: Chapter 7

Section 8: The Dysarthrias

- Upper motor neuron lesions
 - ❖ Unilateral upper motor neuron dysarthria
 - ❖ Swallowing in patients with unilateral damage
 - ❖ Spastic dysarthria
 - Etiology
 - Associated neurologic condition
 - Oral musculature
 - Speech characteristics
 - Phonation
 - Resonance
 - Articulation
 - Swallowing
- Lower motor neuron lesions
 - ❖ Flaccid dysarthria
 - Etiology
 - Associated neurologic condition
 - Oral musculature
 - Speech characteristics
 - Phonation
 - Resonance
 - Articulation
 - Swallowing
 - ❖ Myasthenia gravis
 - Speech characteristic
- Mixed upper and lower motor neuron lesions
 - ❖ Amyotrophic lateral sclerosis

- Associated neurologic condition
- Oral musculature
- Speech characteristics
 - Phonation
 - Resonance
 - Articulation
- Swallowing
- Basal ganglia lesions: Dyskinetic dysarthrias
 - ❖ Hypokinetic dysarthria: Parkinsonism
 - Associated neurologic condition
 - Oral musculature
 - Speech characteristics
 - Phonation
 - Articulation
 - Resonance
 - Prosody
 - Swallowing
 - ❖ Hyperkinetic dysarthrias
 - Pathologic tremor and voice disorders
 - Speech characteristics
 - ❖ Chorea
 - Associated neurologic condition
 - Oral musculature
 - Speech characteristics
 - Phonation
 - Resonance
 - Articulation
 - Swallowing

Readings: Chapter 8

Section 9: The Central Language Mechanism and Its Disorders

- A model for language and Its disorders
 - ❖ Perisylvian zone
 - ❖ Broca's and Wernicke's' Areas
 - ❖ Arcuate fasciculus
 - ❖ Angular gyrus
 - ❖ Inferior frontal lobe
 - ❖ Supramarginal gyrus
 - ❖ Subcortical mechanisms
 - ❖ Model Functioning
 - ❖ Model usefulness
 - ❖ New approaches to models
- Aphasia classification
 - ❖ Dichotomous classification
 - ❖ Classification agreement
 - Broca's aphasia

- Wernicke's aphasia
- Conduction aphasia
- Global aphasia
- Transcortical aphasia
- Anomic aphasia
- Progressive aphasia
- Subcortical aphasia
- Associated central disturbances
 - ❖ Agnosia
 - Visual agnosia
 - Auditory agnosia
 - Tactile agnosia
 - ❖ Gertsman syndrome
 - ❖ Apraxias
 - Ideomotor apraxia
 - Oral apraxia
 - Apraxia of speech
 - Developmental apraxia of speech (developmental dyspraxia)
 - Ideational apraxia
 - ❖ Constructional disturbances
 - ❖ Alexia
 - Alexia without agraphia
 - Alexia with agraphia
 - Frontal alexia
 - Aphasic alexia
 - Psycholinguistic classification of dyslexia
 - ❖ Agraphia
 - ❖ Dementia
 - ❖ Acute confusional states
 - ❖ Traumatic brain injury
 - ❖ Right-hemisphere lesions

Readings: Chapter 9

Section 10: Language Mechanisms in the Developing Brain

- Brain growth
 - ❖ Brain weight
 - ❖ Differential brain growth
 - ❖ Myelination for language
- Cerebral plasticity
- Development of language dominance
- Childhood language disorders
 - ❖ Acquired childhood aphasia
 - ❖ Childhood aphasia with abnormal EEG findings: Landau-Kleffner Syndrome
 - ❖ Developmental language disability
- Specific language impairment

- Attention deficit- hyperactivity disorder
 - ❖ Differential diagnosis of language disorders
 - Hearing loss
 - Generalized cognitive deficit: Mental retardation
 - Childhood autism
 - ❖ Developmental dyslexia

Readings: Chapter 10

Section 11: Clinical Speech Disorders and the Developing Brain

- Developmental motor speech disorders
 - ❖ Cerebral palsy
 - ❖ Childhood suprabulbar paresis
 - ❖ Muscular dystrophy
- Diagnosis of neurologic disorder with primitive reflexes
 - ❖ Asymmetrical tonic neck reflex
 - ❖ Symmetrical tonic neck reflex
 - ❖ Positive support reflex
 - ❖ Tonic labyrinthine reflex
 - ❖ Segmental rolling reflex
 - ❖ Galant reflex
 - ❖ Moro reflex
- Oral and pharyngeal reflexes
 - ❖ Rooting reflexes
 - ❖ Sucking reflex
 - ❖ Swallowing reflex
 - ❖ Tongue reflex
 - ❖ Bite reflex
 - ❖ Gag reflex
- Assessing mastication and deglutition

Readings: Chapter 11

Tentative Course Schedule

CDDS 172 Neural Aspects of Speech, Language and Hearing

Dates	Topics	Readings
	Introduction to CDDS 172 Section 1: Scope, Principles and Elements of Neuroscience	Ch 1
	Section 1: Scope, Principles and Elements of Neuroscience	Ch 1
	Section 2: Organization of Nervous System I	Ch 2

	<i>Class Canceled: Presidents' Holiday</i>	
	TPQ Discussion Groups	Ch 2
	Midterm Examination (Sections 1 and 2)	Ch 1&2
	Section 3: Organization of Nervous System II	Ch 3,7
	Section 3: Organization of Nervous System II Section 4: Neuronal Function in the Nervous System	Ch 3,7
	TPQ Discussion Groups	Ch 4
	<i>Class Canceled: Spring Break</i>	
	<i>Class Canceled: Department Furlough Day</i>	Ch 5&6
	Midterm Examination (Sections 3 and 4) Section 5: Neurosensory Organization of Speech and Hearing	Ch 5&6
	Section 5: Neurosensory Organization of Speech and Hearing Section 6: Neuromotor Control of Speech	Ch 5&6
	Dr. Don Fields – Developmental/Neurological Assessment	Ch 10&11
	Carol Giovacchini - Aphasia and Dysarthria Wendy Garbarino - Apraxia and Dysphasia	Ch 8&9
	Section 7: Clinical Speech Disorders of the Motor Systems Section 8: The Central Language Mechanism and Its Disorders	Ch 8&9
	Final Examination (Sections 5, 6, 7 and 8) (5:45 - 7:45 pm)	