AMERICAN ACADEMY OF NEUROLOGY
BEHAVIORAL NEUROLOGY
FELLOWSHIP CORE CURRICULUM

1. INTRODUCTION AND DEFINITIONS

The specialty of Behavioral Neurology focuses on clinical and pathological aspects of neural processes associated with mental activity, subsuming cognitive functions, emotional states, and social behavior. Historically, the principal emphasis of Behavioral Neurology has been to characterize the phenomenology and pathophysiology of intellectual disturbances in relation to brain dysfunction, clinical diagnosis, and treatment. Representative cognitive domains of interest include attention, memory, language, high-order perceptual processing, skilled motor activities, and "frontal" or "executive" cognitive functions (adaptive problem-solving operations, abstract conceptualization, insight, planning, and sequencing, among others). Advances in cognitive neuroscience afforded by functional brain imaging techniques, electrophysiological methods, and experimental cognitive neuropsychology have nurtured the ongoing evolution and growth of Behavioral Neurology as a neurological subspecialty. Applying advances in basic neuroscience research, Behavioral Neurology is expanding our understanding of the neurobiological bases of cognition, emotions and social behavior. Although Behavioral Neurology and neuropsychiatry share some common areas of interest, the two fields differ in their scope and fundamental approaches, which reflect larger differences between neurology and psychiatry.

Behavioral Neurology encompasses three general types of clinical syndromes: 1) diffuse and multifocal brain disorders affecting cognition and behavior (e.g. delirium and dementia), 2) neurobehavioral syndromes associated with focal brain lesions (e.g. aphasia, amnesia, agnosia, apraxia), and 3) neuropsychiatric manifestations of neurological disorders (e.g. depression, mania, psychoses, anxiety, personality changes, or obsessive-compulsive disorders, which may accompany diseases such as epilepsy, cerebrovascular disease, traumatic brain injury, or multiple sclerosis). These syndromic categories may be etiologically subdivided into either primary (e.g. neurodegenerative) and secondary (e.g. systemic toxic-metabolic) brain disorders, or on the basis of developmental, inherited, or sporadic (acquired) mode of occurrence.

The clinical specialty of Behavioral Neurology requires a unique combination of knowledge and skills that are beyond the scope of a general neurologist, including expertise in: 1) functional behavioral neuroanatomy, as applied in correlating clinical findings with structural and functional brain markers provided by neuroimaging and electrophysiological methods, 2) administering and interpreting mental status examinations, including both neuropsychological and neuropsychiatric assessments, and 3) the neurochemical bases and pharmacological management of cognitive, emotional, and behavioral disturbances. As a supplement to these core areas of expertise in Behavioral Neurology, fundamental knowledge is required in the areas of epidemiology, natural history, developmental context (childhood and geriatric disorders), molecular genetics, pathophysiology, comprehensive clinical management, and prognosis that pertain across the range of neurobehavioral syndromes and disorders.

II. CORE CONTENT

Behavioral Neurology broadly encompasses basic neuroscientific and clinical aspects of cognition, behavior, and emotions. For didactic purposes, it may be divided into five core areas:

1) Neurobiological Bases of Behavior
2) Neurobehavioral and Aphasic Syndromes
3) Neurobehavioral and Mental Status Examination
4) Neuropsychological Assessment
5) Neuropsychopharmacology and Patient Management

Core disciplinary areas in Behavioral Neurology require basic knowledge of the neuroanatomical, neurochemical, neurophysiological, and developmental neurobiological substrates of complex behavior, and the clinical features, pathophysiological correlates, diagnosis, and therapeutic management of neurobehavioral syndromes. In conjunction with the five core disciplinary areas, six clinical / research focus areas entail specific expertise in age-related disorders, the interface between neurology and psychiatry, or particular investigative or therapeutic techniques.

1) Childhood and Childhood-Onset Neurobehavioral Disorders
2) Geriatric Behavioral Neurology
3) Neuropsychiatry
4) Neuroimaging and Neurophysiology
5) Cognitive Neuroscience
6) Cognitive Rehabilitation

A. Core Areas

1. Neurobiological Basis of Behavior:

- Organization of the cerebral cortex, white matter tracts, basal ganglia, thalamus, hypothalamus, hippocampus, amygdala, and brainstem.
  - Behaviorally-relevant cortico-cortical and cortical-subcortical functional circuitry.
  - Cerebral hemispheric specialization; localization and lateralization of function.
  - Neurodevelopmental aspects of cognition and behavior.
  - Anatomy of the cerebrovascular and ventricular systems.
  - Clinical applications of structural and functional neuroimaging methodologies.
  - Distribution, metabolism, and functional significance of local circuit (e.g. amino acid) and modulatory (e.g. cholinergic and monoaminergic) neurotransmitter systems.

2. Neurobehavioral Syndromes:

- Description and classification of recognized neurobehavioral syndromes including amnesia, aphasia, agnosia, apraxia, executive dysfunction, unilateral neglect, and visuospatial disturbances, delirium and dementia, dyslexia, and attention deficit / hyperactivity disorder.
- Knowledge of relevant neuroanatomy, pathophysiology, and potential etiologies (neurodegenerative, cerebrovascular, multiple sclerosis, traumatic brain injury, hydrocephalus, brain tumors, CNS

infections, attention deficit / hyperactivity disorder, learning disabilities and toxic-metabolic encephalopathies).

- Core clinical manifestations, natural history, epidemiology, and putative neurological substrates of affective, psychotic, anxiety, personality, obsessive-compulsive, impulse control, attention deficit / hyperactivity disorder, developmental disability, autism, and learning disabilities, and factitious disorders.
- Knowledge of the onset, course, prognosis, management, epidemiology, and public health impact of neurobehavioral syndromes associated with dementia, aphasia, delirium, AIDS, epilepsy, stroke, movement disorders, traumatic brain injury, multiple sclerosis, sleep disorders, attention deficit / hyperactivity disorder, developmental disability, autism, and learning disabilities.

3. Neurobehavioral and Mental Status Examination:

- Supervised instruction in executing and recording a mental status examination, including the assessment of comportment, attention, language, memory, visuospatial skills, praxis, executive functions, calculations, and abstract conceptualization.
- Instruction in interpreting the results of a mental status examination with respect to anatomic correlates and differential diagnosis.
- Instruction in adjusting the mental status examination to a level that is sensitive to the patient's abilities or pertinent observations to be made in the case of patients who are unable to cooperate with a formal examination.
- Instruction in the clinical neuropsychiatric assessment and criteria for classification of depression, mania, psychosis, anxiety, personality disorders, substance abuse, conversion disorder, and obsessive-compulsive disorder; determining the severity of the disorder and the urgency of the need for treatment.
- Knowledge of the childhood and adulthood manifestations of attention deficit / hyperactivity disorder and learning disabilities, and their implications for performing and interpreting a neurobehavioral assessment.
- Experience in the use of standardized mental status questionnaires and standardized psychodiagnostic rating scales and interviews.
- Become familiar with the basic aspects of a forensic evaluation including the determination of testamentary capacity, specific competencies, criminal responsibility, and the degree of disability in patients with brain dysfunction.

4. Neuropsychological Evaluation:

- Become familiar with standard neuropsychological assessment tools (e.g. WAIS-R, WMS-R, Wisconsin Card Sort Test, Trail-Making Tests, Stroop Test, Rey-Osterrieth Complex Figure, Boston Diagnostic Aphasia Examination), with respect to their content, sensitivity, and specificity, the influence of age, education, cultural background, fatigue, drugs, sensory impairment, and primary psychiatric illnesses on test performance, and the role of neuropsychological testing in the evaluation and treatment planning related to neurobehavioral disorders.
- Understand the relationship between neuropsychological test results and screening mental status examinations, and the anatomic and disease correlates of neuropsychological test abnormalities.

- Become familiar with the content and applications of standardized assessments of personality such as the MMPI.

5. Neuropsychopharmacology and Patient Management:

- Instruction regarding the indications, contraindications, drug interactions, and adverse side effects of the major agents used to treat neurobehavioral disorders and their underlying etiologies including anticonvulsants, anti-parkinsonian agents, platelet anti- aggregants, anticoagulants, antioxidants, antipsychotic agents, antidepressants, anxiolytics, psychostimulants, analgesics, and antidementia drugs.
- Instruction in the recognition and management of drug side effects including tremor, neuroleptic malignant syndrome, parkinsonism, and delirium.
- Instruction in the indications and contraindications of electroconvulsive therapy and neurosurgical procedures for treating basal ganglia disorders.
- Instruction and/or experience in the pharmacologic management of:
  – major behavioral disorders including depression, psychosis, anxiety, obsessive-compulsive disorder, attention deficit / hyperactivity disorder, autism, and agitation, including management of the acutely agitated patient and non-neuroleptic alternatives to managing agitation and aggression.
  – disorders such as substance abuse, developmental disabilities, and sleep disorders.
  – neurobehavioral and other manifestations of the major neurologic disorders including epilepsy, Parkinson's disease, Alzheimer's disease, Wilson's disease, Huntington's disease, frontotemporal dementias, traumatic brain injury, stroke, multiple sclerosis, and Tourette's syndrome.
- Become familiar with behavioral modification techniques and the range of psychotherapeutic techniques available.

B. Clinical / Research Focus Areas

1. Childhood and Childhood-Onset Neurobehavioral Disorders:

- Become familiar with normal human development and developmental milestones.
- Identification and management of common developmental and childhood-onset neurobehavioral disorders including dyslexia, attention deficit / hyperactivity disorders, autism, mental retardation, conduct disorders, Asperger's syndromes, and tic disorders.
- Instruction in the behavioral manifestations of childhood neurologic disorders (e.g. subacute sclerosing panencephalitis, hydrocephalus, Rett's syndrome).
- Instruction in the adult manifestations of childhood-onset disorders and the influence of childhood-onset disorders on adult behavior.

2. Geriatric Behavioral Neurology:

- Become familiar with age-related changes in cognitive, behavioral, and neurologic functioning and the principles of assessing elderly patients.
- Instruction in the identification and management of common late-onset neurobehavioral disorders including the dementias, delirium, depression, late-onset psychoses, behavioral

disturbances associated with Parkinson's disease and other extrapyramidal disorders, and neurobehavioral alterations associated with cerebrovascular disease.

- Develop skill in working with caregivers and family members of individuals with geriatric neurobehavioral disorders and become familiar with the range of resources and ancillary services available for the care of the elderly including day-care programs, nursing homes, personal care homes, respite care, community organizations, and home healthcare services.

3. Neuropsychiatry:

- Instruction in the diagnosis and treatment of neuropsychiatric disorders such as Tourette's syndrome, attention deficit / hyperactivity disorder, delirium, and dementia,
- Instruction in the assessment and management of neuropsychiatric manifestations associated with neurological disorders such as multiple sclerosis, cerebrovascular disease, and epilepsy.
- Instruction in the assessment and management of neurological complications associated with psychiatric disorders, such as tardive dyskinesia and drug-induced parkinsonism.

4. Neuroimaging and Neurophysiology:

- Instruction in the appropriate indications for conventional neuroimaging and neurodiagnostic tests such as CT, MRI, angiography (conventional and MR), EEG, evoked potentials, and polysomnography.
- Instruction in the basic principles and characteristic features, landmarks, patterns, and artifacts of conventional neuroimaging and neurodiagnostic tests relevant to clinical interpretation.
- Develop the ability to relate the anatomical localization of lesions demonstrated on imaging to specific neurobehavioral syndromes.
- Where available, instruction in the theory, interpretation, and potential clinical and research applications of positron-emission tomography (PET), single-photon emission tomography (SPECT), MRI spectroscopy, of functional MRI methodologies.
- Become familiar with clinical indications and research applications of neurophysiological techniques including EEG, evoked potentials, and topographic brain-mapping in evaluating neurobehavioral disorders such as epilepsy, delirium, dementia, and focal neurological disorders.

5. Cognitive Neuroscience:

- Instruction in the theory, design, and interpretation of cognitive neuropsychological experiments.
- Instruction in basic principles of neural-network models and their application to investigating higher cognitive and complex behavioral phenomena.
- Develop skills in combining cognitive neuropsychological methods with functional imaging and/or electrophysiological techniques for investigating the neural substrates of cognitive, emotional, and behavioral processes.

6. Cognitive Rehabilitation:

- Instruction in the short-term and long-term neurological and neurobehavioral sequelae of traumatic brain injury, stroke, and other neurological disorders amenable to rehabilitative efforts.
- Instruction in comprehensive cognitive, behavioral, and functional abilities assessment techniques.
- Instruction in multimodal therapeutic approaches for behavioral modification, language disturbances, memory disorders, visual-perceptual disturbances, and disorders of praxis.
- Develop skills in working with a multidisciplinary team in the design, implementation, and monitoring of a rehabilitative program.

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