

1 Neuropsychological Aspects of Frontal Lobe Function

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2 Important Concepts

- Phylogenetically newest area of cortex
- Exquisite connectivity based on feedback loops
- Inhibitory/excitatory control
- Farthest removed from external environment (reflective, not reflexive)
- Highly preprocessed, convergent projections (emergent concepts)
- Only neocortical representation of the limbic system
- Motivational/emotional interaction (goal-direction)

3 Symptoms of Frontal Lobe Damage

- Elementary Neurological Defects
- Skilled Movement Disorders
- Language/Speech Disorders
- Memory Disorders
- Executive Deficits
- Neuropsychiatric Disturbances

4 Frontal Lobe Cortex

- Functional subdivisions:
 - Lateral (4, 6, 8-10, 43-47)
 - Medial (6, 8-12, 24, 25, 32, 22)
 - Inferior (11-15, 25, 47)
- Another division:
 - Motor (4)
 - Premotor (6, 8, 43, 44, 45)
 - Prefrontal (9-15, 46, 47)

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12 Dorsolateral Loop

- Critical for executive function
- Damage produces
 - Inflexibility
 - Planning
 - Problem-solving
 - Goal-directed behavior

13 Orbitofrontal Loop

- Involved in social and emotional functioning
- Damage produces:
 - Disinhibition
 - Hyperactivity
 - Emotional lability
 - Aggressiveness
 - Reduce self-awareness

14 Medial Frontal Loop

- Important in behavioral activation
- Damage results in
 - Akinetic mutism
 - Abulia
 - Impairments in spontaneous initiation of behavior

15 Neuropsychological Domains

- motor activity
- attention
- personality/emotion
- perceptual organization
- spatial/visual function
- memory
- cognitive skills
- executive skills

16 Elementary Neurological Deficits in Frontal Syndromes

- Contralateral hemiparesis
- Re-emergence of primitive reflexes

- Gaze abnormalities (spontaneous eye-movements, conjugate gaze)

17 Frontal Lesions and “Personality” (overall ‘emotional tone’)

- **orbital syndrome**
 - emotional lability
 - disinhibition
 - exaggeration of pre-existing personality traits
- **medial/lateral syndrome**
 - abulia/apathy
 - depression-like presentation
 - defects in self-initiation

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19 Frontal Lobe Symptoms Relevant to Emotion and Personality

- NOT independent of cognitive impairments
- Poor self-monitoring and self-reflection
- Defective arousal and orienting responses
- Affective changes

- Witzelsucht and Moria (Oppenheim)
- Depression with lack of concern
- “Acquired sociopathy” (Damasio) – unconcern for punishment

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21 Somatic Marker Hypothesis

- Biasing signals from body are integrated in the decision-making and emotional parts of the brain (VMPFC) and used to regulate decision-making under uncertainty
- Markers signal value and bolster attention and working memory
- Case EVR (tumor of VMPFC) – became unable to make decisions despite good NP performance; unsuitable choices for business partners, friends, etc.
- EVR impaired in psychophysiological responses to positive and threatening information
- Much of the data for SM hypothesis is based on the Iowa Gambling Task

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28 Motor Deficits in Frontal Syndromes

- Two dominant behavioral syndromes:
 - hyperactivity
 - apathy/abulia
- Contralesional hemiparesis; in less severe form, contralateral reduction in speed or dexterity
- Ideomotor apraxia – impaired skilled movement in nonhemiparetic hand/extremity
- Motor impersistence- failure to maintain motor activity; test with eye closure, tongue protrusion
- Impaired verbal control over conscious motor acts - inability to invoke verbal rules(e.g., Go-No Go); inability to use verbal intentions to guide behavior (e.g., don't drink the water)

29 Motor Deficits (cont'd)

- Defects in motor programming and sequencing - recursive writing sequences
- Impaired guidance and error correction
- Poverty of movement without weakness, hemiparesis, or abnormality in tone (intentional disorder)

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33 Tests of Frontal Motor Function

- hand-grip strength
- finger tapping speed
- static steadiness
- manual dexterity
- maze coordination

- complex tests of praxis

34 Frontal Lobes and Attention

- Inhibition/gating of sensory transmission through thalamic interaction

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38 Attentional Defects in Frontal Disease

- attention-focusing
- attention-maintenance
- attention-selectivity
 - interference susceptibility
 - Poor goal-dependent filtering of irrelevant stimuli
- attention-shifting

39 Tests of Attentional Function

- span tests (DS, Sentence Rep)
- cancellation tasks (simple and conditional)
- sustained attention
 - PASAT
 - Trail Making Test
 - Digit Symbol
- qualitative features from other tests

40 Frontal Lobes and Memory

- Classic studies of delayed response (DR) and delayed alternation (DA)
- Dorsolateral and frontal polar lesions produce greatest deficits
- DR = dorsal?
DA = ventral?

41 Human Frontal Memory Defects

- Short-term memory
 - deficits in working memory
- Learning
 - susceptibility to proactive interference
 - shallow semantic encoding
 - impairment in “voluntary memorizing”
 - impaired “directed forgetting”
- Long-term memory
 - recall deficits relative to recognition
 - impaired memory for temporal order
 - impaired recency judgments
 - Contamination of “true memory” with “inert stereotypes”

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Table

Grill

Ounce

Crayon

Fable

Pencil

Grill Fable

46 **Human Frontal Memory Deficits (cont'd)**

- Impairments in "metamemory"
 - failure of emergent awareness
 - poor self-monitoring and self-correction
 - poor knowledge of content of memory system (e.g., poor connection between search and FOK)
 - deficits in source memory
 - poor strategy use
 - impaired memory for self-generated responses

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48 **Frontal "Executive" Skills**

- a working definition of "executive" skill
- relevant skill domains
 - planning
 - goal establishment
 - anticipation
 - cognitive estimation
 - hypothesis testing (TOTE)

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50 **Cognitive Deficits in Frontal Syndromes**

- **impaired abstract thinking**
 - tendency to interpret abstract concepts concretely (e.g., proverbs, similarities)
 - tendency to be "pulled" to more immediately available sensory information
- **impaired verbal reasoning**
- **impairments in memory**
 - organizational role
 - informational - specific memory capacities of frontal lobe (e.g., working memory; retrieval)

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57 **Tests Tapping 'Frontal' Cognitive Defects**

- Wisconsin Card Sorting Test
- Halstead Category Test
- Shipley-Hartford Analogic Reasoning
- Trail-Making A and B
- Porteus Mazes (planning)
- Constructional Tasks (ROCF, BD)
- practically any other test calling for response production and organization!

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61 **Theories of Frontal Lobe Function**

- Pribram (1960): Feedback
- Teuber (1964): Corollary discharge
- Nauta (1971): interoceptive (limbic) and exteroceptive (sensory, association) connectivity
- Fuster (1980): temporal organization
- Shallice (1978): information processing
- Luria (1973): hierarchical model