

Neurocognitive Assessments at the Bedside

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Disclosures

If you have disclosures, state:

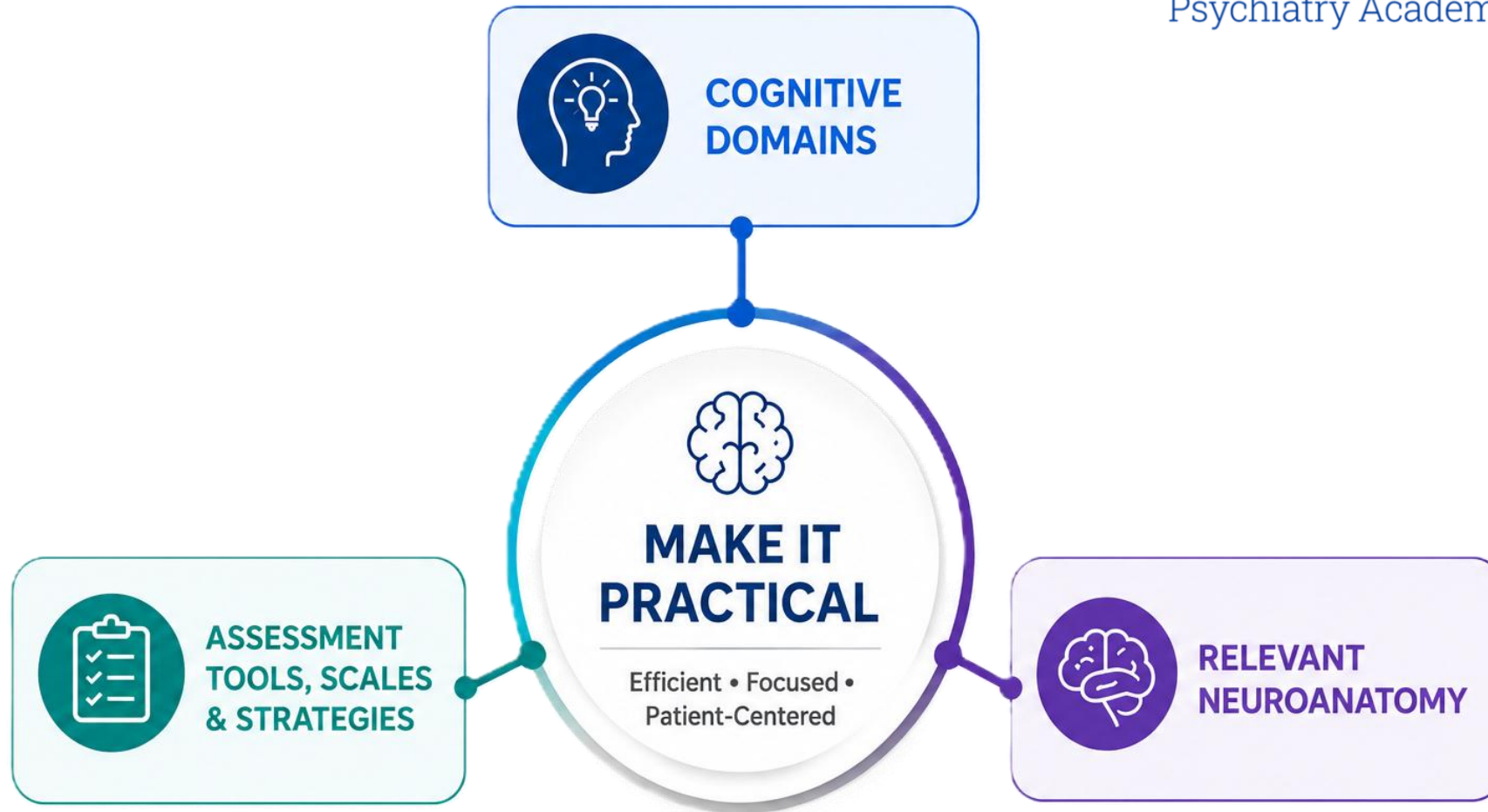
“My spouse/partner and I have the following relevant financial relationship with a commercial interest to disclose:” followed by disclosures

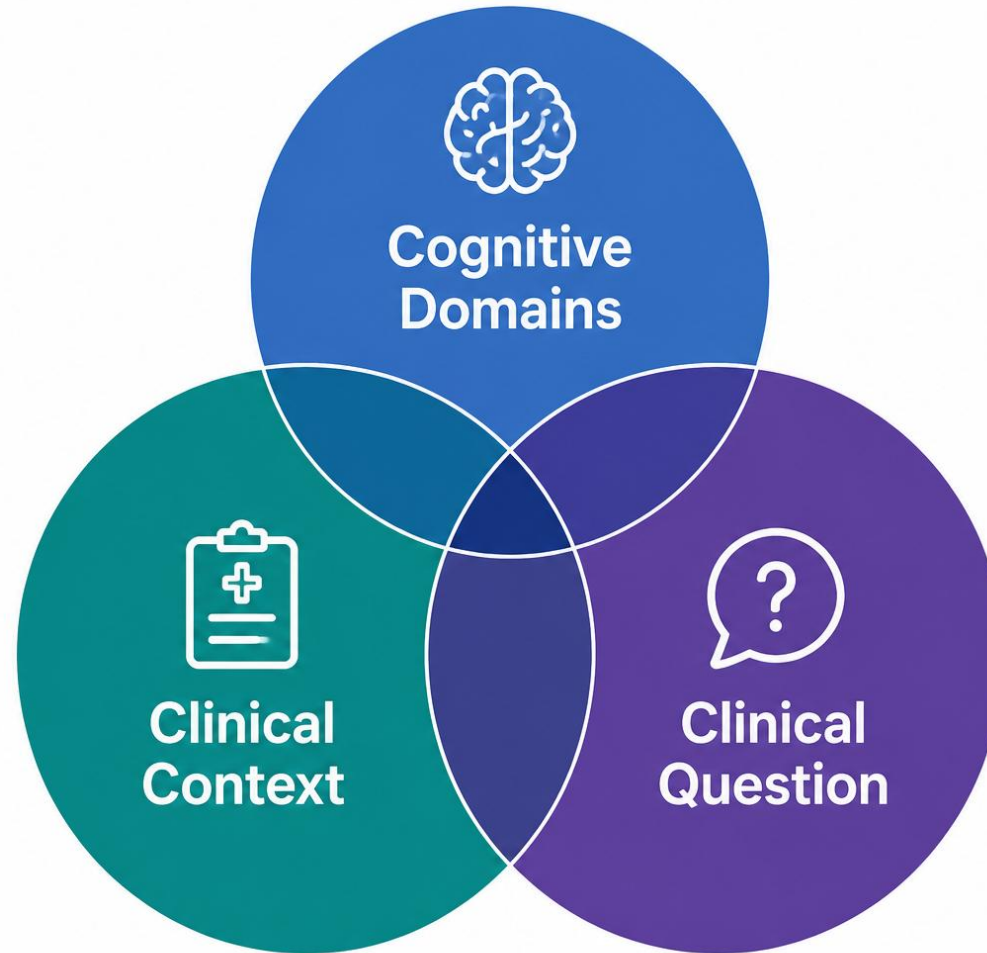
or

If you do not have disclosures, state:

“Neither I nor my spouse/partner has a relevant financial relationship with a commercial interest to disclose.”

Note: Disclosures must match the information provided on your disclosure form.





Cognitive Domains

- Consciousness
- Attention
- Language
- Orientation
- Memory
- Executive Function
- Visuospatial Planning

Consciousness

- Measurement of arousal and response to external stimuli

Consciousness

Glasgow Coma Scale		
Response	Scale	Score
Eye Opening Response	Eyes open spontaneously	4 Points
	Eyes open to verbal command, speech, or shout	3 Points
	Eyes open to pain (not applied to face)	2 Points
	No eye opening	1 Point
Verbal Response	Oriented	5 Points
	Confused conversation, but able to answer questions	4 Points
	Inappropriate responses, words discernible	3 Points
	Incomprehensible sounds or speech	2 Points
	No verbal response	1 Point
Motor Response	Obeys commands for movement	6 Points
	Purposeful movement to painful stimulus	5 Points
	Withdraws from pain	4 Points
	Abnormal (spastic) flexion, decorticate posture	3 Points
	Extensor (rigid) response, decerebrate posture	2 Points
	No motor response	1 Point
Minor Brain Injury = 13-15 points; Moderate Brain Injury = 9-12 points; Severe Brain Injury = 3-8 points		

Consciousness

Richmond Agitation and Sedation Scale (RASS)		
+4	Combative	violent, immediate danger to staff
+3	Very Agitated	Pulls or removes tube(s) or catheter(s); aggressive
+2	Agitated	Frequent non-purposeful movement, fights ventilator
+1	Restless	Anxious, apprehensive but movements not aggressive or vigorous
0	Alert & calm	
-1	Drowsy	Not fully alert, but has sustained awakening to <i>voice</i> (eye opening & contact $\geq$ 10 sec)
-2	Light sedation	Briefly awakens to <i>voice</i> (eye opening & contact < 10 sec)
-3	Moderate sedation	Movement or eye-opening to <i>voice</i> (but no eye contact)
-4	Deep sedation	No response to <i>voice</i> , but movement or eye opening to <i>physical</i> stimulation
-5	Unarousable	No response to <i>voice</i> or <i>physical</i> stimulation

Attention

- The ability to focus, direct cognition, and resist distraction

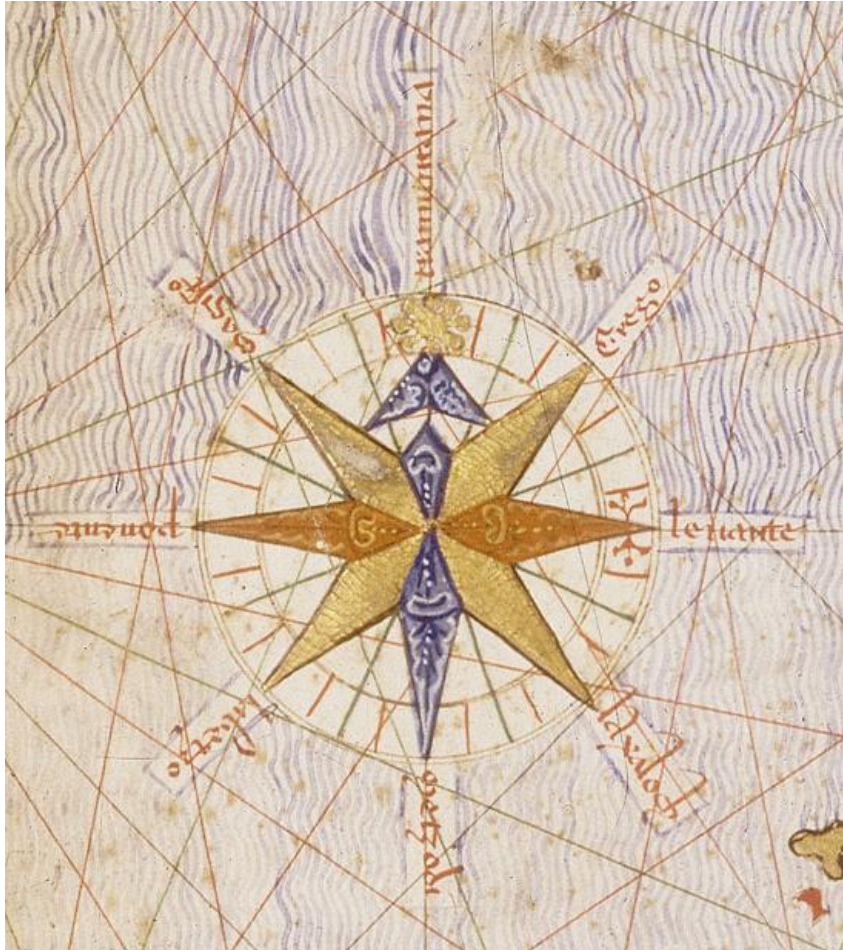
Attention

- Digit Span
 - Forwards
 - Backwards
- Vigilance “A” tests
 - C-A-S-A-B-L-A-N-C-A
- Serial 7s
- Months of the year or days of the week backwards

Language

- Fluency
- Content
- Comprehension
- Naming
- Repetition
- Reading
- Writing

Orientation



- Person
- Place
- Year
- Month
- Date
- Day of the week
- Season
- Situation

Memory

- Immediate
- Working
- Recent
- Remote
- Semantic
- Episodic

- Confabulation



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Executive Function

- Observation
- Trail Making Test
- Motor Programming
 - Luria's "fist-edge-palm" test
- Response Inhibition
 - "Go / No go" tests
- Abstraction
 - Similarities, idioms, proverbs

Praxis

- Ideomotor
- Ideational



Praxis

Praxis Type

Ideomotor

Buccofacial

Constructional

Ideational

Conceptual

Dressing

Gait

Ocular

Bedside Test

Pantomime tool use

Whistle, puff cheeks

Clock, cube

Multi-step task

Tool-object knowledge

Put on a jacket

Observe gait initiation

Voluntary saccades

Typical Localization

Left parietal/premotor

Left frontal/insula

Right parietal

Diffuse cortex, dominant hemisphere

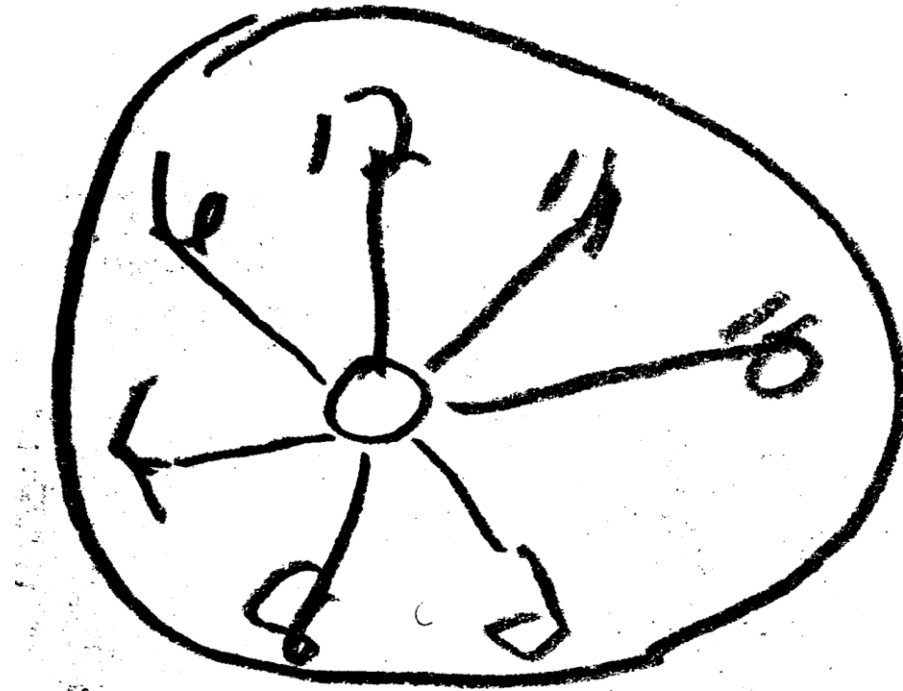
Left parietal/semantic network

Right parietal

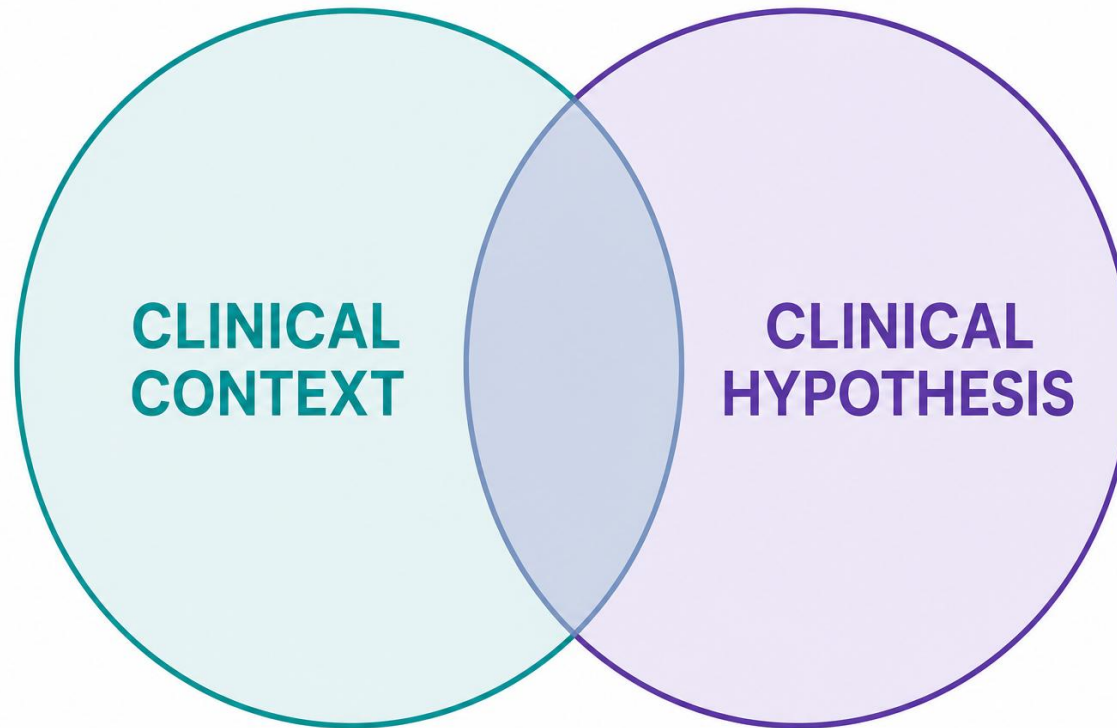
Frontal lobes

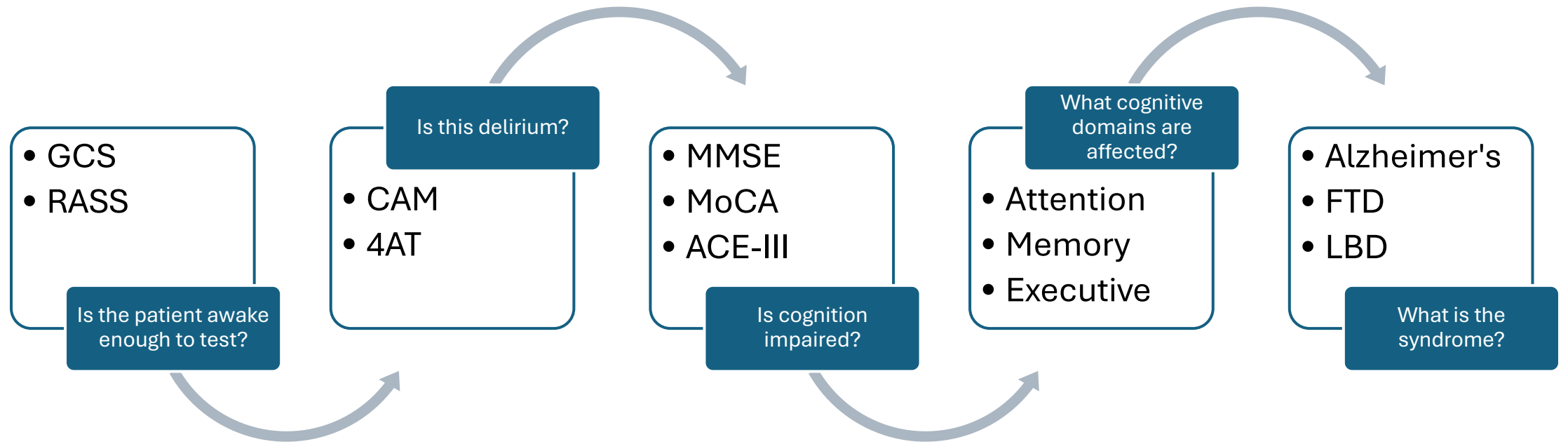
Parietal–frontal eye fields

Clocks



Scales





Scales

Delirium

- CAM
- CAM-ICU
- 4AT

Cognitive Impairment

- MMSE
- MoCA
- Mini-Cog
- SLUMS
- ACE
- MIS
- FAB

Scales

Tool	Time	Best for	Major limitation
MMSE	7–10 min	Moderate dementia	Poor executive assessment
MoCA	10–15 min	Mild cognitive impairment	Not diagnostic
ACE-III	15–20 min	More comprehensive domain assessment	Longer administration
Mini-Cog	3 min	Primary care screening	Limited detail



VIRTUAL BEDSIDE COGNITIVE ASSESSMENT



WHAT CAN BE RELIABLY ASSESSED



Mental status

Appearance, behavior, alertness, arousal



Attention

Months backward, digit span, WORLD backwards, serial 7s



Language

Fluency, naming (objects in environment), repetition, comprehension, conversation



Memory

Registration, delayed recall, cueing, recognition



Executive function

Letter fluency, category fluency, abstraction, Go/No-Go (adapted), Luria sequence (demonstrate to camera)



Praxis

Pantomime tool use, buccofacial praxis, gesture imitation



MORE DIFFICULT BUT STILL FEASIBLE



Clock drawing

Patient draws on paper and holds to camera



Cube copy

Patient draws on paper and holds to camera



Figure copy

Patient draws on paper and holds to camera



Trail-making

If screen-sharing or using mailed materials



Visuospatial tasks

Modified administration as able



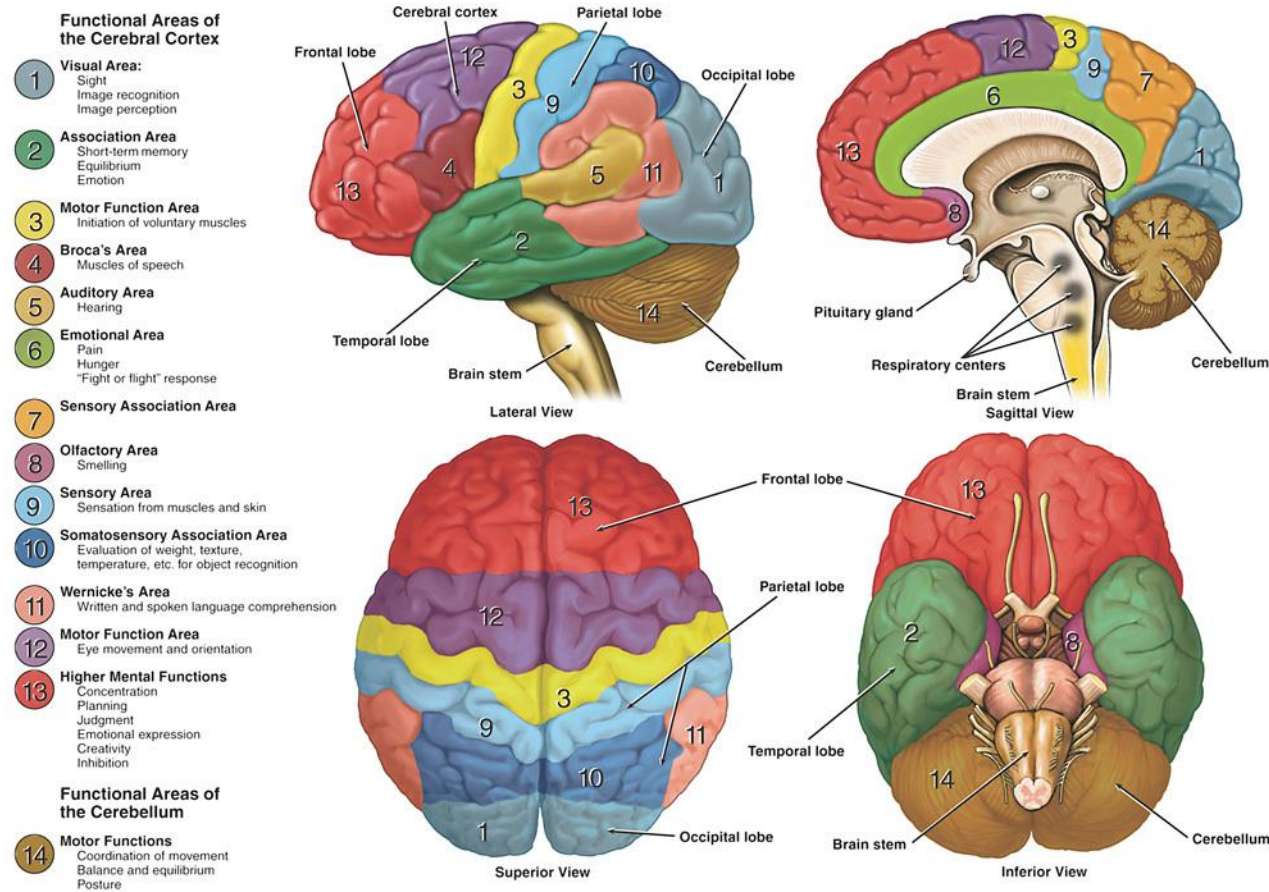
ADVANTAGES

- Observe patient in their natural environment
- Assess functional cognition (e.g., find objects, describe medications, navigate home)
- Involve family/caregivers more easily
- Reduce travel burden, especially for neurodegenerative disorders



COMPUTERIZED COGNITIVE TESTING	TABLET-BASED ASSESSMENT	DIGITAL BIOMARKERS (EMERGING FIELD)	VIRTUAL REALITY (VR) FUNCTIONAL ASSESSMENT
EXAMPLES • CNS Vital Signs • Cogstate • CANTAB • BrainCheck • NIH Toolbox Cognition Battery • ImPACT (sports concussion) 	 Increasingly used in - Stroke - Memory clinics - Primary care - Clinical trials Can measure ✓ Processing speed ✓ Attention ✓ Working memory ✓ Executive function	Instead of asking questions, we measure behavior. Examples - Typing speed - Mouse movement - Voice analysis - Eye tracking - Facial expression - Gait - Smartphone use - Passive activity monitoring - Wearable sensors <i>These may eventually detect subtle cognitive decline before traditional testing.</i>	Instead of asking "Draw a clock," ask "Navigate through a grocery store." VR can assess: ✓ Navigation ✓ Prospective memory ✓ Divided attention ✓ Executive function ✓ Multitasking ✓ Spatial memory ✓ Functional performance 
AUGMENTED REALITY (AR)		AI-ASSISTED ASSESSMENT	
 Less mature than VR. Potential applications include: • Guided cognitive rehabilitation • Real-time cueing • Functional task assessment in the home • Adaptive support for patients with cognitive impairment		 Emerging tools can analyze: - Speech and language - Facial expression - Motor behavior - Gaze patterns - Writing - Conversation Potential uses: earlier detection of neurodegenerative disease and more sensitive longitudinal monitoring.	
COMPARISON OF COGNITIVE ASSESSMENT APPROACHES			
METHOD	BEST MEASURES	MAJOR STRENGTH	LIMITATION
Bedside exam	Global cognition, clinical reasoning	Flexible, integrates history and exam	Examiner-dependent, less standardized
Paper-and-pencil tests	Screening, memory, language, visuospatial	Familiar, inexpensive, widely available	Limited ecological validity, less sensitive to change
Computerized testing	Speed, attention, executive function	Precision, automated scoring, rich norms	Requires technology, less flexible
Telehealth assessment	Most cognitive domains	Accessible, convenient, expands reach	Standardization challenges, tech limitations
Virtual reality (VR)	Functional cognition, multitasking, navigation, real-world tasks	Highly ecological, engaging, measures complex behaviors	Cost, availability, need for more validation
Digital biomarkers	Continuous passive data	Remote, continuous, early detection potential	Validation needed, privacy and data concerns

Localization



<https://dana.org/resources/neuroanatomy-the-basics/>

Localization

Domain

Attention

Processing speed

Executive function

Language

Episodic memory

Semantic memory

Visuospatial function

Social cognition

Brain regions

Frontal-parietal networks

Diffuse white matter/subcortical

Frontal lobes

Dominant hemisphere

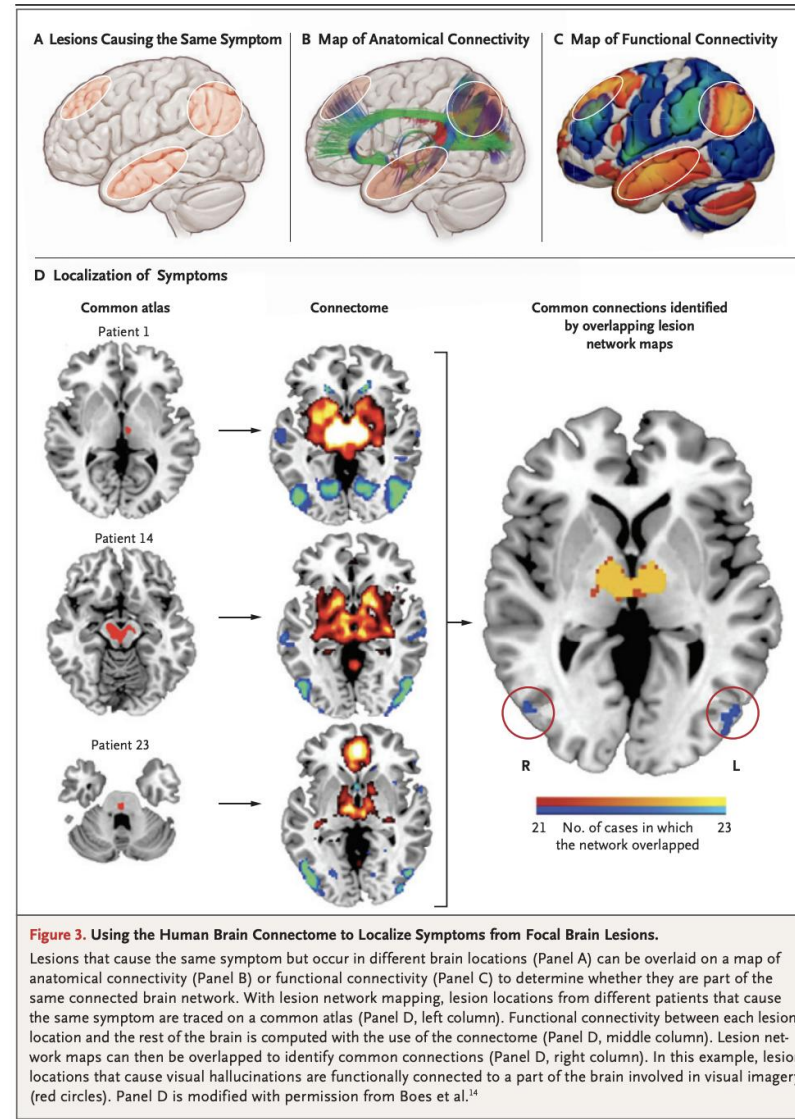
Hippocampus/medial temporal

Temporal neocortex

Parietal/occipital

Frontal and anterior temporal

Localization



Fox MD. Mapping Symptoms to Brain Networks with the Human Connectome. *N Engl J Med*. 2018 Dec 6;379(23):2237-2245. doi: 10.1056/NEJMra1706158. PMID: 30575457.

Summary

- Identify the clinical question
 - Use tools, scales and observational skills
 - Consider relevant neuroanatomy
 - Describe and document accordingly
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- Thank you!