

Cognitive Testing. Achilles Heel of Clinical Neurology

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Stroke and Cognition - a new era

- Vascular cognitive disorder
- Vascular cognitive impairment
- Vascular dementia
- Dementia: Vascular vs neurodegenerative
- *Alert, orientated x 3*
- *MMSE*
- *Neuropsychological testing*
- A treatable condition

Scope of the problem

- Cerebrovascular disease and neuropsychiatric disorders are leading cause of disability worldwide
- The frontal lobes comprise ~ 1/3 of the cerebrum and are supervisory to all other cortical and subcortical processes
- The frontal lobes and their networks are damaged in over half of all ischemic stroke
- No stroke measurement scale incorporates testing of frontal systems
- This impacts decisions regarding treatment or management.

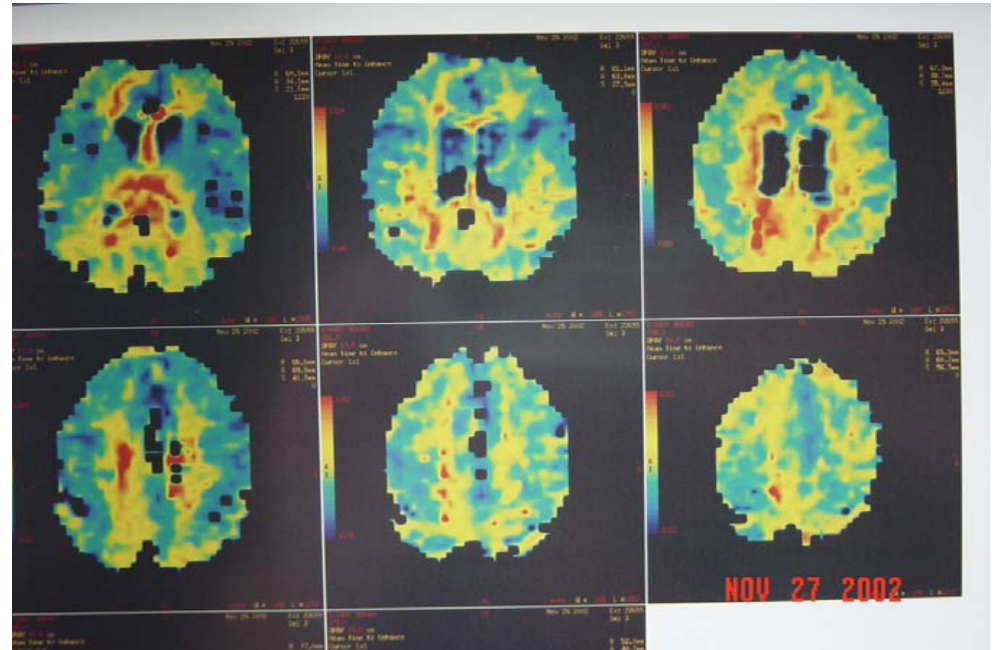
The importance of Metacognition

Frontal network syndromes (FNS)

- FNS are the most common cognitive disorders
- Confirmed by animal models
- FNS increasingly reported with discrete lesions outside anatomical boundary of the frontal lobe
- Include; subcortical grey matter, subcortical white matter, isolated lesions of the brainstem, cerebellum, temporal and parietal lobes

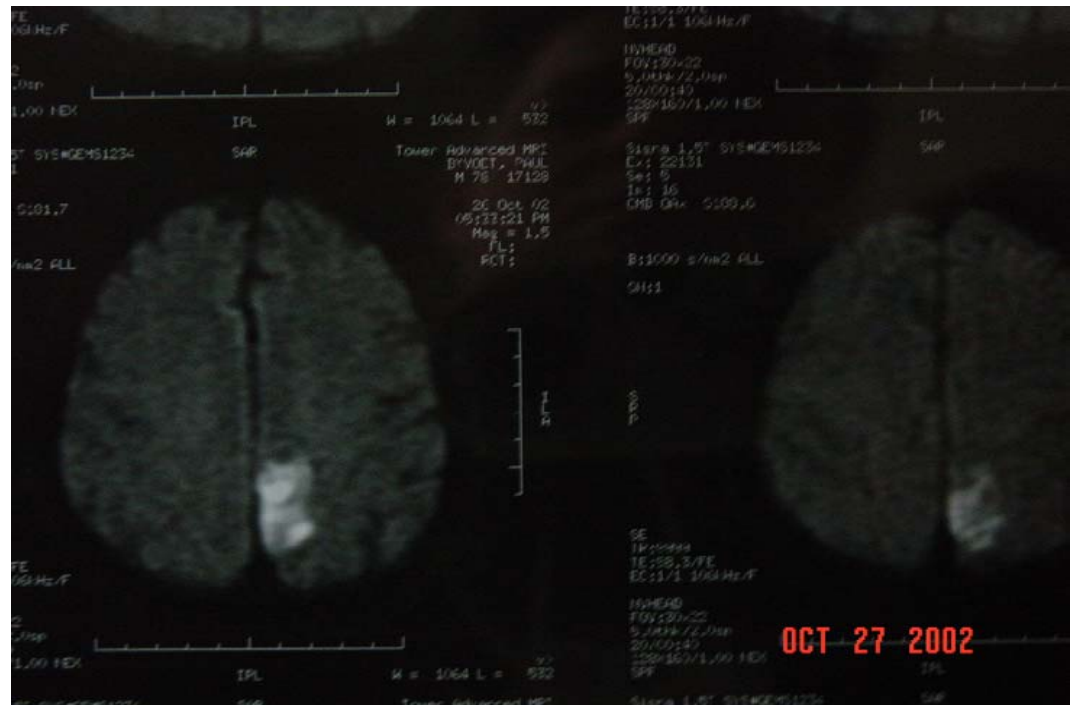
Spectrum of Frontal Network Disorders

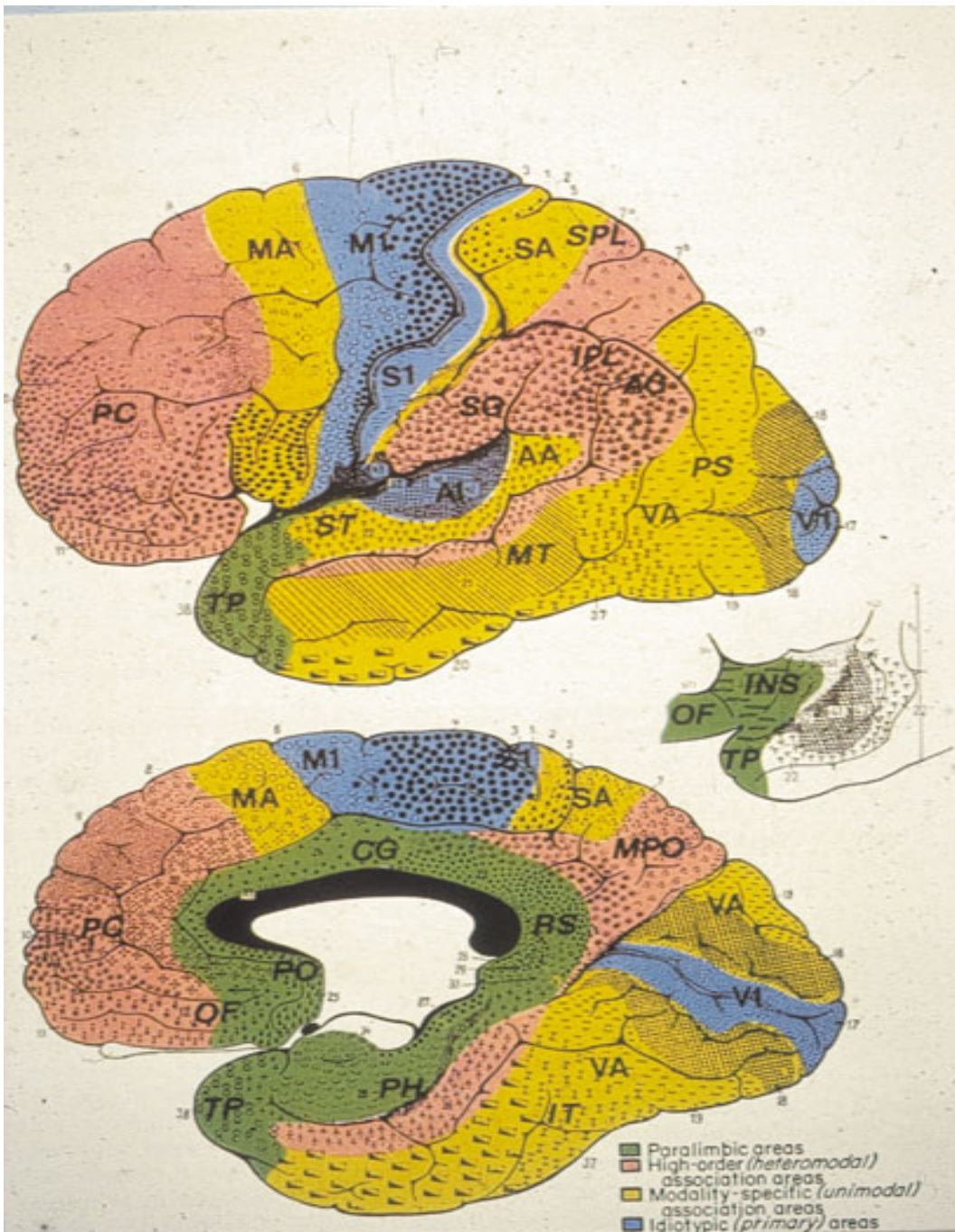
- Structural (stroke, tumour)
- Frontal Lobe Epilepsies
- Schizophrenia
- Anxiety
- Depression
- Obsessive Compulsive
- Tourette's syndrome
- ADHD
- Traumatic brain injury
- Autism
- Pervasive developmental disorders



Cognitive Testing.

- **Mental Status**
- Cranial Nerves
- Motor System
- Reflexes
- Sensation
- Coordination
- Gait





Hemispheric dominance

Left hemisphere

- Language
- Analytical/mathematical
- Temporal sequencing of stimuli

Right hemisphere

- Attention
- Prosody
- Spatial construction
- Body image
- Melody
- Emotion

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

Cognitive impairment and stroke.

Pilot Data

- Hoffmann M, Sacco RS, Mohr JP, Tatemichi TK. Higher cortical function deficits among acute stroke patients: The Stroke Data Bank experience. Journal of Stroke and Cerebrovascular Diseases 1997;6:114-120
- Hoffmann M. Higher Cortical Functions After Stroke: An Analysis of 1000 Patients from a Dedicated Cognitive Stroke Registry. Neurorehabilitation and Neural Repair. 2001;15:113-127
- Hoffmann M, Schmitt. Cognitive impairment in isolated subtentorial stroke. Acta Neurologica Scandinavica 2004;109:14-24.

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.



A



B



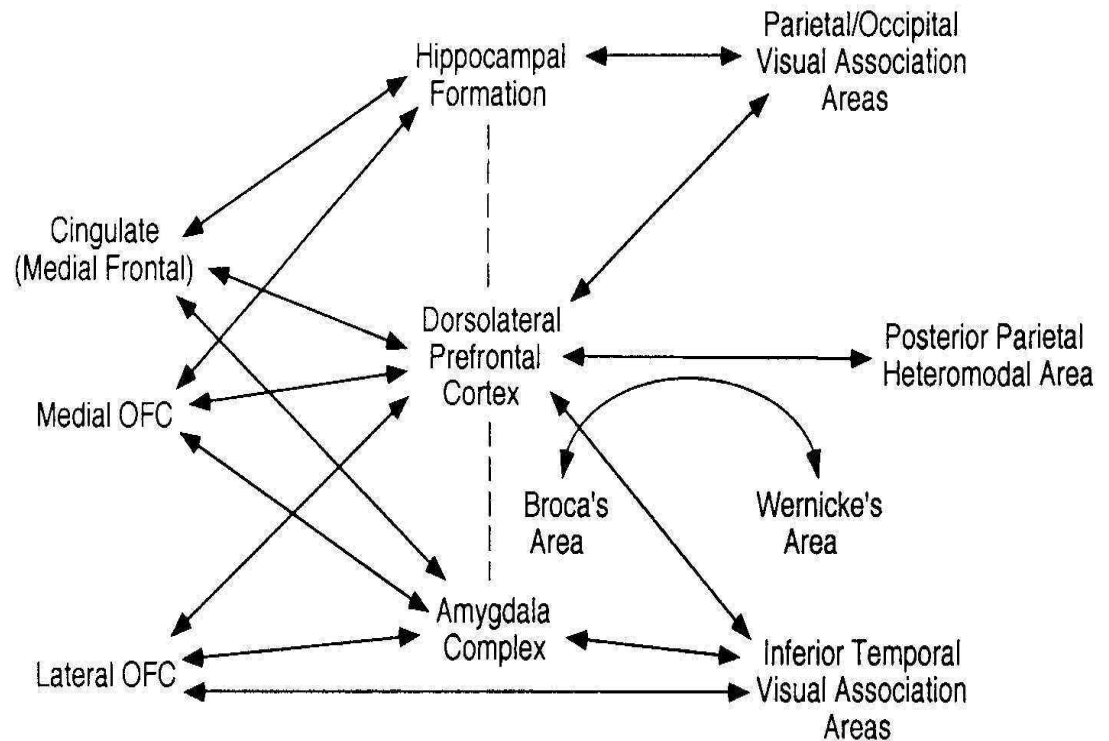
Lhermitte F. Human Autonomy and The Frontal Lobes.

Part 1: Imitation and Utilization Behavior. A Neuropsychological Study of 75 Patients.

Ann Neurol 1986;19:326-334.

Metacognition

- Neural search engines
- Frontal network syndromes ubiquitous
- Analogy of fever to infections

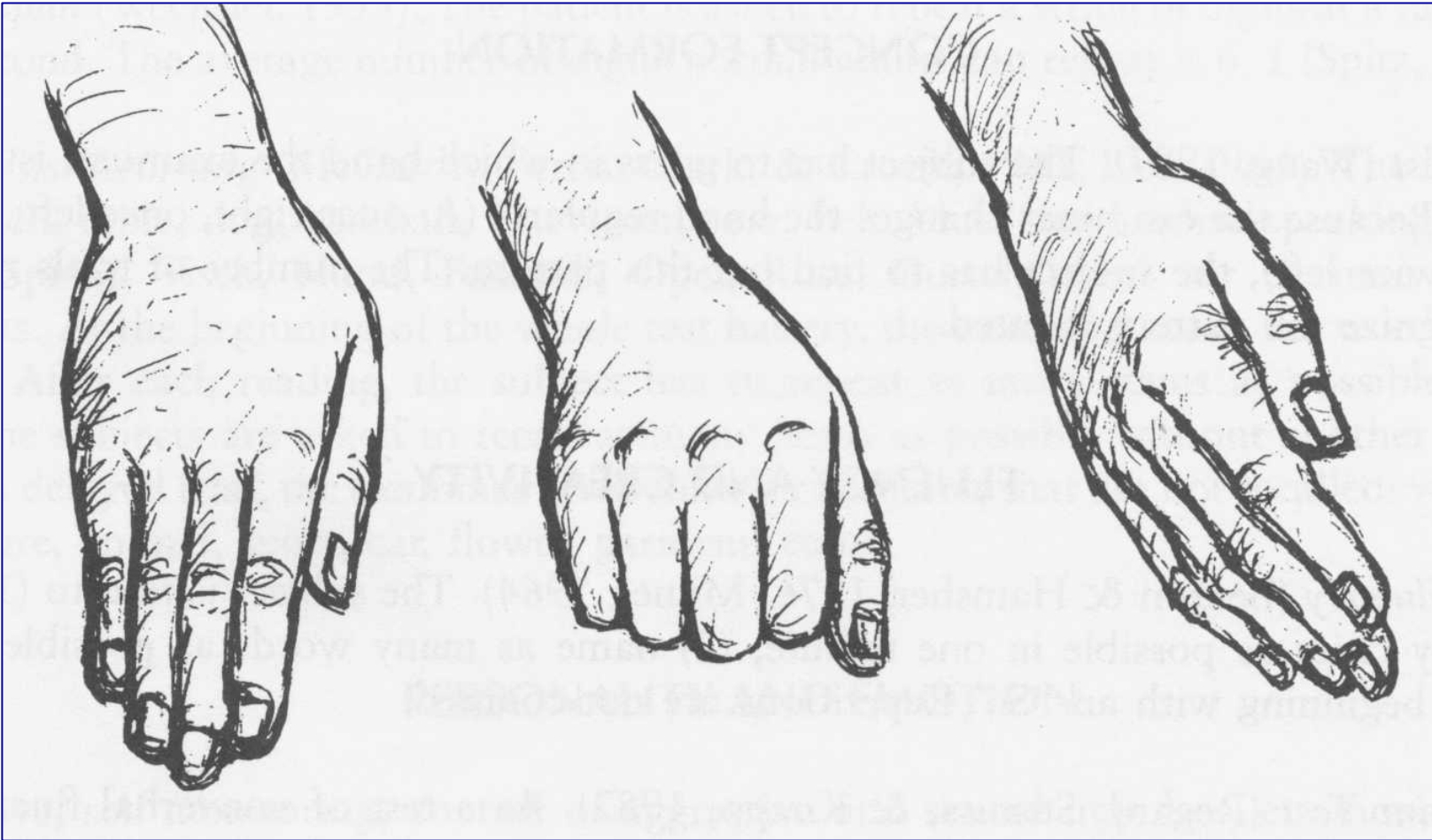


Coconut Testing

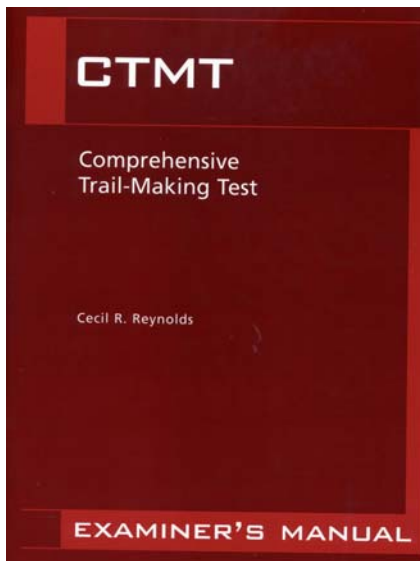
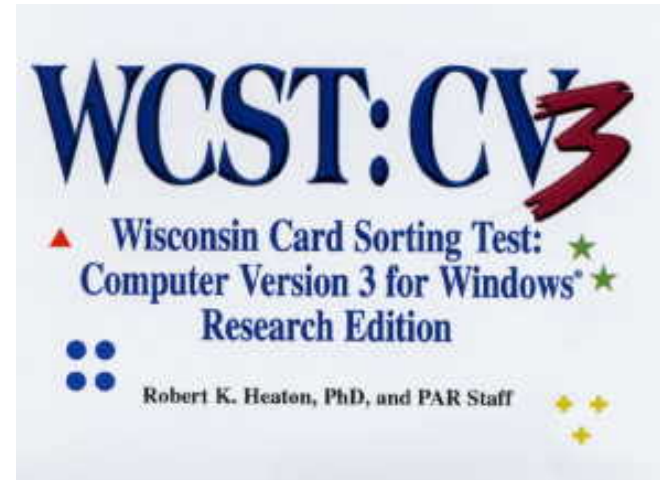
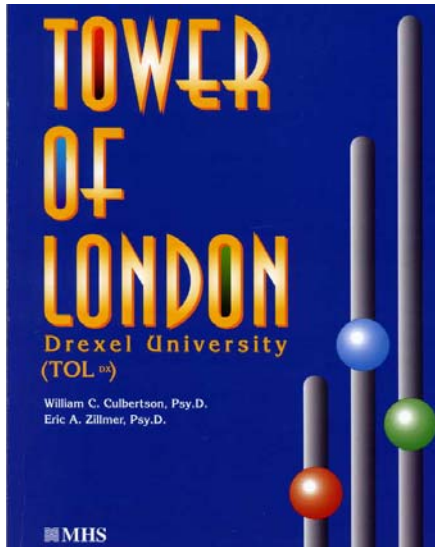
- Neuropsychological metric examination
- Bedside behavioral neurological
- Neuropsychiatric

Motor Programming

Luria Hand Sequence Test



Neuropsychological Tests



STROOP
Neuropsychological Screening Test
RECORD FORM

Max B. Tenney, Ph.D.
Diane Cooney, Ph.D.
James DeBoo, Ph.D.
William R. Lober, Ph.D.

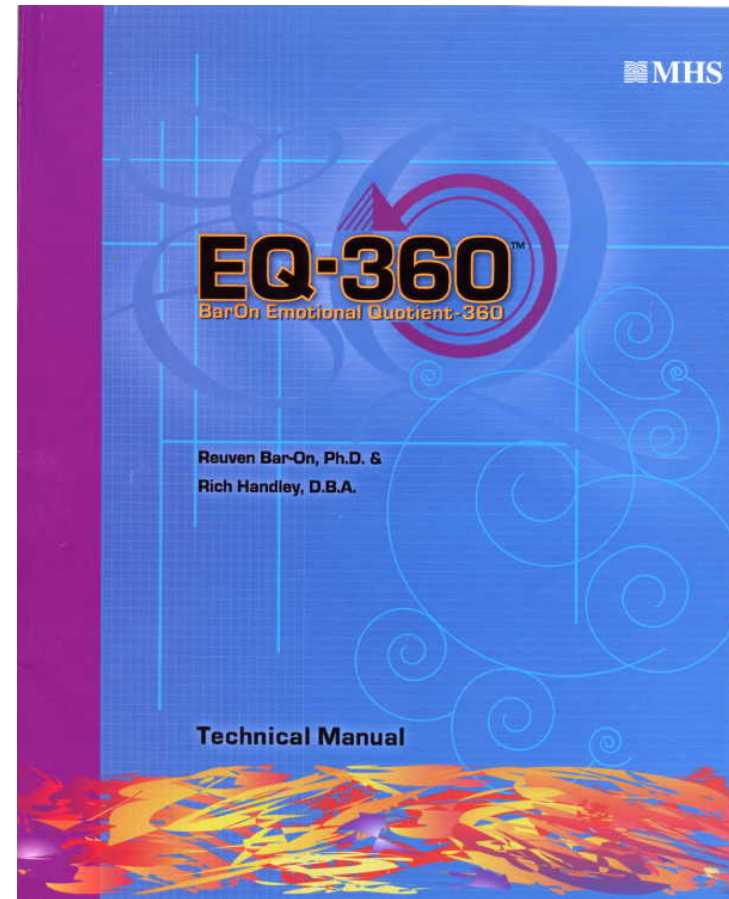
Name _____
Sex _____ Age _____ Date _____
Reason for Referral _____
Diagnosis/Notes _____

	SCORES	
	Color Task	Color Word Task
Number of Responses	_____	_____
Incorrect Responses	_____	_____
Scale	_____	_____
Percentile	_____	_____
Pt. (Brain Damage)	_____	_____

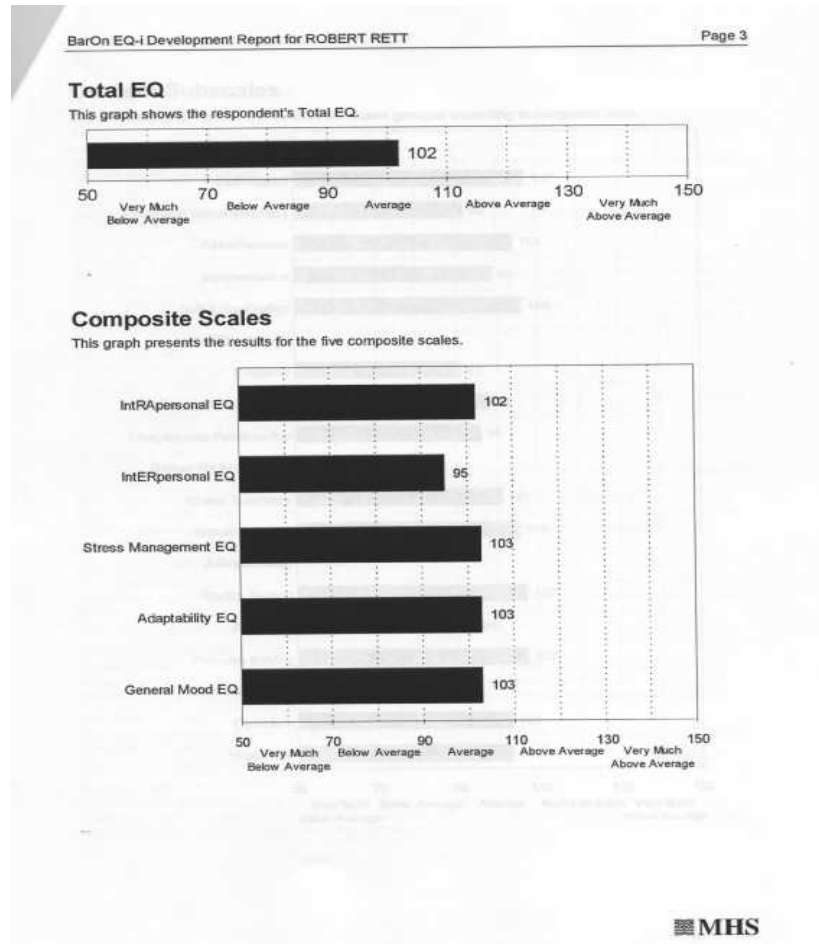
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Neuropsychological Tests

- Wisconsin Card Sorting Test (4.0)
- Frontal Systems Behavioral Test
- Tower of London
- Emotional Intelligence (Baron)
- Comprehensive Trail Making Test

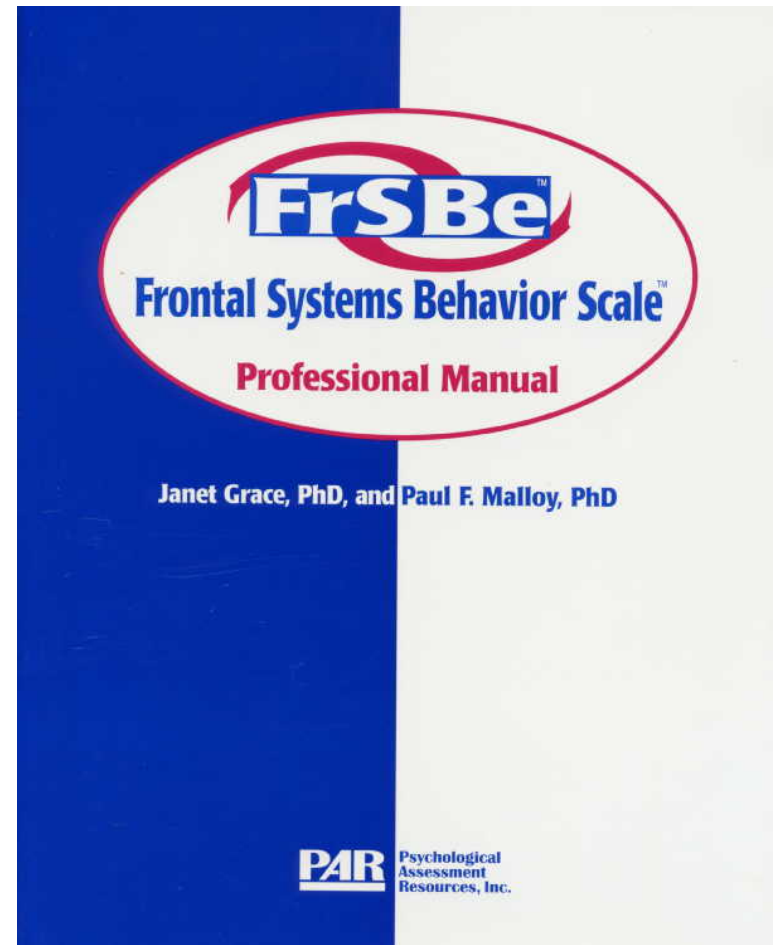


Emotional Intelligence Scoring



Frontal Systems Behavioral Scale

- Lickert Scale
- 46 questions
- Executive dysfunction
- Apathy
- Disinhibition
- Before/After options
- T scores ≥ 65 impaired
- T scores 6-64 marginal



FRSBE

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Cognitive stroke registry n=2000

• <i>Coma</i>	154	• Agnosia	16
• <i>Enceph</i>	113	• Achromatopsia	8
• Frontal	340	• Prosopagnosia	6
• Aphasia	283	• Angular Gy	7
• Amnesia	268	• Gerstmann's	5
• Neglect Synd	88	• Pure Word	2
• Anosognosia	69	• Alexia no agr	2
• Apraxia	49	• Anton' Synd	2
• Visuospatial	41	• Akinetopsia	2
• Aprasodia	31	• Astereopsis	1
• Alexia	23	• Foreign Acc	1
		• Del Mis ID	14
		• <i>Normal</i>	308

Misery Perfusion Syndrome. Post stent deployment

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Young woman 36 y. NIHSS = 3, FNS score =
16. Management: EC - IC bypass

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A 24 year old man

- NIHSS = 1
- FNS = 32
- Frontal syndrome with disinhibition, perseverative responses, stimulus bound behavior and echopraxia.
- ICH

QuickTime™ and a
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are needed to see this picture.

Dysexecutive syndrome

- Subcortical lesions
- Frontal subcortical circuits

Kramer et al. Executive dysfunction in subcortical ischemic vascular disease. J Neurol Neurosurg Psych 2002;72:217-220



Abulia - spectrum of disorders

- Athymhormia
- Abulia
- Apathy
- Akinetic mutism

QuickTime™ and a
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are needed to see this picture.

32 year old woman

- Post partum
- Profound abulia
- Severe frontal syndrome
- Duration 5 days

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are needed to see this picture.

Deep venous thrombosis

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TIFF (LZW) decompressor
are needed to see this picture.

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Accurate diagnosis and treatment

- Both the syndrome (simultanagnosia) and.....
- mechanism (eclampsia) required for firm diagnoses
- Call Fleming syndrome not unexpected

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are needed to see this picture.

Posterior lesions and frontal syndromes

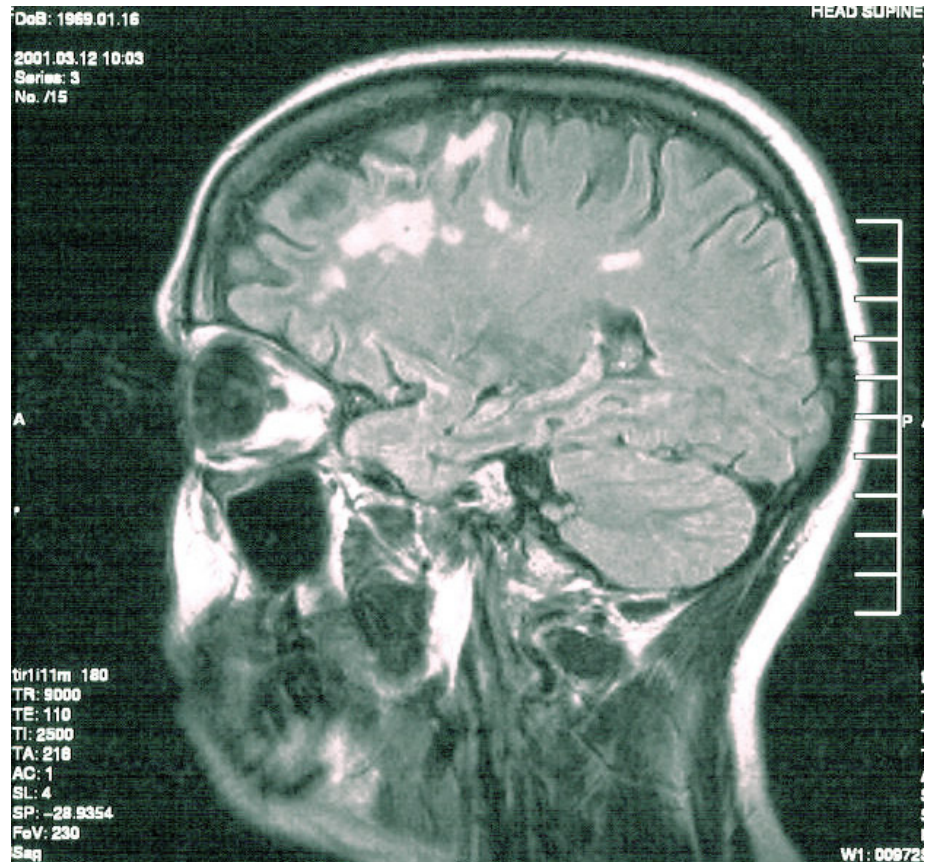
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Mandarin Chinese – an example of a tone language

• Mandarin phoneme tone	English word
• Ma	mother
• Ma	numbness
• Ma	horse
• Ma	curse

Transcortical Motor Aphasia

- Internal watershed infarction
- Misdiagnosed as multiple sclerosis

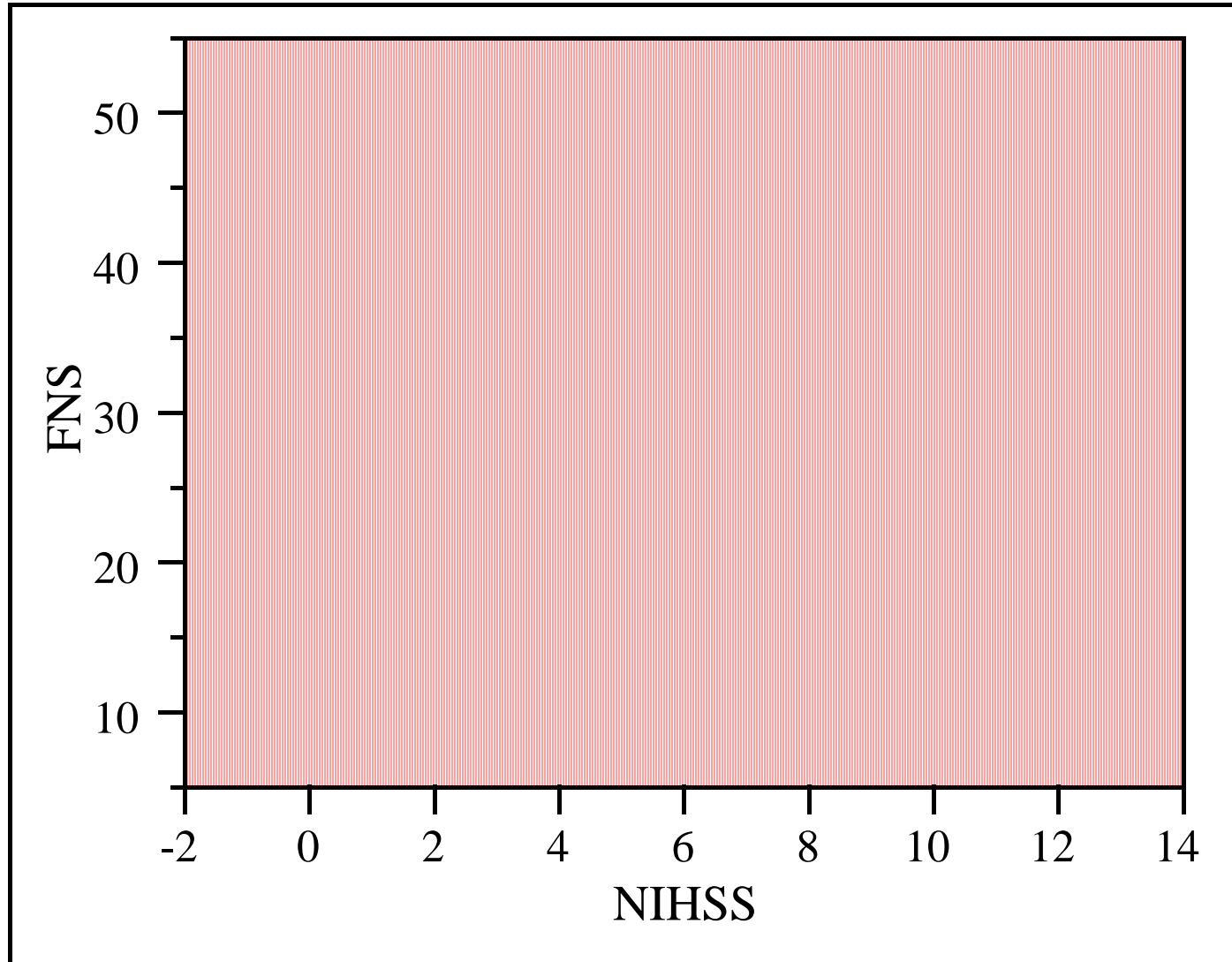


Denying blindness

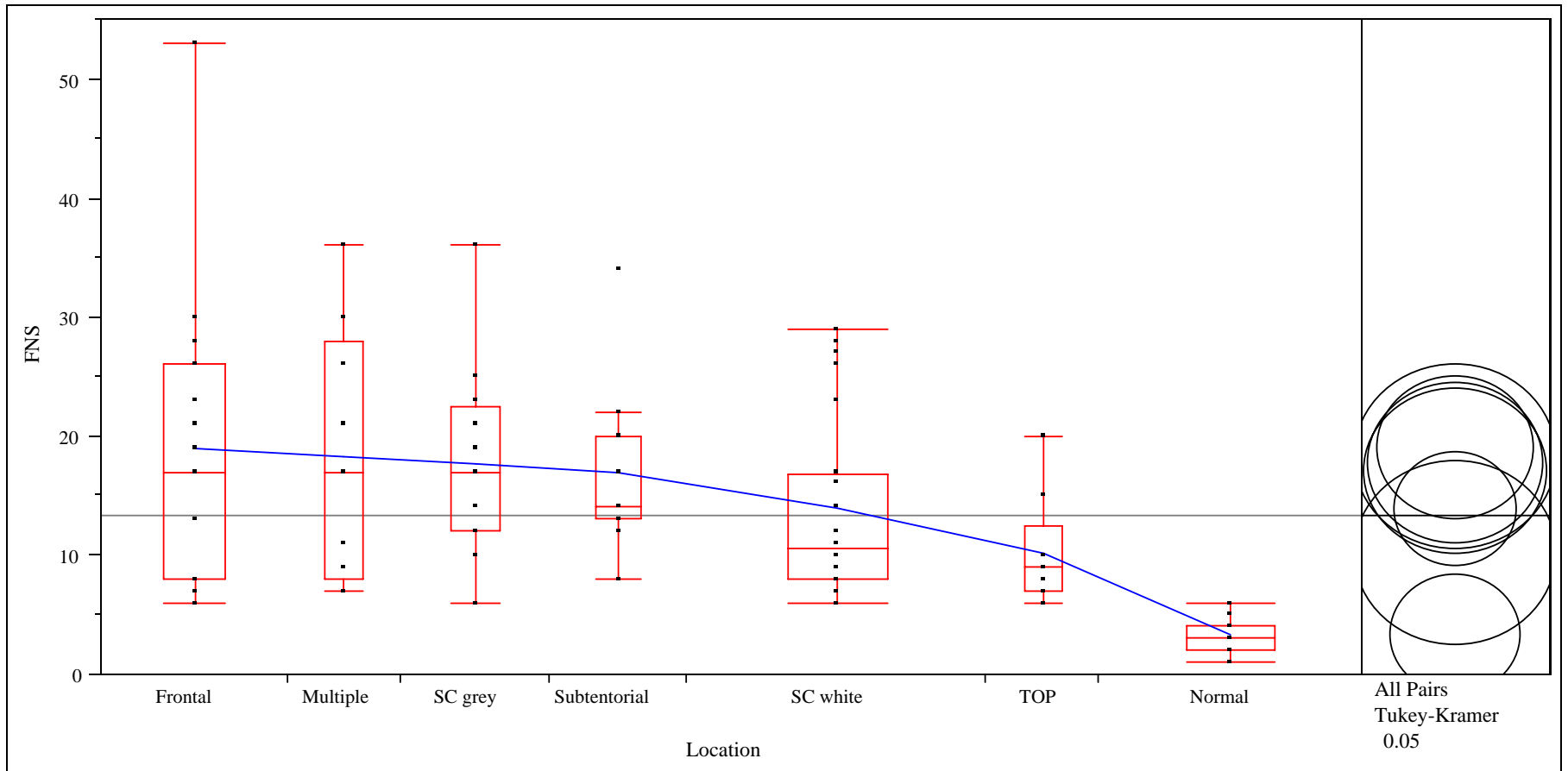
- Cerebroappendicular syndrome
- Top of basilar syndrome
- Cortical blindness
- Anton's syndrome
- Visual agnosia



FNS by stroke severity. F ratio 4.7, $r=0.2$, $p=0.03$

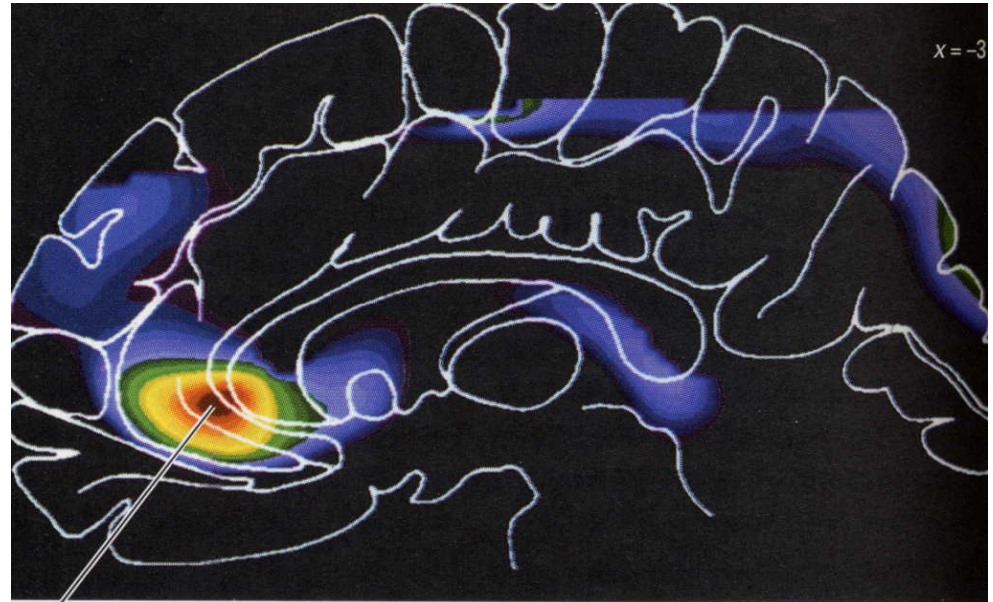


Lesion location vs FNS: ANOVA



Organicity: Structural/Chemical/Electrical

- Decrease in metabolism in depression relative to controls.
- Drevets et al.
Nature
1997;386:824-827



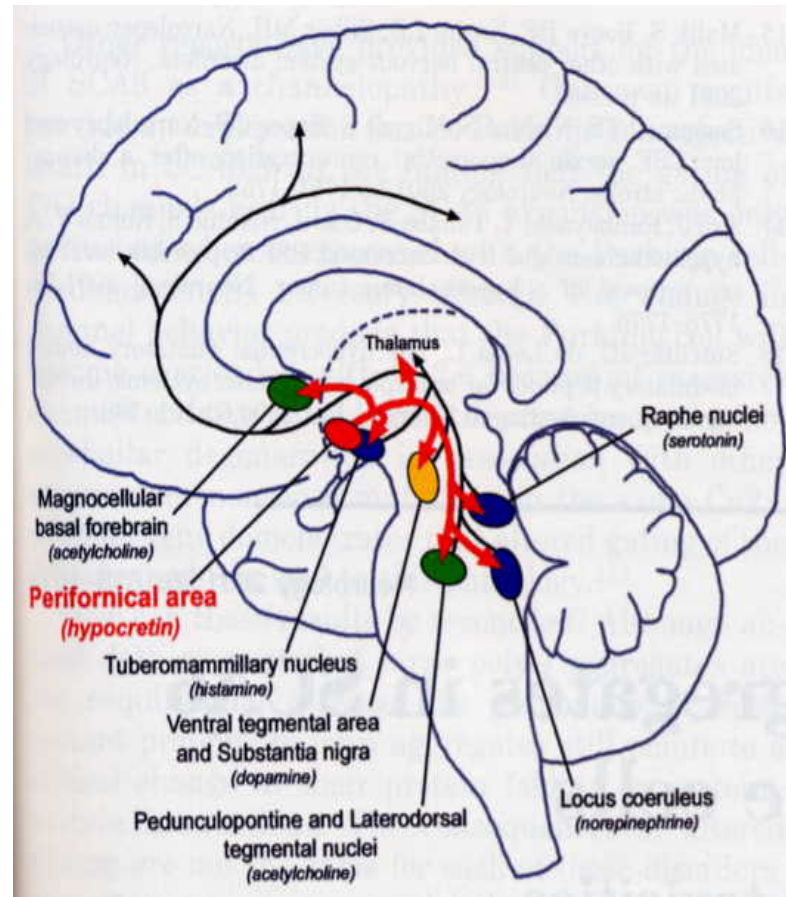
Principle chemical projections to cerebral cortex

State dependent systems

1. Cholinergic - n. basalis of Meynert
2. Histaminergic - hypothalamus
3. Dopaminergic - ventral tegmental area
4. Serotonergic - brainstem raphe nuclei
5. Noradrenergic - locus ceruleus

Pharmacotherapy of cognitive disorders

- Aricept in aphasia
- Dopamine effective for working memory *
- Dopamine for akinetic mutism
- Dopamine in apathy
- Modafanil in apathy
- Bromocriptine in motor aphasia



* Knecht S, Breitenstein C, Bushuven S, Ringelstein EB. Levodopa: Faster and better word learning in normal humans. *Ann Neurol* 2004;56:20-26

Experimental trial

- Primary aims: To test the hypothesis that metacognitive deficits in young people with stroke are improved with dopaminergic medication by comparing pre and post treatment test scores following a 6 week randomized, double blinded placebo controlled trial using dopaminergic therapy.

Experimental Trial

- Secondary Aim: To test the hypothesis that different metacognitive components (attention, executive function, emotional intelligence, apathy, disinhibition) and their subtest scores are differentially affected by dopaminergic therapy.

Why the fuss ?

- Health policy planners long needed an index of frontal dysfunction to determine eligibility for long-term care benefits.
- Improved imaging capability of MRI, SPECT and PET scanners delineated frontal impairment without gross frontal lesions.
- Strong link between impaired frontal function by testing and impaired performance in the goal directed behavior: careers and employment

State dependent vs “hard wired” network systems

- Diagnosis of frontal systems impairment in patients, not imageable by surrogate markers such as MRI or PET scans ?
- Schizophrenia, depression and frontal subcortical systems impairment attest to the severity of frontal dysfunction with normal neuroimaging.
- Improved clinical diagnostics will remain the directional beacon to follow

Quantitative Frontal Bedside Testing

- Ettlín TM, Kischka U, Beckson M, Gaggiotti M, Rauchfleisch U, Benson DF. The Frontal Lobe Score: part I: construction of a mental status of frontal systems. Clin Rehabil. 2000 Jun;14(3):260-71
- Dubois B, Slachevsky A, Litvan I, Pillon B. The FAB. A frontal assessment battery at the bedside. Neurology 2000;55:1621-1626
- Royall DR, Mahurin RK, Gray KF. Bedside assessment of executive cognitive impairment: the executive interview. J Am Geriatr Soc 1992;40:1221-1226
- Hoffmann M, Schmitt F. Metacognition in stroke. Bedside assessment and relation to location, size and stroke severity. Cognitive and Behavioral Neurology 2006;19(2):85-94.

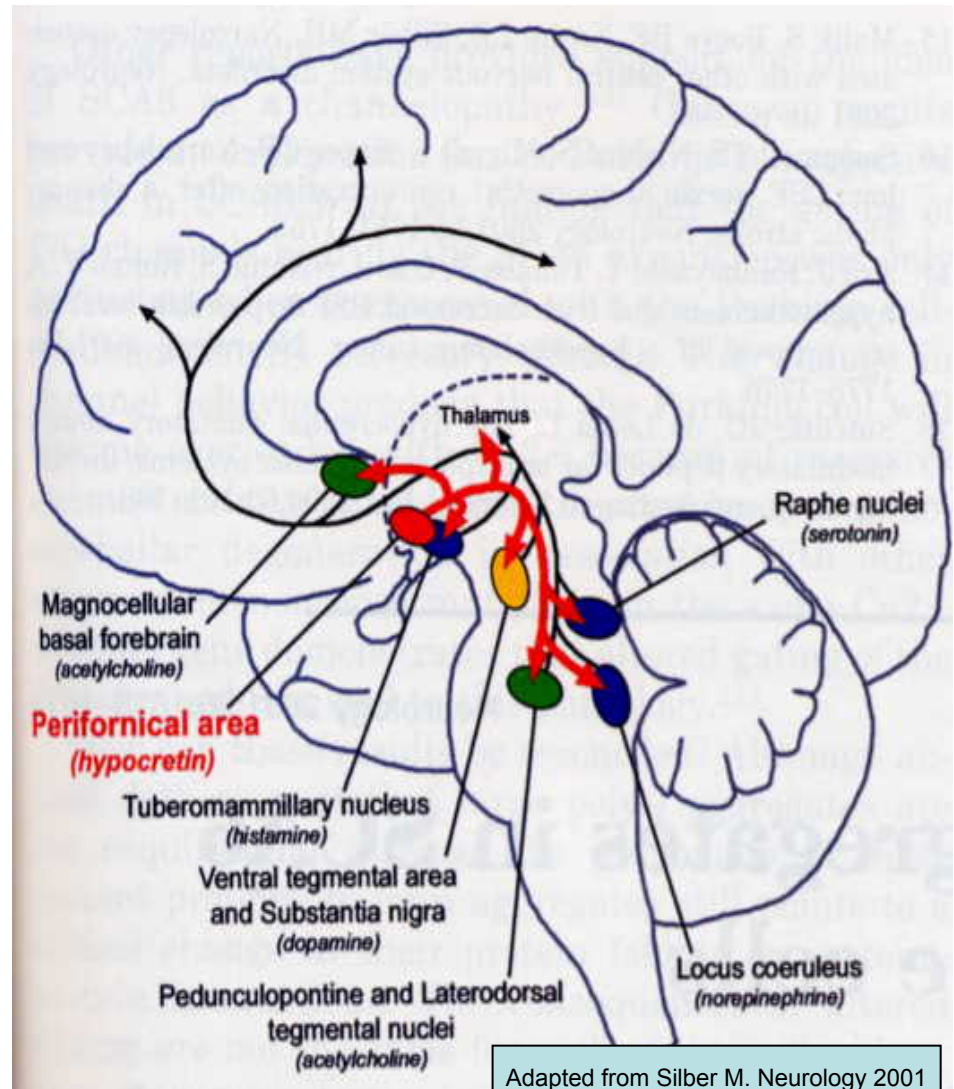
Thank You



Affecting tone and color of behavior as opposed to content

- **NA** - Novelty seeking behavior and resistance to distraction
- **DA** - Encoding of reward and effort associated with cognition
- **5HT** - sensory gating of environmentally behavioral clues
- **Ach** - promotes arousal, motivational valence, learning
- **Hist** - cortical arousal, energy metabolism, autonomic function

Cognitive Impairment in Isolated Subtentorial Stroke. Hoffmann M 1, Schmitt F 2.
Department of Neurology, University of South Florida, Tampa Fl 1 and
Department of Neurology University of Kentucky, Lexington KY 2. Acta
Neuologica Scandinavica 2004;109:14-24



Adapted from Silber M. Neurology 2001