

Clinical Assessment of Prefrontal Functions

Morris Freedman MD, FRCPC, FAAN

Division of Neurology

Baycrest and University of Toronto

Rotman Research Institute, Baycrest

World Congress of Neurology

Dubai 2019

Baycrest

mfreedman@baycrest.org



Disclosures

None related to presentation

Objectives

To discuss bedside assessment of prefrontal function with focus on:

- Cognitive and behavioural processes
- Underlying neuroanatomy

Key Messages

- Prefrontal regions mediate higher cortical functions
- Prefrontal functions are not equivalent to executive functions

Executive function

Task setting

- Left dorsolateral frontal

Monitoring

- Right dorsolateral frontal

-
- Stuss and Alexander. *Phil Trans R Soc B*. 2007
 - Henri-Bhargava, Stuss, Freedman.
In Glebius G. *Progressive Cognitive Impairment and its Neuropathologic Correlates*, 2016
 - Henri-Bhargava, Stuss, Freedman. *Continuum* 2018

Task Setting

Putting in place a plan in response to a stimulus or demand

eg



- Performing a cognitive task
- Learning how to drive a car
- Planning an event

Monitoring

Process of checking a task over time and adjusting behaviour as needed for successful completion

eg



- Not repeating numbers on clock drawing
- Tapping with a consistent beat

Clinical Examples

History

- Extremely important
- eg difficulty carrying out a novel task suggests problems with task setting

Bedside Mental Status Exam

- Clock drawing
- Multiple loops
- Alternating square and triangular figures

Other Measures of Executive Function

Digit span backward

- Task setting: Repeating digits backwards instead of forwards
- Monitoring: Repeating digits only once
- Working memory also involved (ability to consciously retain and manipulate information in the short term)

Other Measures of Executive Function

Trails A

- Energization (speed) and some monitoring

Trails B

- Monitoring and task setting (remembering to shift set)

Phonemic fluency

- Energization but also task setting (eg don't use proper names) and monitoring (avoid repeating same word)

Energization

Process of initiating and sustaining a response

Neuroanatomy

- Bilateral superior medial (SM), including anterior cingulate

Henri-Bhargava, Stuss, Freedman. Continuum 2018

Energization (Superior Medial)

Behavioural Observation

- Akinetic mutism at extreme end
- Reduced initiation and drive of motor or cognitive responses (**apathy**)

Cognitive Testing

- Phonemic word fluency (fewer words later)
- Slow to perform tests in general

Orbitofrontal Function

Important for evaluating outcomes & options for action

Patients with orbitofrontal lesions

- May perform well on neuropsychology tests
- Social cognitive deficits (examples)
 - a) Socially inappropriate
 - b) Poor judgement
 - c) Impulsive
 - d) Excess jocularity
 - e) Obsessions
 - f) Hyperorality
 - g) Personal neglect

56-year-old woman with bvFTD

- School teacher
- Recent change in behaviour

Video

Cognitive Test of Orbitofrontal Function

- Majority of clinical neuropsychological tests are sensitive primarily to dorsolateral frontal lesions
- Need clinical tests that are sensitive to orbitofrontal and medial frontal lesions

Object Alternation

In humans

- Sensitive to ventrolateral-orbitofrontal and medial frontal lesions
- BA areas 10, 24, 32, 47, and possibly 11

Freedman, Black, Ebert, Binns. *Cerebral Cortex*, 1998

Object Alternation Test

Processes

- Working memory for objects
- Ability to shift set

Frontopolar

Theory of Mind (ToM)

Awareness of

- Content of other people's minds
- One's own mental state

Premack & Woodruff. Behavioural and Brain Sciences, 1978

Freedman & Stuss. J of Neurological Sciences, 2011

Conclusions

- Different frontal regions subserve different cognitive functions:
 - a) Dorsolateral: Executive (task setting and monitoring)
 - b) Superior medial: Energization
 - c) Orbitofrontal and Frontopolar: Social Cognition
- Executive dysfunction is determined by the nature of errors on cognitive tasks rather than simple performance on a specific task

References

Freedman M, Stuss DT. Theory of Mind in Parkinson's disease. *J. Neurol. Sci.* 2011;310(1-2):225-227

Henri-Bhargava A, Stuss DT, Freedman M. Function and Dysfunction of the Prefrontal Lobes in Neurodegenerative Diseases. In: Gediminas PE, ed. *Progressive Cognitive Impairment and its Neuropathologic Correlates*. New York: Nova Science Publishers Inc; 2016; 51-68.

Henri-Bhargava A, Stuss DT, Freedman M. Clinical Assessment of Prefrontal Lobe Functions. 2018.

Premack D, Woodruff G. Does the chimpanzee have a theory of mind? *The Behavioral and Brain Sciences.* 1978;1:515-526.

Stuss DT, Alexander MP. Is there a dysexecutive syndrome? *Philosophical Transactions of the Royal Society of London - Series B: Biological Sciences.* 2007;362(1481):901-915.