



ASSESSMENT OF ATTENTION IN CLINICAL CONDITION

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BRAIN AND COGNITION

5/25/2019

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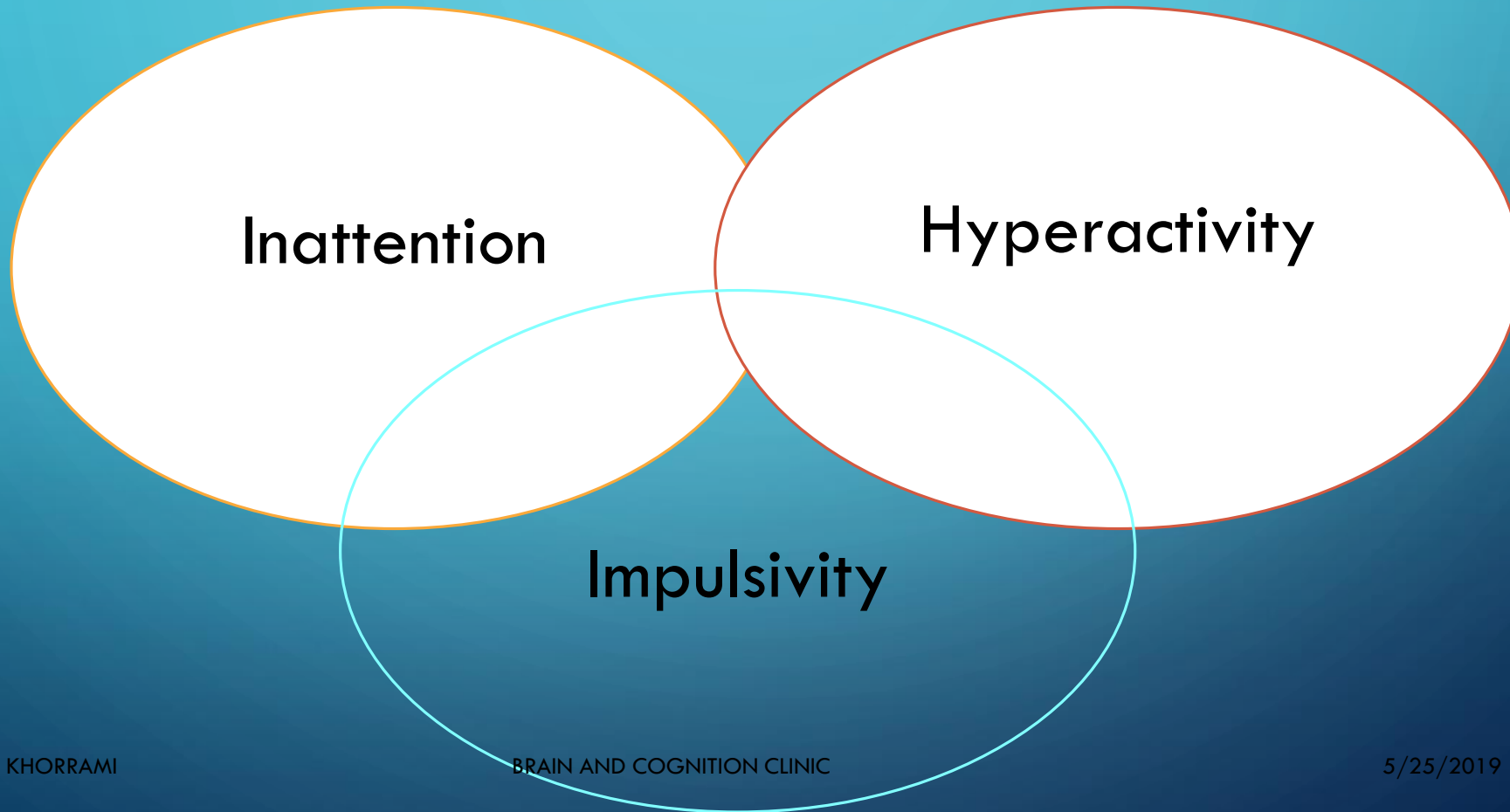


- ADHD definition
- Neuropsychology of Attention in ADHD and similar clinical condition
- Clinical assessment of attention RDoC, Interview and Examination, Biomarker
- Other assessment of Attention
- WORKING MEMORY
- Functional Anatomy



Attention deficit hyperactivity disorder (ADHD) is one of the most common childhood disorders and can continue through adolescence and adulthood. According to Oakland and Brue (2002), "From 6% to 8% of school-aged children (approximately 2 to 3 million) are affected in the United States." Treatment of ADHD ranges from many types of medications that are stimulants to more natural remedies. In this study we will take a look at our brain and how it functions with ADHD, the symptoms of ADHD, treatment options as well as ways to support children with ADHD.

WHAT IS ADHD?



Defining ADHD: Symptoms

- Often fidgets or squirms about when seated
- Is easily distracted
- Talks out of turn
- Has trouble with follow through
- Has difficulty staying on task
- Shifts rapidly from one task to another without completing first task or activity
- Seems unable to play quietly
- Talks excessively
- Frequently interrupts or intrudes
- Seldom listens attentively
- Is disorganized: loses assignments, pencils, toys.
- Often seems unaware of consequences and so engages in potentially dangerous behavior. (Allen & Bowdery, 2010)



CLINICAL NEUROPSYCHOLOGY

- ◎ Neuropsychologists use models of brain-behavior relationships to determine whether expected neurobehavioral function is different from normal, or has changed to a degree that is consistent with impairment
- ◎ Typically, neuropsychologists perform assessments (psychological tests) that evaluate functioning of the brain
 - Determine if performance is in expected range
 - Determine if performance is consistent with brain damage
 - Make recommendations about how to manage cope with weaknesses, utilize strengths, and improve functioning

WHAT IS NEUROPSYCHOLOGY?

- *Neuropsychology* is the study of the effects of lesions or dysfunctions of the Central Nervous System (CNS) on cognition and behaviour.
- The regions of interest are the cortex of the two brain hemispheres, the sub-cortical structures (such as thalamus, basal ganglia, hypothalamus, and amygdala) and the main connecting white matter fibres.

THE AIMS OF NP

- Neuropsychology is useful for both research and clinical purposes:
 1. It explores the functional architecture of the mind and its neural correlates;
 2. It provides patients with a diagnosis and possibly with rehabilitative recommendations.
- No research is possible without a clear understanding of the nature of the deficit.

Problems in current psychopathology diagnosis

- Defined by clusters of signs & symptoms, but not primary aspects of behavior or brain functioning
- Poor validity: A system created for reliability
- Heterogeneity of DSM/ICD categories (polythetic criteria sets)
- Extensive co-morbidity: Multiple mechanisms
- Result: difficult to relate diagnoses to genes, particular brain circuits, or basic behavioral mechanisms;
- AND: our diagnostic system drives research grants, journal publications, clinical trials, and regulatory agencies

RDoC: Candidate Domains/Constructs and Units of Analysis (v. 1.0)

v. 3.1, 6/30/2011	DRAFT RESEARCH DOMAIN CRITERIA MATRIX							
	----- UNITS OF ANALYSIS -----							
DOMAINS/CONSTRUCTS	Genes	Molecules	Cells	Circuits	Physiology	Behavior	Self-Reports	Paradigms
Negative Valence Systems								
Acute threat ("fear")								
Potential threat ("anxiety")								
Sustained threat								
Loss								
Frustrative nonreward								
Positive Valence Systems								
Approach motivation								
Initial responsiveness to reward								
Sustained responsiveness to reward								
Reward learning								
Habit								
Cognitive Systems								
Attention								
Perception								
Working memory								
Declarative memory								
Language behavior								
Cognitive (effortful) control								
Systems for Social Processes								
Imitation, theory of mind								
Social dominance								
Facial expression identification								
Attachment/separation fear								
Self-representation areas								
Arousal/Regulatory Systems								
Arousal & regulation (multiple)								
Resting state activity								

Construct: A concept summarizing data about a specified functional dimension of behavior (and implementing genes and circuits).

Review Article

An Update on Biomarkers in Psychiatric Disorders - Are we aware, Do we use in our clinical practice?

Hema Venigalla

Texas Behavioral Health Clinic, Texas, USA

Hema Madhuri Mekala

University of Missouri, MO, USA

Mudasar Hassan

NYU Lagone Medical Center, NY, USA

Rizwan Ahmed

Liaquat College of Medicine and Dentistry, Pakistan

Hira Zain

Dow University of Health Sciences, Pakistan

Sabrina Dar

Bucks County Mental Health Center, USA



MODELS AND THEORIES ARE NEEDED TO BETTER ASSESSMENT

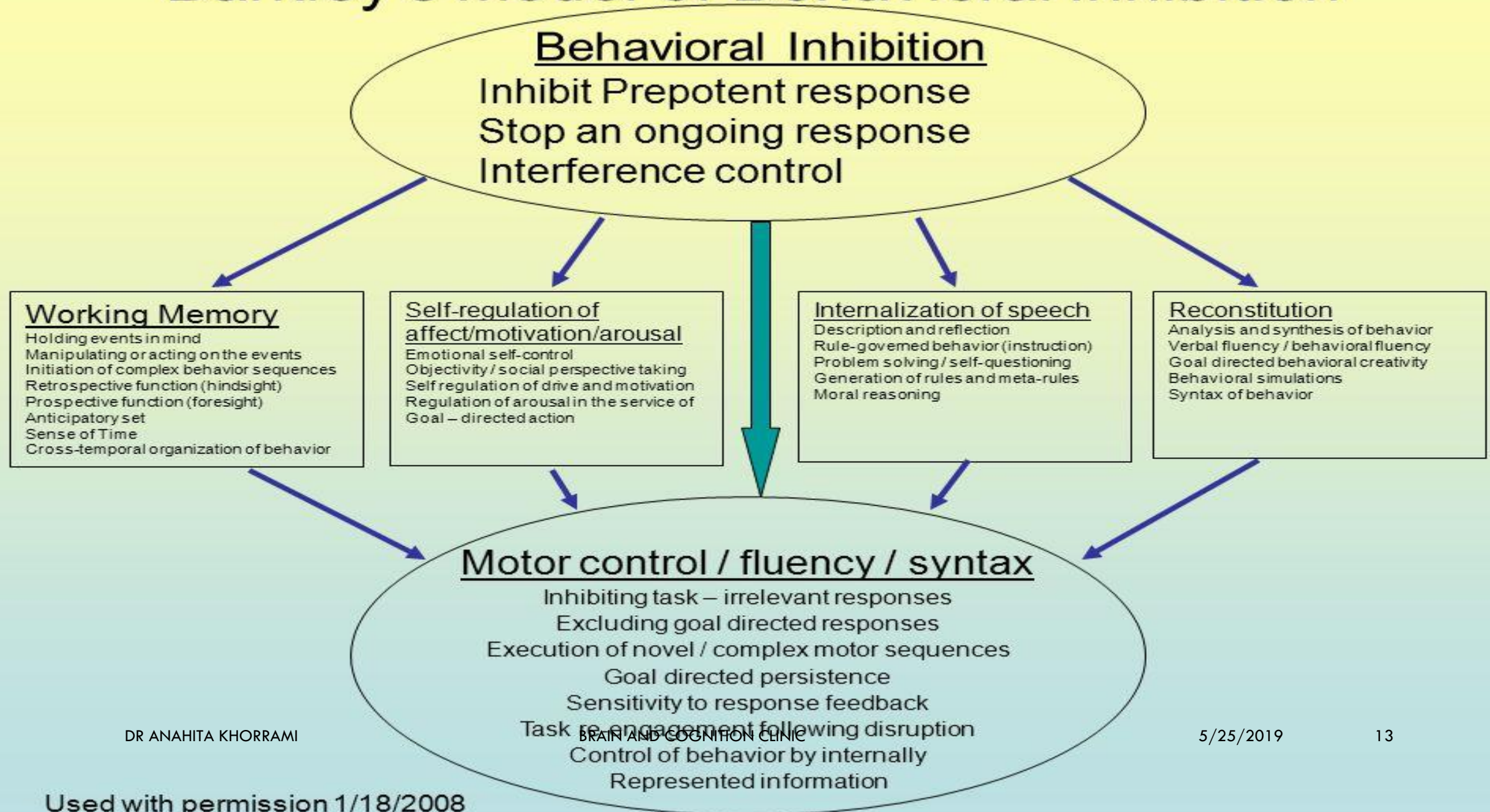
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Barkley's Model of Behavioral Inhibition



ADHD: NEUROPSYCHOLOGICAL THEORIES

- **Cognitive-Energetic Model**
2005

Sergeant 1999,

- Overall efficiency of information processing is determined by interplay between computation mechanisms of attention, state factors & management/executive function.
- Encompasses both bottom-up and top-down process and approaches in ADHD at 3 levels.

- **Attention to fact that ADHD causes defects at 3 levels:**

- **Cognitive mechanisms (e.g., response output)**
- **Energetic mechanisms (e.g., activation; effort)**
- **Management systems**

ADHD: NEUROPSYCHOLOGICAL THEORIES

- Cognitive-Energetic model levels
- 1) 4 stages of the computational mechanisms of attention
- 2) 3 distinct energetic pools
- 3) Overriding management or executive system

ADHD: Neuropsychological theories

- Cognitive-Energetic model levels
- 1) **4 stages of the computational mechanisms of attention**
 - Encoding
 - Search
 - Decision
 - Motor organization
- Stages all associated with experimental task variables

ADHD: Neuropsychological theories

- Cognitive-Energetic model levels
- 2) **3 distinct energetic pools:**
 - Effort, arousal & activation
- A) **EFFORT:**
 - Defined as energy necessary to meet **task demands**.
 - Affected by **cognitive load**.
 - Required when current organism state **does not match task demand**.
 - Encompasses motivation & **response to contingencies**.
 - Associated with **hippocampus**.
 - Functions to **excite & inhibit arousal & activation**.

ADHD: NEUROPSYCHOLOGICAL THEORIES

- Cognitive-Energetic model levels
- 2) **3 distinct energetic pools:**
 - B) **AROUSAL:**
 - Defined as phasic responding to that is time locked to stimulus processing.
 - Typically influenced by **signal intensity and novelty.**
 - Associated with **mesencephalic reticular formation & amygdala.**

ADHD: NEUROPSYCHOLOGICAL THEORIES

- Cognitive-Energetic model levels
- 2) **3 distinct energetic pools:**
 - **C) ACTIVATION:**
 - Association with the **tonic physiologic readiness to response.**
 - Affected by **task variables** such as 1- **preparation**, 2- **alertness**, 3-**time of day**, and 4-**time on task.**
 - Associated with **basal ganglia.**

ADHD: NEUROPSYCHOLOGICAL THEORIES

- Cognitive-Energetic model levels
- 3) **Overriding management or executive system**
 - Associated with 1-planning, 2-monitoring, 3-error detection & correction
 - Associated with prefrontal cortex

ADHD: NEUROPSYCHOLOGICAL THEORIES

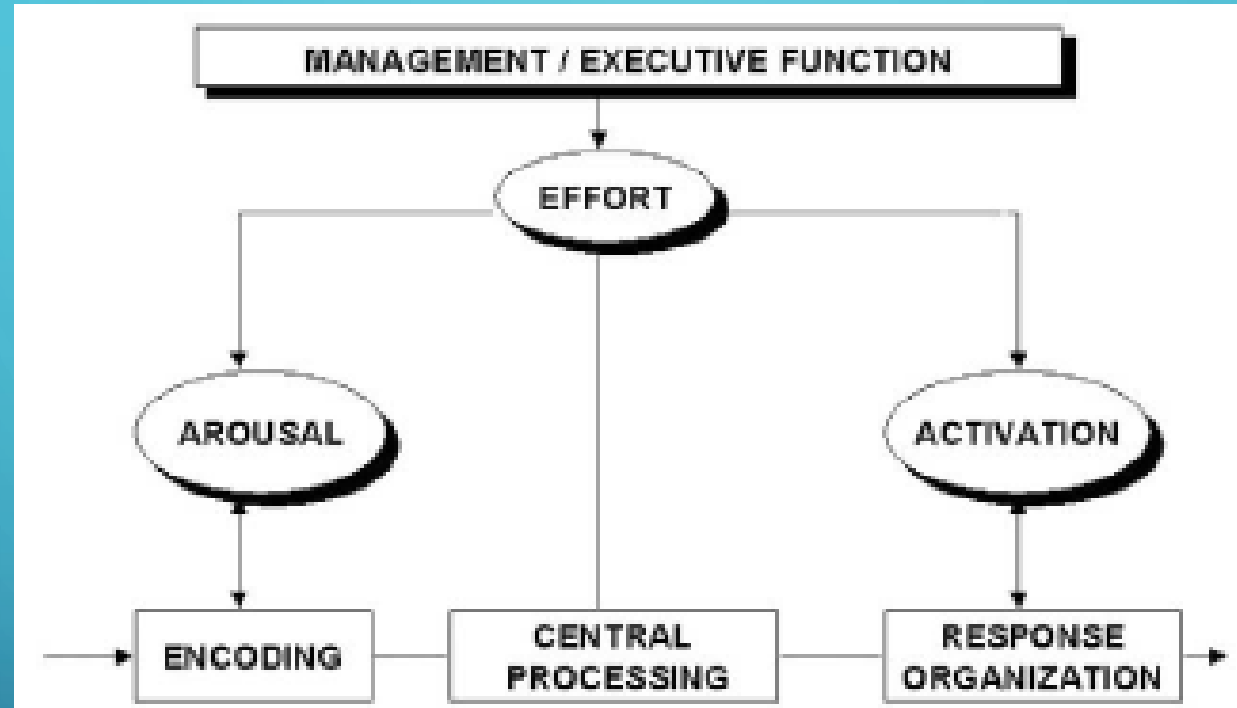


Figure 1. The cognitive-energetic model contains three levels. The upper level is the executive control system. The middle level contains the energetic pools: arousal, effort, and activation. A lower level contains the encoding stage, a central stage for memory search and a motor stage. The three levels are interactive with both a top-down and a bottom-up stream. Reprinted from Sergeant J (2000) with permission by Elsevier Inc.

ADHD: NEUROPSYCHOLOGICAL THEORIES

- Cognitive-Energetic model levels
- Supported by the following:
 - ADHD individuals are **slower and more variable in RTs than controls**
 - ADHD performance **varies more than controls as a function of event rate** (e.g., **faster rate normalizes performance of ADHD** groups)

HYPERACTIVITY

- ***Excessive motor activity, described as:***
 - constantly moving or “on the go”
 - **fidgety** or restless
 - difficulty remaining seated when required to do so

HYPERACTIVITY

- ***Subjective sense of motor restlessness***

- **A subtle finding more common in girls, and frequently found in adolescents and adults**

HYPERACTIVITY

- **Over-talkativeness, described as:**
 - **excessive, continuous talking (“blabbermouth”)**
 - **poor modulation of speech, with loud speech**
 - **verbosity**
 - **blurts out answers, interrupts conversation**

HYPERACTIVITY

- ***Poor motor control, characterized by:***
 - **difficulty engaging in leisure activities quietly**
 - **work, particularly handwriting, is often messy**
 - **poor physical boundaries, with socially inappropriate, intrusive behavior**
 - **aggressiveness or clumsiness, related to poor modulation of motor activities (e.g., breaks toys, hurts others unintentionally)**

IMPULSIVITY

- *Difficulty inhibiting responses (“Ready, fire, aim!”), manifested by:*
 - **intrusiveness**
 - **impatience, manifested by:**
 - **difficulty with turn taking in games**
 - **similarly manifest in conversation, with interruption and comments out of turn**
 - **inappropriate behavior**

IMPULSIVITY

- ***Risk taking/Novelty-seeking behavior***
 - **engagement in physically dangerous activities without consideration of potential consequences**
 - **often described as “accident prone”, with a history of injuries**
 - **tendency to become easily bored and seek external stimulation**

IMPULSIVITY

- ***Altered responsiveness to behavioral rewards, consequences and contingencies***
 - **resistance to conditioning effects of reward or punishment**
 - **failure to apply past experiences to current situations, resulting in repetitive mistakes**
 - **neurophysiological basis**



CLINICAL ASSESSMENT OF ATTENTION

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Evaluation Components

- Clinical Interview
- Mental Status Examination
- Family Interview
- Behavioral Observation
- Standardized Psychometric Testing
- Interpretive Report
- Integrated Feedback Session



Neuropsychological Domains





NEUROPSYCHOLOGY OF ATTENTION

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Neuropsychological Evaluation

- Has the capacity to...
 - Assess ADHD patient's unique collection of skills
 - Identify comorbid conditions associated with development or mood/conduct
 - Allow for the consideration of personalized treatment plans



Lifetime Course of ADHD Symptoms: Inattention Domain

Childhood

Doesn't listen

No follow through

Loses important items

Adult

Slow, inefficient, disorganized

Paralyzing procrastination

Poor time management

APA. *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV-TR)*. 2000.
Weiss MD, Weiss JR. *J Clin Psych*. 2004;65(suppl 3):27-37.

Lifetime Course of ADHD Symptoms: Hyperactivity/Impulsivity Domain

Childhood

Squirming, fidgeting
Runs/climbs excessively
On the go/driven by motor
Blurts out answers

Adult

Inefficiencies at work
Drives too fast
Can't tolerate frustration
Makes inappropriate comments

APA. *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV-TR)*. 2000.
Weiss MD, Weiss JR. *J Clin Psych*. 2004;65(suppl 3):27-37.

WHAT ARE EXECUTIVE FUNCTIONS?

- The term “**Executive Functions**” refers to the higher-level cognitive skills you use to **control and coordinate your other cognitive abilities and behaviors**. The term is a business metaphor, where the chief executive monitors all of the different departments so that the company can move forward as efficiently and effectively as possible. **Who we are**, how **we organize our lives**, how **we plan** and how we **then execute those plans** is largely guided by our executive system

TYPES OF EXECUTIVE FUNCTIONS

- Executive functions can be divided **into organizational** and **regulatory abilities**. Organization includes **gathering information and structuring it for evaluation**. Regulation involves **evaluating the available information and modulating your responses to the environment**. Seeing a wonderful dessert in front of you may be tempting to devour, but your executive system might remind you that eating it would conflict with your inner goals, such as losing weight. That long range thinking and reasoning is typical of the executive system. **One type of executive function is called prospective memory**, the ability to **project into the future and solve problems that are likely to arise**.

- **Organization:** attention, planning, sequencing, problem solving, working memory, cognitive flexibility, abstract thinking, rule acquisition, selecting relevant sensory information
- **Regulation:** initiation of action, self-control, emotional regulation, monitoring internal and external stimuli, initiating and inhibiting context-specific behavior, moral reasoning, decision-making

IMPAIRED EXECUTIVE FUNCTIONS

- Because these skills integrate information at higher level across cognitive domains, damage to the executive system typically involves a cluster of deficiencies, not just one ability. The loss of that "**administrative**" control affects the ability to organize and regulate multiple types of information and, therefore, behaviors.

DAMAGE TO THE EXECUTIVE SYSTEM, OFTEN LEADS TO:

- **Socially inappropriate behavior**
- **Inability to apply consequences from past actions**
- **Difficulty with abstract concepts (the inability to make the leap from the symbolic to the real world)**
- **Difficulty in planning and initiation (getting started)**
- **Difficulty with verbal fluency**
- **Inability to multitask**
- **Difficulty processing, storing, and/or retrieving information**
- **Frequent “policing” by others to monitor the appropriateness of their actions**
- **Loss of fine motor skills like grabbing something with your thumb and forefinger more than gross motor skills like running and jumping**
- **Moody or “roller coaster” emotions**
- **Lack of concern toward people and animals**
- **Loss of interest in activities**
- **Unawareness or denial that their behavior is a problem**
- **Antisocial behavior associated with disinhibition**
- **Trouble planning for the future**

NEUROPSYCHOLOGICAL PERSPECTIVE

BRAIN—BEHAVIOR relationships

- **Neuropsychology** is the “applied science concerned with the behavioral expression of brain dysfunction” (Lezak, 1995)
- **Questions to think about in neuropsychology:**
 - What brain regions are implicated in the behavioral manifestations of attention problems and ADHD?
 - How do we measure the functioning of those brain regions?
 - **Inattention**
 - **Impulsivity**
 - **Hyperactivity**

Executive Function



Regulates, controls and manages thought and actions



NEUROPSYCHOLOGICAL ASSESSMENT IS HELPFUL WHEN...

- There is suspicion of low cognitive abilities
- There is low academic achievement
- In order to differentiate among coexisting disorders
- In order to describe an individual's strengths and weaknesses and to tailor recommendations and help with treatment and educational planning
- In order to increase validity of diagnostic impressions
- There are coexisting medical conditions (e.g., epilepsy)



ATTENTION ASSESSMENT

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- SELECTIVE ATTENTION
- FOCUS ATTENTION
- DIVIDED ATTENTION
- SUSTAIN ATTENTION
- OVERT ATTENTION
- COVERT ATTENTION
- OBJECT BASE ATTENTION
- SPATIAL BASED ATTENTION
- JOINT ATTENTION

- SOME TERMS FOR ATTENTION
- SHIFT OF ATTENTION
- LIMITED RESOURCE FOR ATTENTION
- CAPACITY FOR ATTENTION
- Voluntary ATTENTION (EPLICIT)
- Involuntary(IMPLICIT)
- Bottom up
- Top down

WHAT CAN WE ATTEND TO?

Spatially oriented attention
vs.
Object oriented attention

Popout as a pre-attentive mechanism

ATTENTION: BASIC DEFINITIONS

- Selective or Focused Attention: vigilance in monitoring information
- Divided Attention: ability to respond to more than one task simultaneously
- Sustained Attention: ability to maintain attention and respond consistently during a repetitive or continuous activity
- Alternating Attention/Mental Shifting: mental flexibility to shift from one task to another as required

Baron, 2004

INATTENTION

- *Difficulty initiating and sustaining attention, characterized by:*
 - difficulty persisting in tasks, especially if they are uninteresting, **tedious, sedentary** or demanding
 - switching from one unfinished task to another
 - failure to complete tasks, chores, schoolwork, etc.

INATTENTION

- ***Difficulty initiating and sustaining attention***, characterized by:
 - difficulty following through with directions
 - “daydreaming”, or appearing as if one isn’t listening or is unable to hear

INATTENTION

- ***Avoidance of, or aversion to, tasks that require sustained attention,***
such as:
 - tasks that require perseverance or sustained, intense mental effort
 - tasks that tax limited organizational skills

INATTENTION

- **Distractibility**, characterized by:
 - **sensory distractibility**, described as the inability to filter out unimportant, extraneous stimuli from important, relevant stimuli
 - **motor distractibility**, described as the inability to inhibit responses to stimulus or, the inability to control the allocation of attention.

INATTENTION

- *Distractibility*, characterized by:
 - **difficulty shifting attention** from one task or activity to another
 - **difficulty attending to more than one task** at a time
 - sometimes manifest as an **extraordinary awareness of detail**, however **irrelevant**

INATTENTION

- *Difficulty with **organization and prioritization** (impaired executive functions),* characterized by:
 - **loses or misplaces belongings or necessary things** such as homework, school materials, toys, etc.
 - **Difficulty prioritizing tasks** in terms of importance or planning objectives
 - **procrastination**
 - **forgetfulness**, e.g., misses appointments, fails to remember gym clothes, etc.
 - **poor awareness of time**, with similarly poor time **management skills**


INATTENTION

- *Difficulty with organization and prioritization (impaired executive functions), characterized by:*
 - **deficits in working memory** - the ability to keep certain information “in mind” over short periods of time in the absence of environmental stimuli – manifested by:
 - difficulty recalling **complex instructions, such as game rules**
 - forgetting information **that has just been read**
 - difficulty **transferring information**
 - difficulty with **math functions such as transposing numbers or computational errors.**

ATTENTION: MEASURES

- Attention batteries:
 - Test of Everyday Attention (**TEA**)
 - adult battery
 - Test of Everyday Attention for Children (**TEA-Ch**)
 - Child extension of adult TEA

ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD)



Moderator: Dr. G. Bezboruah
Prof. & HOD
Deptt. Of Pediatrics

Presenter : Dr. Nishant
P.G.T
GMCH

ATTENTION: MEASURES

- Single instruments:
 - Wechsler test examples: WISC-IV Letter-Number Sequencing, Digit Span, Cancellation, WISC-III Arithmetic
 - Spatial Span tasks: e.g., Corsi blocks/WMS-III Spatial Span
 - Other span tests: Knox Cube (visual span), alpha-, pattern- & word-span measures (discussed in Baron, 2004)
 - Continuous Performance Tests (e.g., CPT-II)
 - Auditory Consonant Trigrams

Neuropsychological Tests



Neuropsychological Test	Executive Function
Color Word (D-KEFS)	Inhibition
Trails Making (D-KEFS), IED (CANTAB), Letter-Number Test (WAIS)	Set Shifting
Stockings of Cambridge (CANTAB)	Planning/Organizing
Symbol Search (WAIS/WISC)	Task Monitoring, Initiating
Digit Span, Arithmetic, Letter-Number Test (WAIS/WISC)	Working Memory
Coding (WAIS)	Initiating
Matrix (WAIS)	Inhibition, Spatial Working Memory

ATTENTION MEASURES

Single Instruments, continued...

- CHIPASAT (Children's Paced Auditory Serial Addition Test)
- Trail Making Tests: D-KEFS Trails, TMT, Color Trails
- Symbol Digit Modalities Test
- Visual Search Cancellation Tests
- Underlining Test
- Progressive Figure Test & Color Form Test

Neuropsychological Tests

- Basic Attention
 - Digit Span, Word Span, Number Letter recall, simple cancellation tasks
- Complex Attention
 - Auditory Consonant Trigrams, Digit Span Reversed, Number Letter Sequencing, Paced Serial Addition Test (PASAT)
- Inhibition
 - Stroop Color Word Test,
 - Attention, Inhibition, Response Set of the NEPSY
 - Stroop tasks on the DKEFS,
- Executive Functions
 - Task planning: Tower Test of the DKEFS; Route Finding on the NEPSY
 - Abstract thinking, logical reasoning: 20 Questions, Similarities, Word Reasoning
- Hyperactivity
 - Statue test on the NEPSY

- COMPUTATIONAL PACKAGE
REHACOM:VISUAL SCAN

Visual Search Task



Disjunctive Search

A

		R		D	
			G		
	C			T	S
		Q			

Disjunctive Search

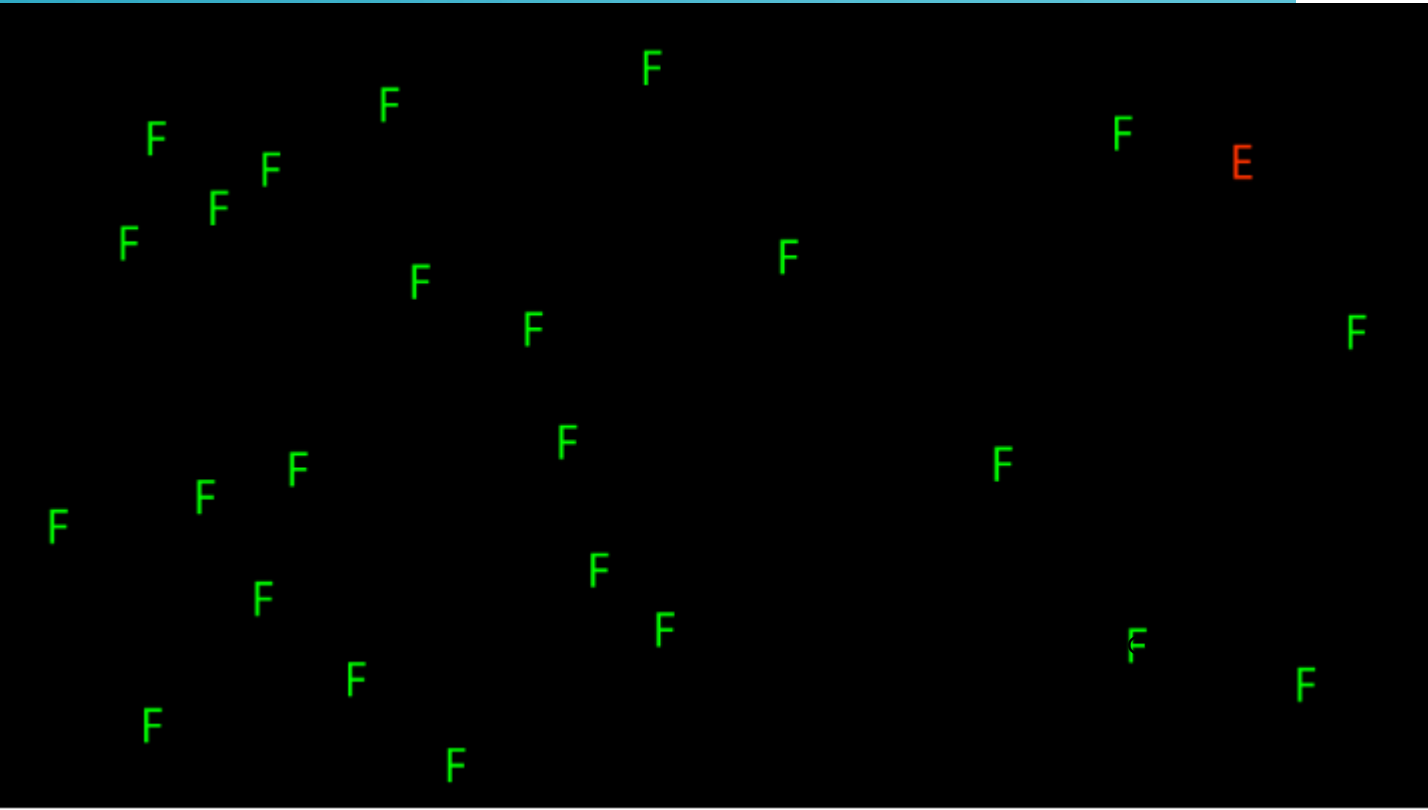
B

L	L	L	L	L
L	L	L	L	L
L	L	L	T	L
L	L	L	L	L
L	L	L	L	L

Conjunctive Search

C

F	T	F	I	T
W	X	W	F	T
T	H	F	T	H
T	I	X	H	T
I	A	H	T	W
				I



RUFF TASK FOR SELECTIVE ATTENTION

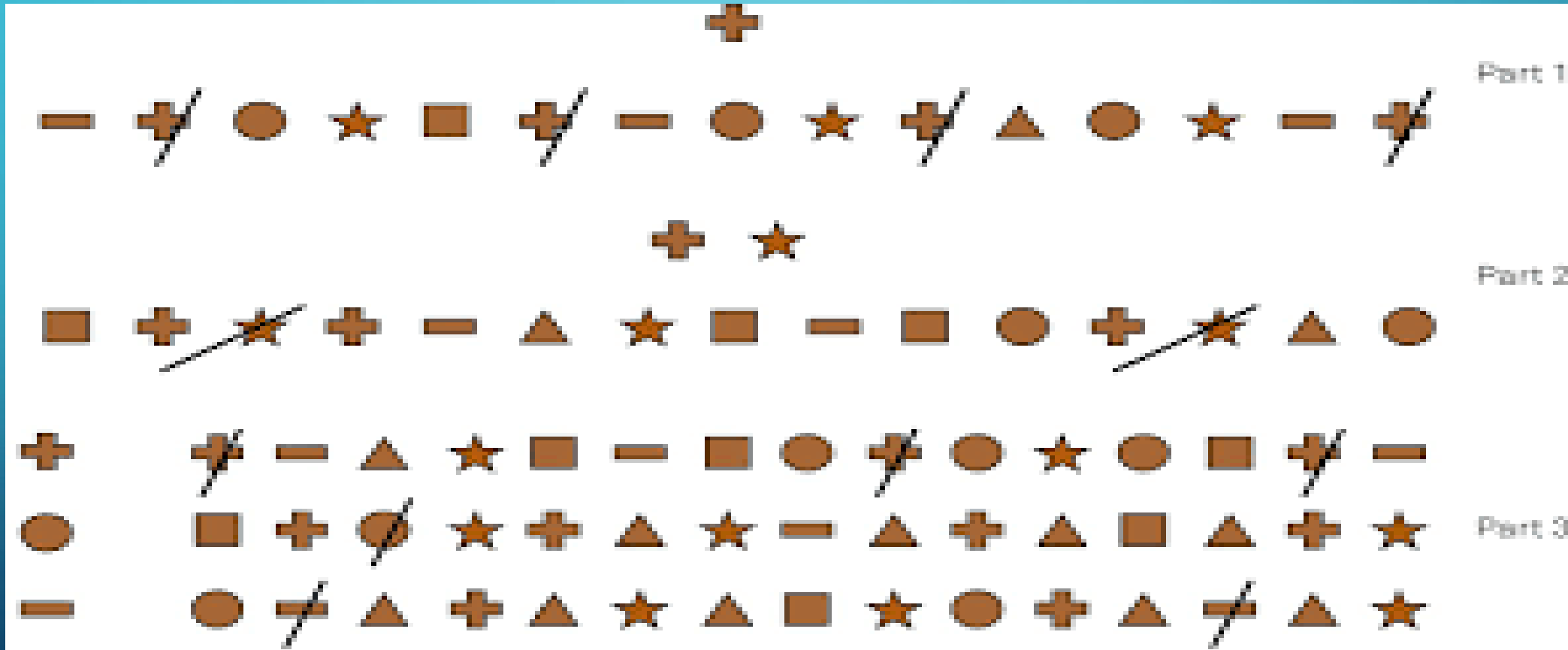
- The 2 and 7 Selective Attention Test was developed to assess sustained and selective aspects of **visual attention** (Cicerone & Azulay, 2002; Ruff & Allen, 1996).
- The test is based on the premise that selective attention (i.e., **the ability to select relevant stimuli while ignoring irrelevant information**) can be assessed by comparing automatic detection versus controlled processing with minimal demands on other cognitive processes such as internal processing of information or immediate memory (Cicerone & Azulay, 2002).
- It is based on the theories of Logan et al. (Logan, 1988; Logan & Klapp, 1991; Logan & Stadler, 1991), which posit two processes through which attention is allocated:
 - automatic information processing and
 - effortful or controlled information processing (Strauss, Sherman, & Spreen, 2006).
- Two types of trials are presented in the test:
 - **Automatic Detection trials**, in which the target numbers are presented among **distractor letters**: Selecting targets from different stimulus categories **represents parallel search** or even **automatic information processing**. This categorical difference between letters and numbers is overlearned, and hence subject to automatic processing even in semiliterate individuals (Ruff & Allen, 1996).
 - **Controlled Search trials**, in which the target numbers are presented among **other distractor numbers**: In contrast, selecting targets from the same stimulus category requires **serial search or controlled information processing**, i.e., **working memory** and effortful processing of stimulus characteristics are required to effectively select targets from distractors (Ruff & Allen, 1996; Ruff, Neiman, Allen, Farrow, & Wylie, 1992; Strauss et al., 2006).

Figure XII: Visual Search and Attention Test. Man, 69 years old, first grade – 30 years of institutionalisation (Patient of Figure I)

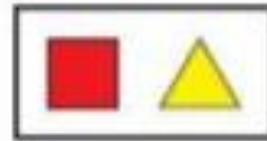


- The actual 2 and 7 test is a paper-and-pencil number-cancellation task that consists of a set of 20 trials (10 Automatic Detection trials and 10 Controlled Search trials), presented semirandomly in the test booklet, with three lines per trial, administered consecutively in 15-s intervals.
- All instructions are provided verbally, and examinees are required to read through each line and cross out specific targets (always the numbers 2 and 7), working from left to right, while ignoring other letters or numbers (Ruff & Allen, 1996; Strauss et al., 2006). The total administration time – after a brief practice set to assure that examinees understand the instructions – is 5 min (Ruff & Allen, 1996).
- Several scores can be derived from the 2 and 7 test as described in detail in the test manual (Ruff & Allen, 1996). Scores are generally based on:
 - errors of omission (correct hits) and
 - commission (incorrect responses).
- Selective attention is measured by the Automatic Detection and Controlled Search scores and
- sustained attention is measured primarily by **the Total Speed (number of correctly identified targets during the allotted 5-min duration), and Total Accuracy (number of targets identified during the 5-min duration divided by the number of possible targets) scores.**
- In the test manual several discrepancy analysis procedures are further provided in order to evaluate performance on various aspects of selective attention (Ruff & Allen, 1996).

CANCELLATION TESTS



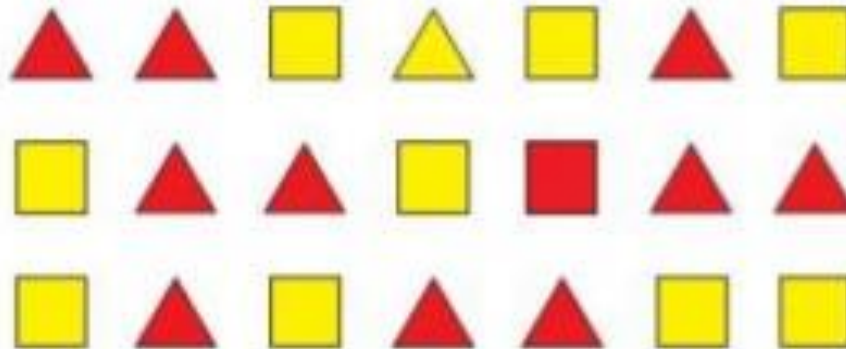
CANCELLATION



Demonstration Item A.



Sample Item A.



"WHEN I SAY GO, DRAW A LINE THROUGH EACH RED SQUARE AND YELLOW TRIANGLE."

ATTENTION: MEASURES

- Behavioral report (covered already in class).

Examples include:

- Connor's Rating Scales-Revised (CPRS)
- Specific subscales from parent/self report (e.g., BASC Attention scale)
- **BRIEF** (2000)
- Brown Attention-Deficit Disorders Scales (2001)
- Diagnostic Rating Scale
- Attention Deficit Hyperactivity Disorder Rating Scale-IV – Home Version

ADULT ADHD

- **Adult ADHD Clinical Diagnostic Scale**
 - total severity
- **Adult ADHD Self-Report Scale**
 - total score
- **attention networks test**
 - **Incongruent minus congruent: Conflict / Executive network efficiency**
- **go/no-go task**
 - **Go trials**

VIGILANT ATTENTION

- When CARS drivers pass through warning or stop signals – as they do many thousands of times per day throughout the world – this is an example, we argue, of an **inefficiency in the functioning of a right hemispheric, fronto-parietal attention system** for ‘**vigilant attention**’.
- Closely linked to Posner’s notion of the ‘**alerting**’ system, **vigilant attention** is distinct from Posner’s other two functionally and anatomically distinct supramodal attentional systems – **selection and control** respectively

- review evidence for the validity of this 3-factor typology of attention
- **vigilant attention**: involves a half-life measured in **seconds rather than minutes**, and is most **sensitively measured in situations where routine action cycles** are under way
- **SUSTAIN ATTENTION**: by time-on-task decrements over extended periods of test performance, as originally proposed by Mackworth

VIGILANT AND AROUSAL

- If you have to drive a car on an icy road, **anxiously feeling** the wheels skidding under you, there is no problem **staying alert and attentive, no matter how tired or drowsy** you might have been feeling beforehand. Contrast this with driving down the empty M6 late at night – **mile after mile of monotony** presents a quite different challenge – **staying alert.**

VIGILANT AND AROUSAL

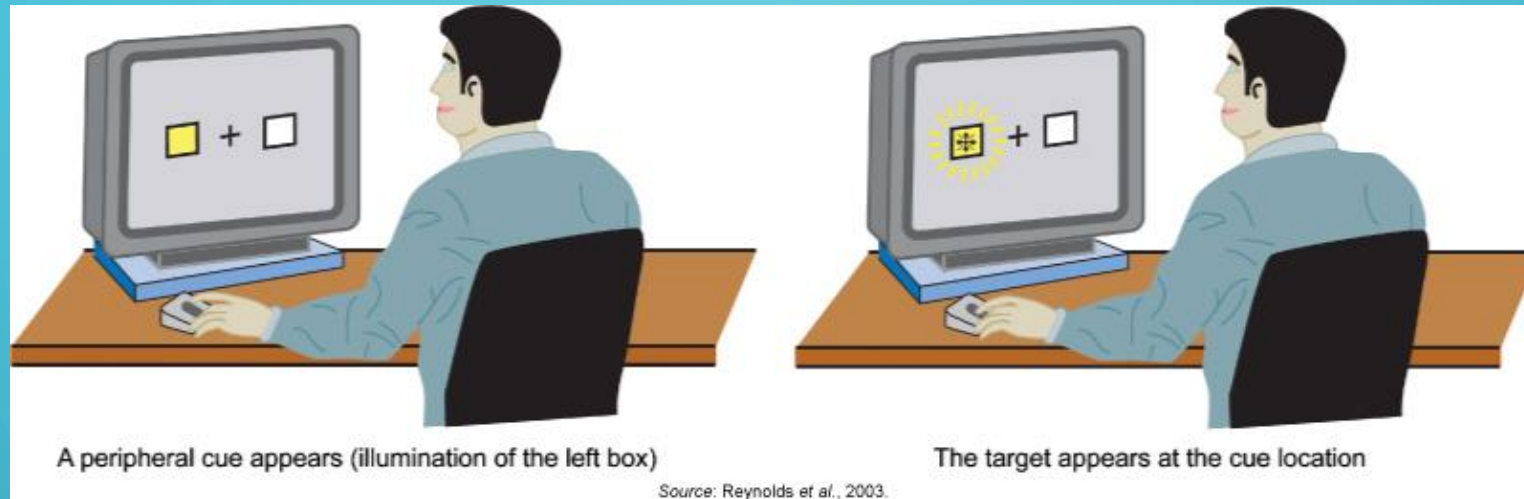
These two examples contrast *exogenously* and *endogenously* mediated **vigilant attention and arousal**. They also represent the interplay between a **right-hemisphere-cortex mediated vigilant/sustained attention system on the one hand and a midbrain-located arousal system on the other**. Successful living requires that these two systems interact in an organised way:

- **TWO** central components of vigilant attention,
 - **arousal**
 - **and goal representation.**

COGNITIVE FAILURES QUESTIONNAIRE (BROADBENT)

- **Do you read something and then find you haven't been thinking about what you're reading?**
- **Do you find you forgot whether you turned off a light or fire, or locked the door?**
- **Do you fail to hear people speaking to you when you are doing something else?**
- **Do you fail to hear people speaking to you when you are doing something else?**
- **Do you start doing one thing at home and then get distracted into doing something else, unintentionally?**

EXPERIMENTS ON ATTENTION "NIH PACKAGE"



□ Visual attention is studied using the flanker task (Posner 1984)

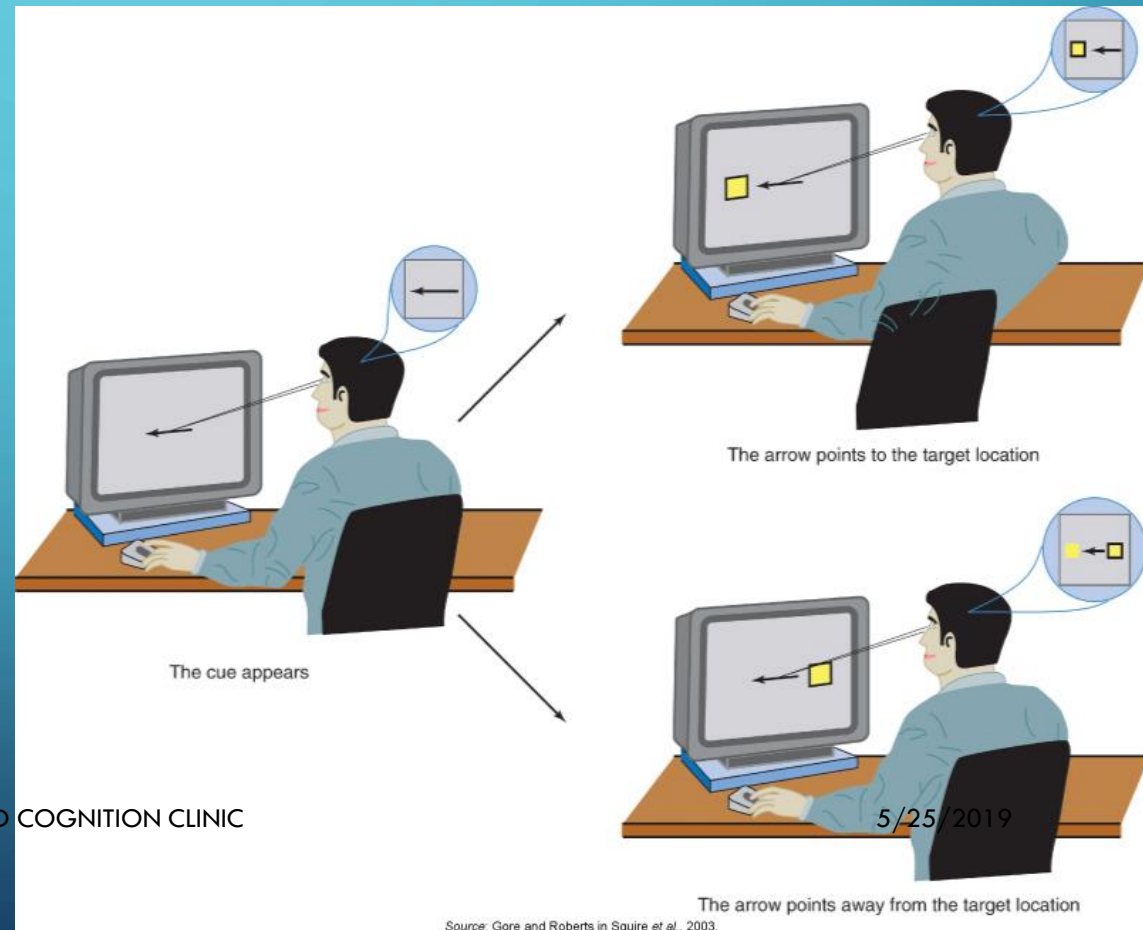
- Subject focuses on the center fixation point – no eye movement allowed.
- The stimuli flashes just outside of the foveal region of maximum resolution (flank).
- Then a target appears at the site of flank with 80% probability.
- When the target appears at the expected location the response time is faster than without flank.
- When the target appears at the opposite location than the flank the response time is slower than no flank.

□ Attention network task

- This is a generalization of the flanker task to test three aspects of attention: alerting, orienting, executive attention.

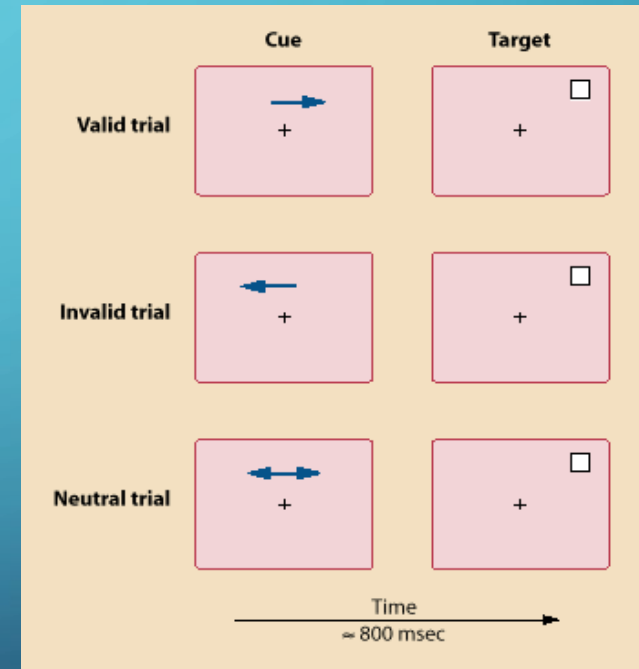
BRAIN BASIS OF ATTENTION

- ❑ Human may learn to go **against a cue or usual response**.
- ❑ For instance he/she may learn **not to respond to the telephone ring**.
- ❑ This involves **executive attention control** as in the experiment shown on figure.
 - First the subject learns to follow the **cue like** in the flanker test,
 - Then the rule changes and the **expected target** appears on the opposite site of the cue.



CUING ATTENTION

- Give people a cue where a target will appear in the visual field
- Manipulate the kind of cue
 - Valid Cue
 - Neutral Cue
 - Invalid Cue
- How does cue affect performance?



CONTINUOUS PERFORMANCE TESTS

- Many different versions: (Riccio et al 2001 has review & comparison)
- Handout explaining CPTs

E.g., CPT-II

- Visual vigilance measure.
- Individuals 4 years to adulthood.
- Press for all letters EXCEPT 'X'
- Non-X and X stimuli are presented in blocks varying from 1-, 2- and 4-second ISIs across blocks.
- Task lasts for approximately 14 minutes.

CPT-II

- Normative data:
 - N=1483 children 6-17 years. The smallest sample is 6-7 years (N=88).
 - Total normative sample: N=1920; through adulthood.
 - Oldest normative group is 55+, also small sample in this subgroup (N=54).
 - Total ADHD clinical sample: N=378.
 - N=271 for ADHD children/adolescents 6-17 years.

CONTINUOUS PERFORMANCE TESTS

- CPT indices (see handout):
 - Omissions: suggestive of inattentiveness. Measures nonresponding
 - Comissions: may represent an inability to withhold motor responses (suggests impulsivity)
 - Overall hit reaction time: average speed of correct responses for entire test. Slowed RT and nonresponding suggestive of inattention to task
 - Overall standard error: attentional variability overall (e.g., high levels suggest inconsistency of speed of responses (fluctuating attention from trial to trial))

CONTINUOUS PERFORMANCE TESTS

- Other CPT indices:
 - Perceptual sensitivity (d'): whether difficulty in discriminating perceptual features of targets vs. non-targets
 - Response bias (B): individual's response tendency. e.g., cautious vs. risk-taking

Other CPT output (e.g., CPT-II) includes hit RT block rate change, hit SE block change, hit RT ISI, hit SE ISI change.

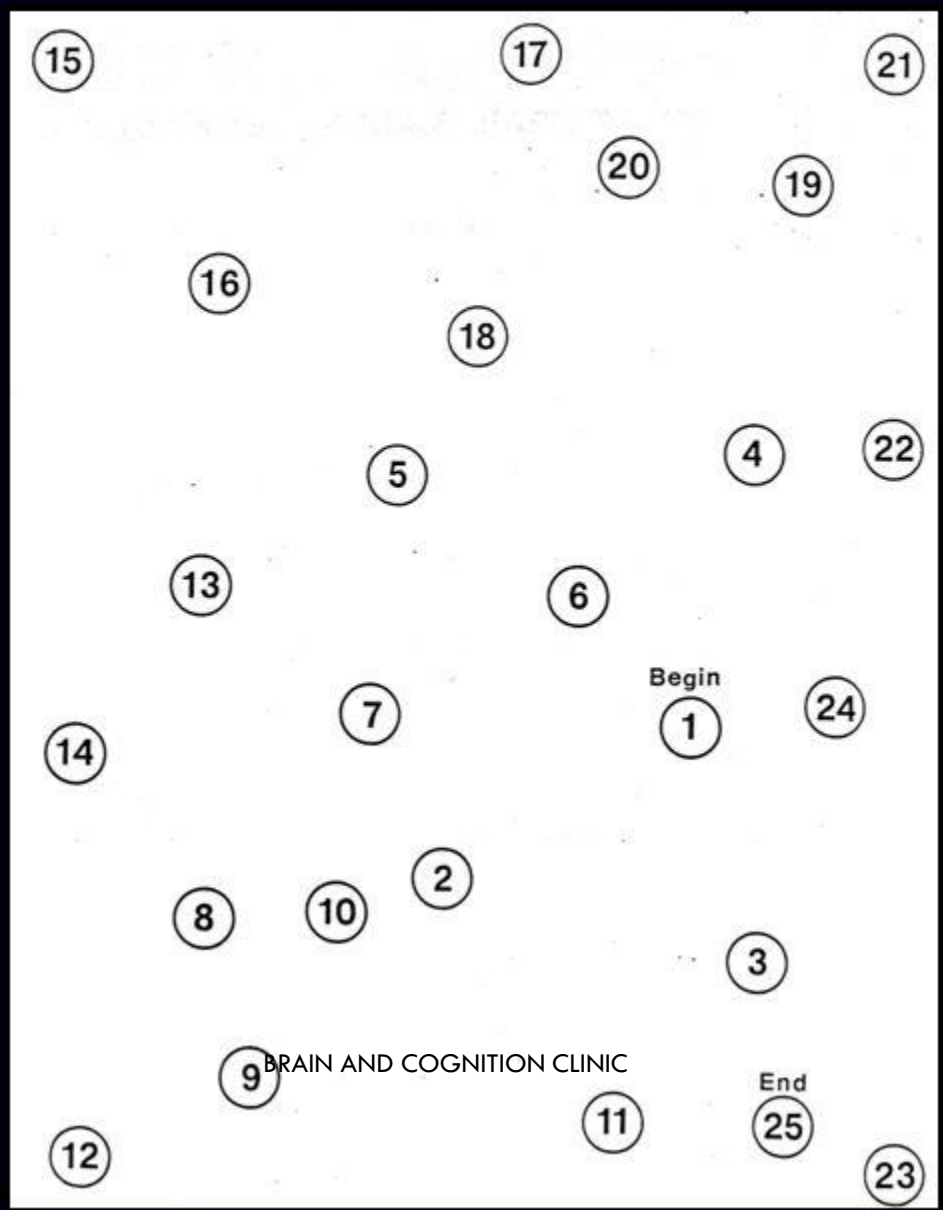
OTHER ATTENTION SINGLE MEASURES

- Trail Making Tests:
- Extension from adult measures (e.g., Army Individual Test Battery (1944), Halstead-Reitan battery)
- Trail A: number sequencing (1-2-3-4...)
- Trail B: Number-letter sequencing (1-A-2-B..)
- Children 9-14 use versions with 15 items for each of the above (some norms available from research extend lower)
- Ages 15-adult use versions A & B with 25 items each

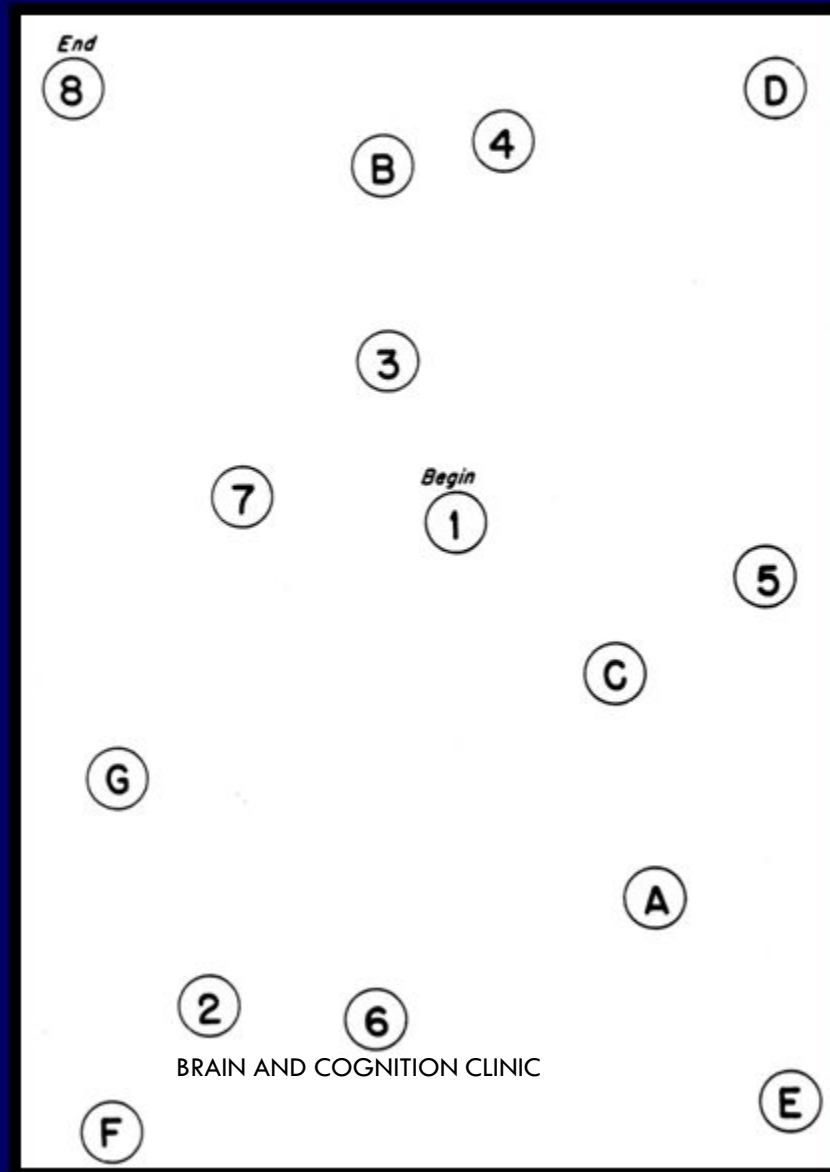
OTHER ATTENTION SINGLE MEASURES

- DKEFS Trail Making Test:
 - normed for 8 to 89 years
 - Better for teasing apart problems with TMT: e.g., if problem is basic motor &/or visual problem vs. cognitive shifting
 - 5 separate conditions:
 - 1) Visual scanning
 - 2) Number sequencing (similar to typ. Trails A)
 - 3) Letter sequencing
 - 4 Number-letter switching (similar to typ. Trails B)
 - 5) Motor speed
 - Maximum times: 150 sec for Conditions 1, 2, 3, 5; 240 sec for Condition 4

HRNB Trail-Making Test Part A



HRNB Trail-Making Test Part B



Trail Making Test B

Patient age: Education: Time/Score:

Once test complete, write in Patient Age, Education, Time/Score to show on PDF.

End 13

Begin 1

Time 27

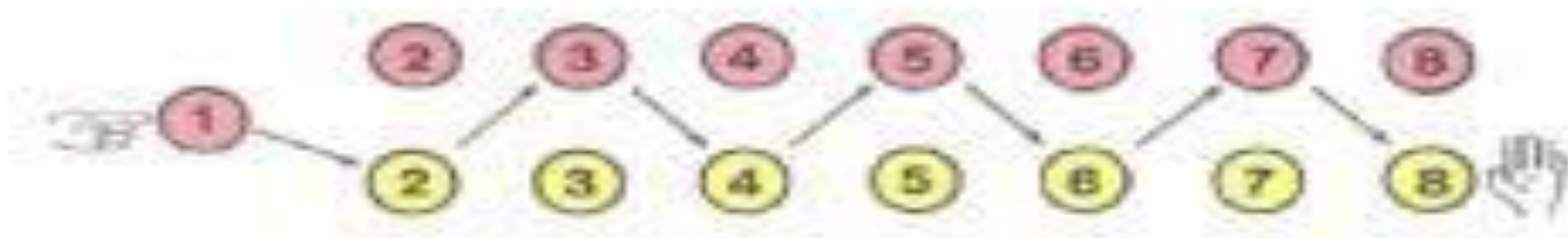
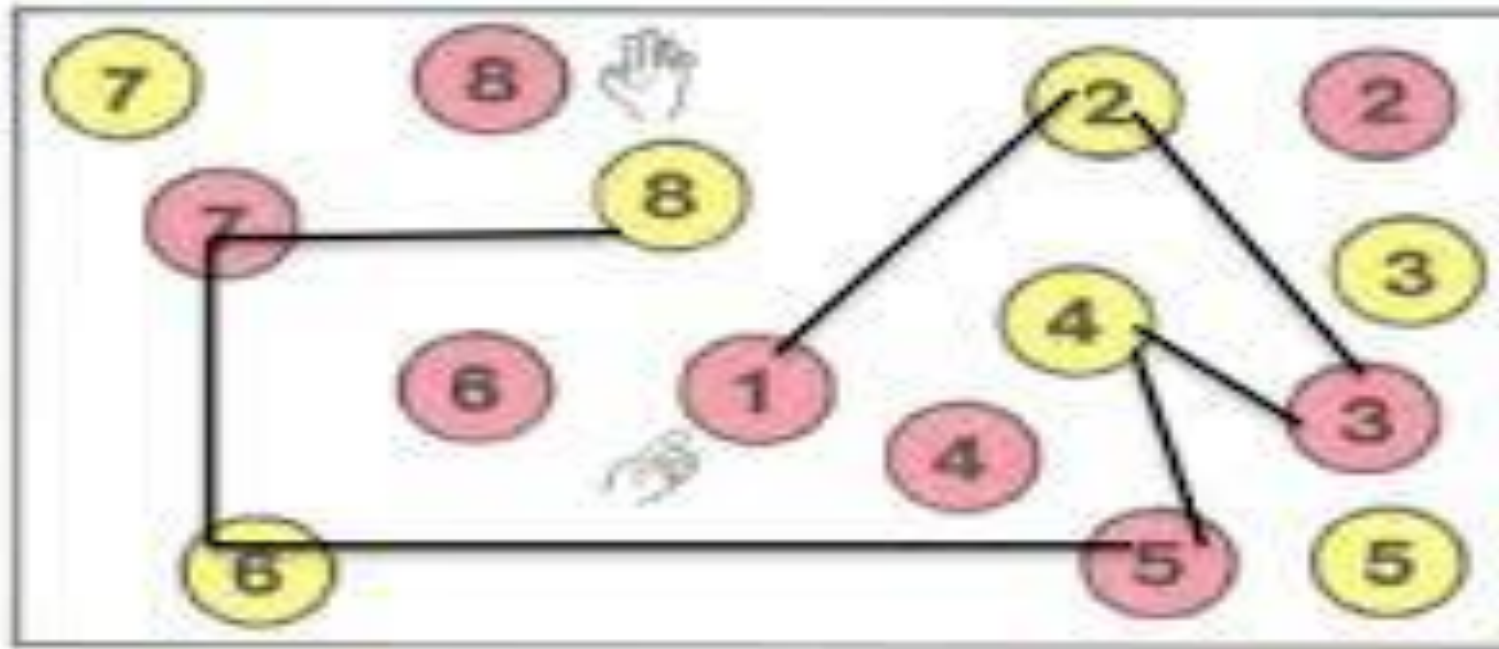
Timer label will disappear when timer started & reappear with test time when timer stopped.

Demonstration Start Timer Stop Timer Score Test Reset Timer

OTHER ATTENTION SINGLE MEASURES

- Color Trails Test:
 - Instead of letters, colors are substituted to minimize knowledge of English alphabet.
 - Alternate between colors and 25 numbers.

Test



- Two trials provide quantitative and qualitative information
- Numbered circles are printed with vivid pink or yellow backgrounds that are perceptible to color-blind individuals. For Part 1, the respondent uses a pencil to rapidly connect circles numbered 1-25 in sequence. For Part 2, the respondent rapidly connects numbered circles in sequence, but alternates between pink and yellow. The **length of time** to complete each trial is recorded, along with **qualitative features of performance** indicative of brain dysfunction, **such as near-misses, prompts, number sequence errors, and color sequence errors.**

- Features and benefits
 - Retains the sensitivity and specificity of the original Trail Making Test but substitutes color for letters, making it more suitable in **cross-cultural and special needs contexts.**
 - Instructions may be presented either verbally or with visual cues.
 - Validity of the CTT has been documented in a variety of clinical and neuropsychological populations.

- The Trail Making Test is a neuropsychological **test of visual attention and task switching**. It consists of two parts in which the subject is instructed to connect a set of 25 dots as quickly as possible while still maintaining accuracy. The test can provide information about **visual search speed, scanning, speed of processing, mental flexibility, as well as executive functioning**. It is sensitive to detecting cognitive impairment associated with dementia.

- it has since been incorporated into the **Halstead-Reitan battery**. The Trail Making Test is now commonly used as a diagnostic tool in clinical settings. Poor performance is brain impairment, in particular **frontal lobe** lesion
- The **second part** of the test, in which the subject **alternates** between **numbers and letters**, is used to examine **executive functioning**. The **first part** is used primarily to examine **cognitive processing speed**.

OTHER ATTENTION SINGLE MEASURES

- Auditory Consonant Trigrams Test:
 - Test of divided attention and rapid information processing
 - Normative data for ages 9-15 are reported in Baron, 2004
 - Interval length for children: 0, 3, 9, and 18 seconds
 - Person is given **3 letters to remember** in any order.
 - S/he is then told to count backwards from a certain number until told to stop. (Children count backward by 1s; adults by 3s.)

OTHER ATTENTION SINGLE MEASURES

- Children's PASAT (CHIPASAT):
 - Test of **divided attention, sustained auditory attention and information processing speed**
 - Requires **math calculation skills**
 - Normative data for ages 8-15 are reported in Baron, 2004. (Note: very small N for 14-15 y.o.)
 - **Presentation is 1 digit every 2.8 (suggested for practice), 2.4, 2.0, 1.6 or 1.2 seconds. 61 digits per trial on tape.**
 - ***Person must add each new number presented to the one heard immediately prior and say the sum aloud, continuing to do this with each new number.***
 - Baron cautions against interpreting scores below 9.5 years with this measure.

ADHD: NEUROPSYCHOLOGICAL THEORIES

- Executive Function Theory of ADHD
 - ADHD symptoms arise from a primary deficit in executive functions (neurocognitive processes for maintaining an appropriate problem-solving set to attain a later goal).
 - Executive functions involves the prefrontal cortex, basal ganglia & thalamus
 - 4 factors of executive function tasks
 - 1) Response inhibition and execution
 - 2) Working memory and updating
 - 3) Set-shifting and task-switching
 - 4) Interference control

ADHD: NEUROPSYCHOLOGICAL FINDINGS

- **Meta-analysis** on executive function Willcutt et al 2005
 - 83 studies (N=3734 ADHD; N=2969 no ADHD)
 - Significant group differences in 109:168 (65%) comparisons
 - Mean weighted effect size=.54 (range .43-.69; medium effect)
 - **ADHD vs. control differences most consistently seen in**
 - **stop-signal reaction time (SSRT) (82% of 27 studies)**
 - **CPT omission errors (77% of 30 studies)**
 - Less studies in **working memory** but promising
 - 75% of spatial WM w/sign group differences
 - 55% of verbal WM w/sign group differences

• **WCST more weakly related to ADHD than other EF measures**

Inhibition



- Ability to control impulses and stop one's own behavior at the appropriate time
- Test
 - Color Word (D-KEFS)
- BRIEF examples
 - Interrupts or disrupts group activities
 - Has trouble putting on the brakes
 - Says/does things impulsively without thinking
 - Makes decisions that get them into trouble

STROOP

- TESTING OF OUR CAPACITY TO DIRECT ATTENTION (MORE IS INHIBITION THAN ATTENTION):
- Restoring and managing a mental resource needed for environmentally resilient living.
- Raymond De Young, School of Natural Resources and Environment, **University of Michigan**, Ann Arbor, MI 48109
- To transition well to this new biophysical reality requires a **mental state called vitality**. Unfortunately, this mental resource **easily fatigues** and at times seems to be **in short supply**. One goal of the research outlined here is to help restore and maintain mental vitality so that we can **transition, in a civil manner, to durable living**. (Resilience.org, 27 March 2012)

STROOP THEORIES

• AUTOMATICITY MODEL

- Since the original study, the Stroop effect has been investigated in a variety of ways. One general finding is that the Stroop effect is very robust. For example, the Stroop effect extends to color-related words (e.g. sky and fire). It extends to non-words that sound like color words (e.g. wred and bloo). It occurs with the words are presented suboptimally (dim, faded, small, etc.). It is resistant to practice. In summary, the difficulty of removing the interference effect of the Stroop task has led some researchers to claim that the brain is wired to recognize words without effort. This explanation is called the "automatic word recognition hypothesis" (or automaticity hypothesis), and it is so widely accepted that it is often given, in psychology textbooks, as the only answer to the Stroop effect. According to this theory, reading is an automatic process, which cannot be turned off. In other words, people see the meaning or words without much effort or consciousness. On the other hand, naming colors is not automatic. It requires more effort than reading, thus creating interference in the Stroop task.

• A SPEED OF PROCESSING MODEL

- The "Speed of Processing" hypothesis suggests that word processing is much faster than color processing. Thus, in a situation of incongruity between words and colors, when the task is to report the color, the word information arrives at the decision process stage earlier than the color information and results in processing confusion. On the other hand, when the task is to report the word, because the color information lags behind the word information, a decision can be made before the conflicting color information arrives.

• A PARALLEL DISTRIBUTED PROCESSING MODEL

- Different tasks develop different processing pathways, and practice, as well as biological wiring, create different pathway strengths. Consequently it is strength, not speed, that is basic. Additionally, the degree of automaticity is a function of the strength of each pathway. What this means for the Stroop task is that if two pathways are active simultaneously and the pathway that leads to the response is stronger (naming words), no interference occurs. However, if two pathways are active simultaneously and the pathway that leads to the response is weaker (naming the color of the word), interference results.

Color Word



Color Word



red

blue

red

green

red

blue

red

blue

green

blue

green

red

Color Word



red

blue

red

green

red

blue

red

blue

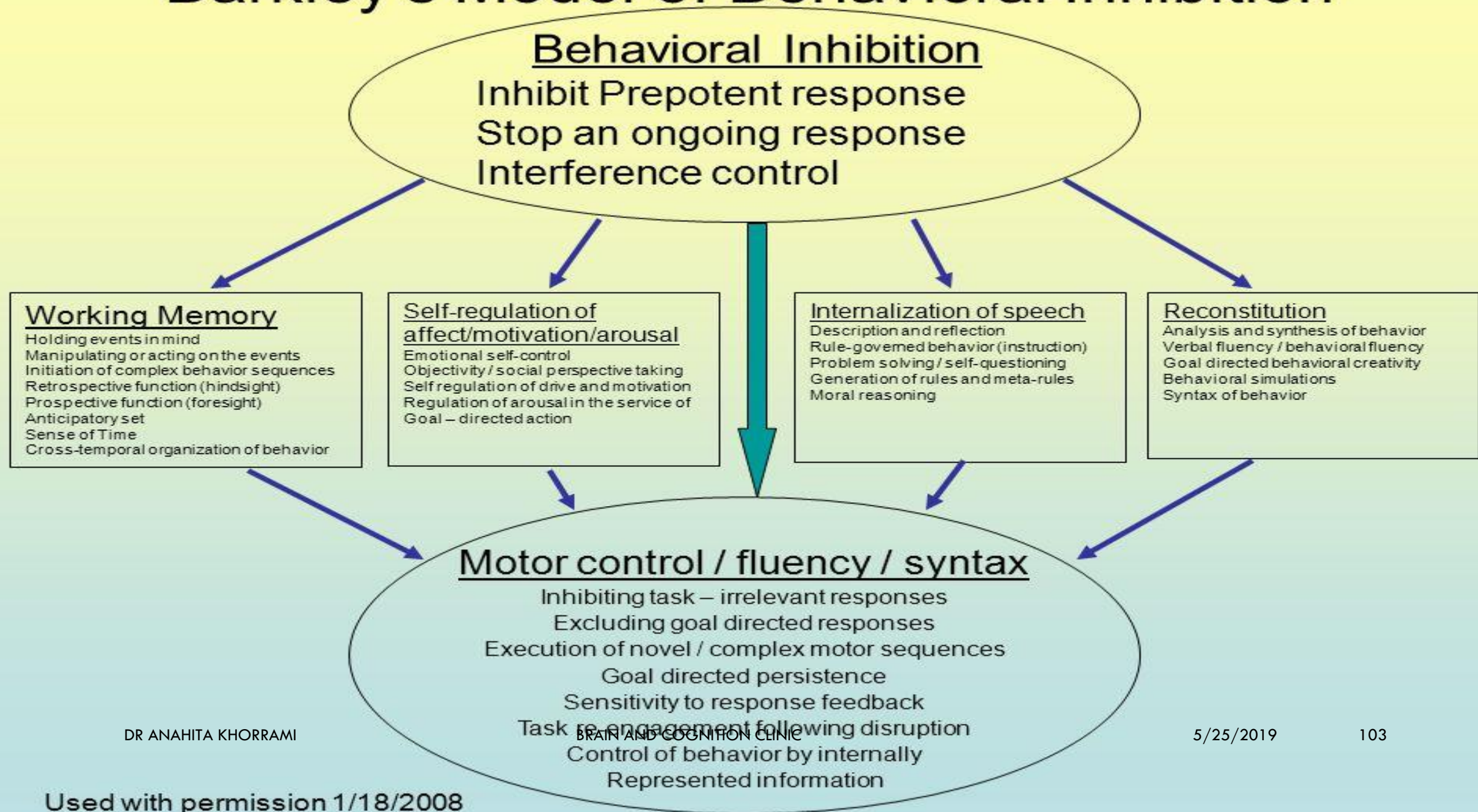
green

blue

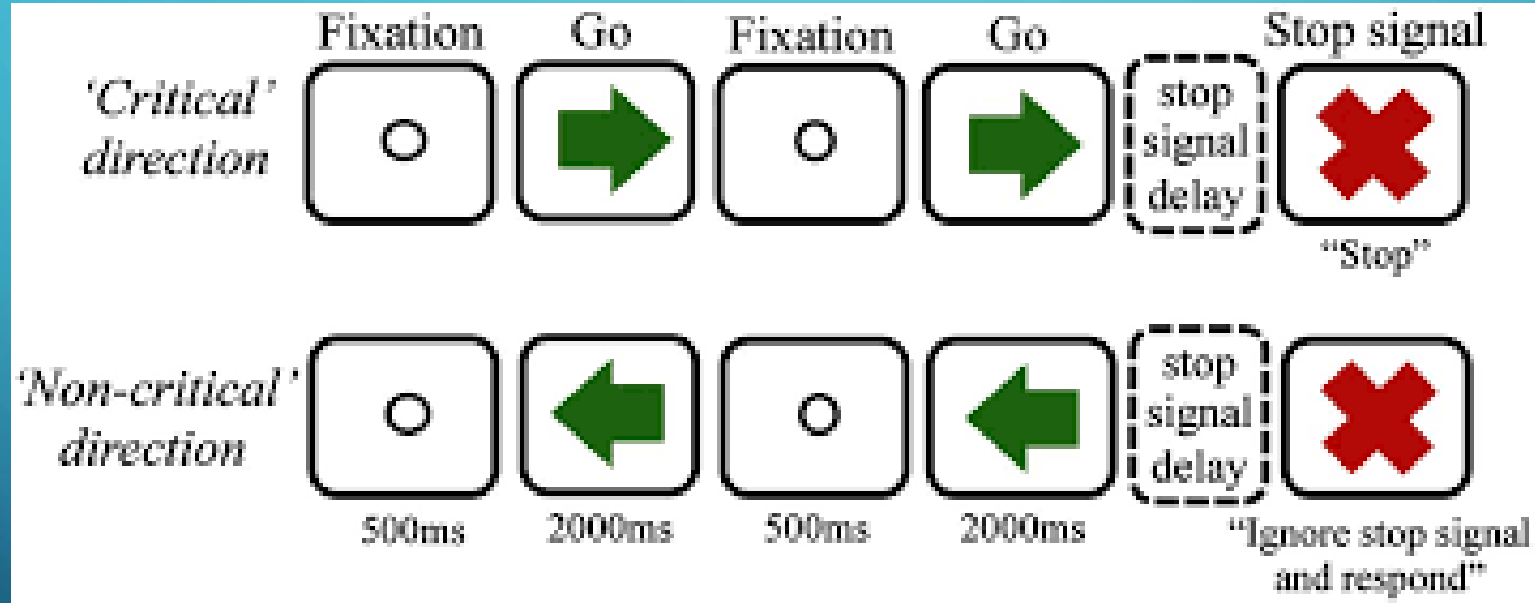
green

red

Barkley's Model of Behavioral Inhibition



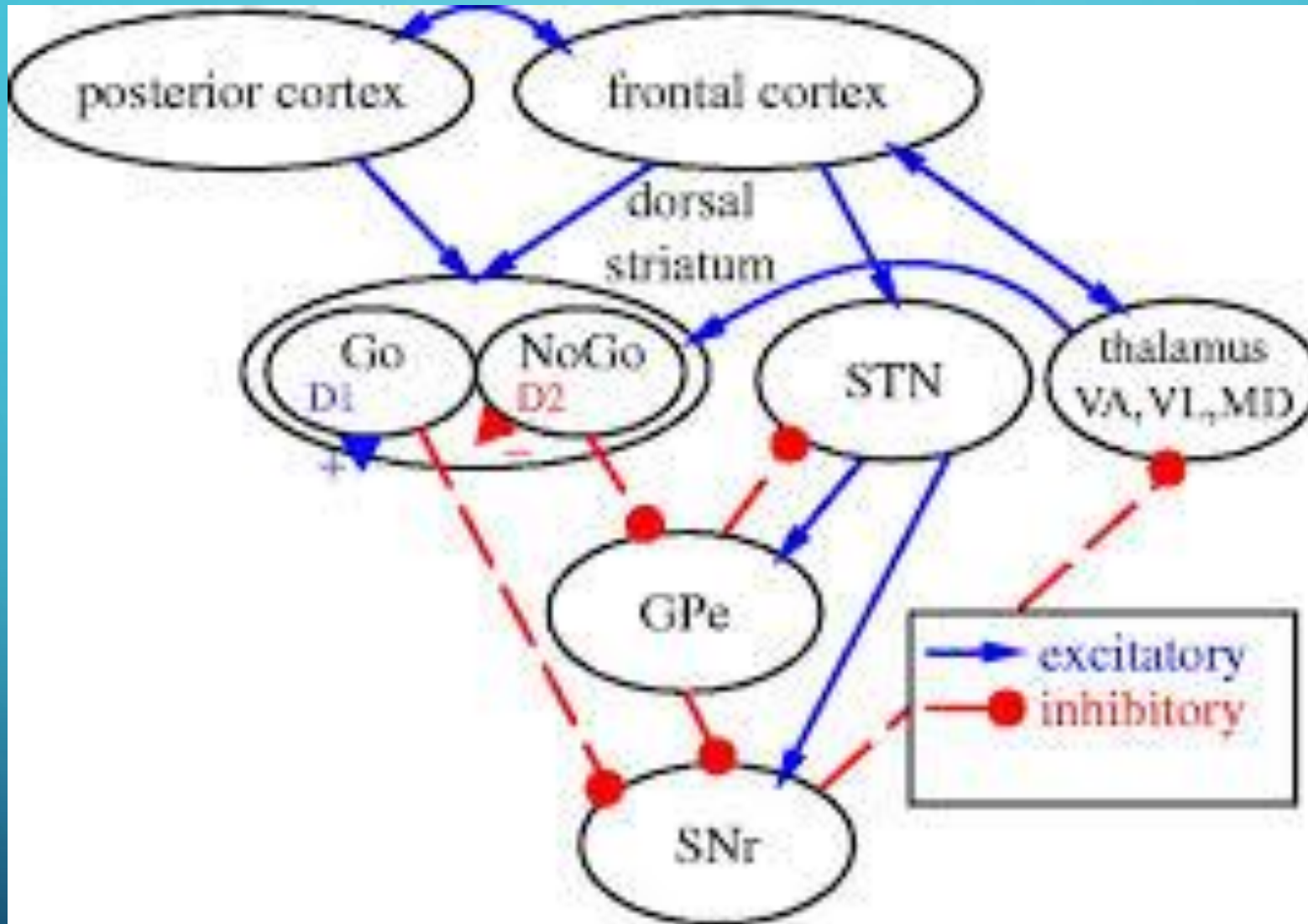
STOP SIGNAL



(SSRT) TASK

- The stop-signal reaction-time (SSRT) task **measures inhibition of a response that has already been initiated**, that is, the ability to stop. Human subjects classified as “impulsive,” for example, those with attention deficit and hyperactivity disorder, are ***slower to respond to the stop signal***

- **Although functional and structural imaging studies in humans have implicated frontal and basal ganglia circuitry in the mediation of this form of response control, the precise roles of the cortex and basal ganglia in SSRT performance are far from understood.**
- We describe effects of excitotoxic fiber-sparing lesions of the **orbitofrontal cortex (OF)**, **infralimbic cortex (IL)**, and **subthalamic nucleus (STN)** in rats performing a SSRT task. Lesions to the **OF slowed SSRT**, whereas lesions to the **IL or the STN had no effect**. On the go-signal trials, **neither cortical lesion affected go-trial reaction time (GoRT)**, but **STN lesions speeded such latencies**.
- The **STN lesion also significantly reduced accuracy of stopping at all stop-signal delays**, indicative of a **generalized stopping impairment that was independent of the SSRT itself**.



Set Shifting

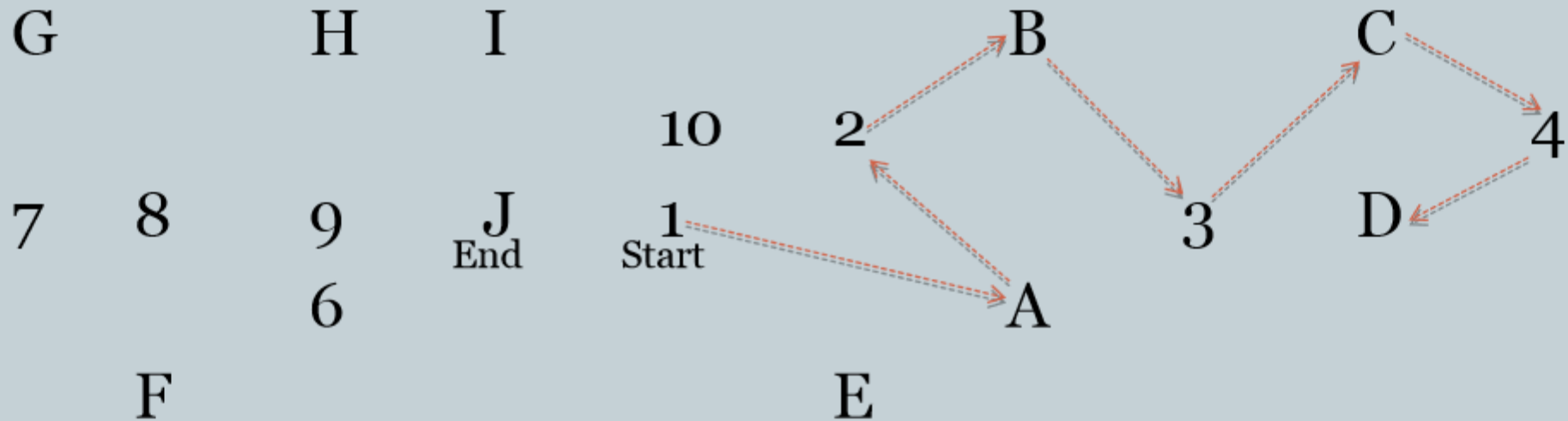


- Ability to move from one situation, activity, or part of a problem to another as the condition demands
- Test
 - Trails Making (D-KEFS)
 - Intra-Extra Dimensional Shift Set (CANTAB),
- BRIEF examples
 - Tries the same approach even when it does not work
 - Has trouble moving from activity to activity
 - Resists accepting a different solution
 - Experiences anxiety, or extreme anger when things change

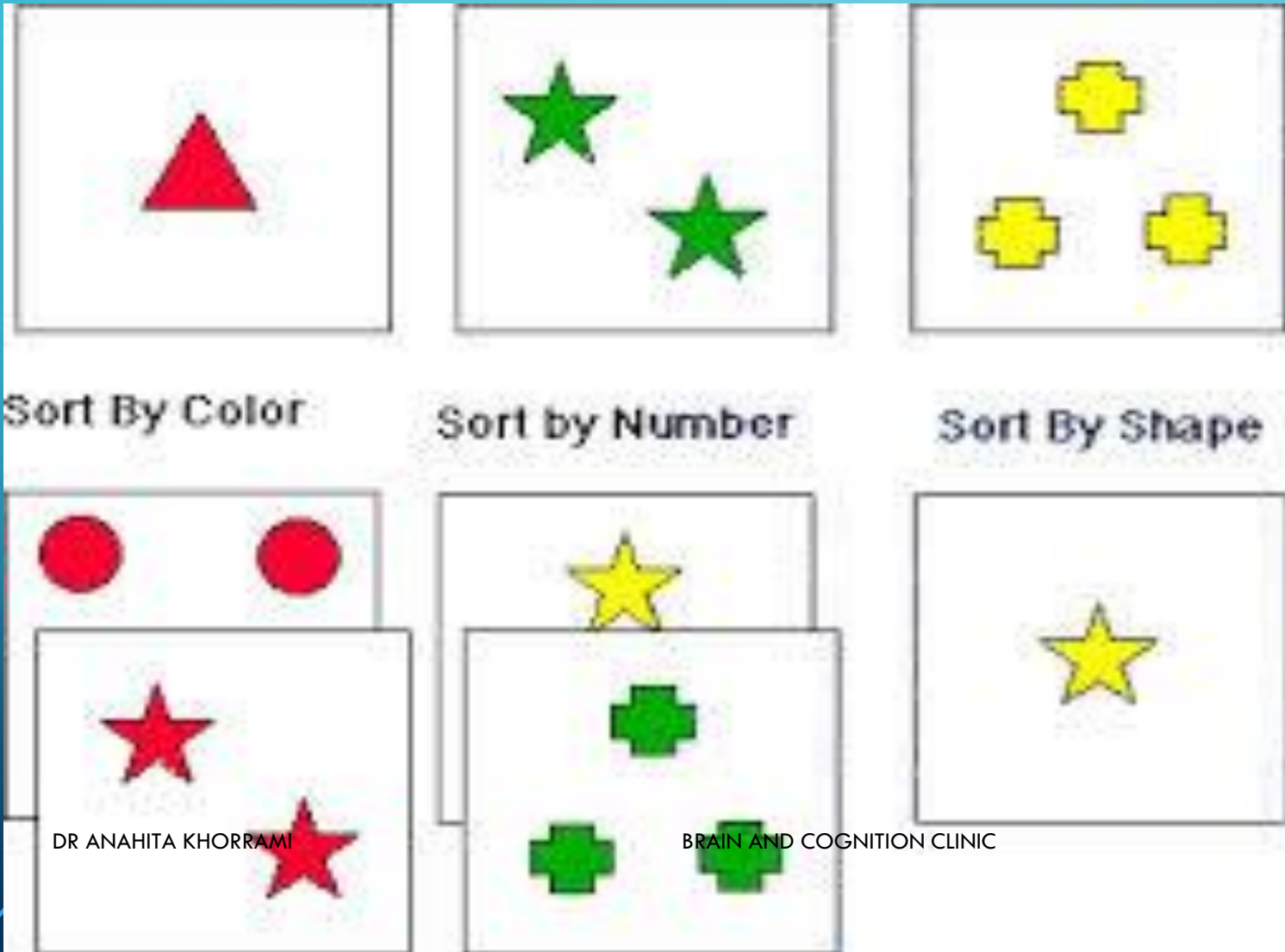
Trails Making



- Switch between connecting the numbers and letters
- Begin at number 1 and draw a line from 1 to A, A to 2, 2 to B, B to 3 and so on until you reach the end



WCST = WISCONSINE



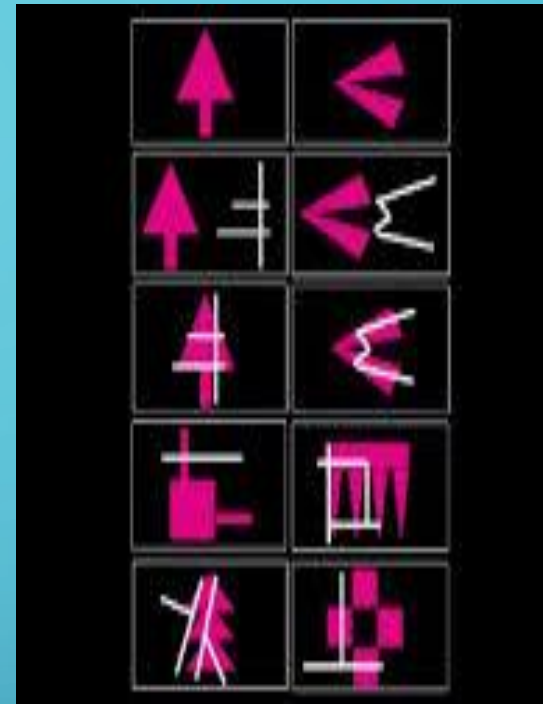
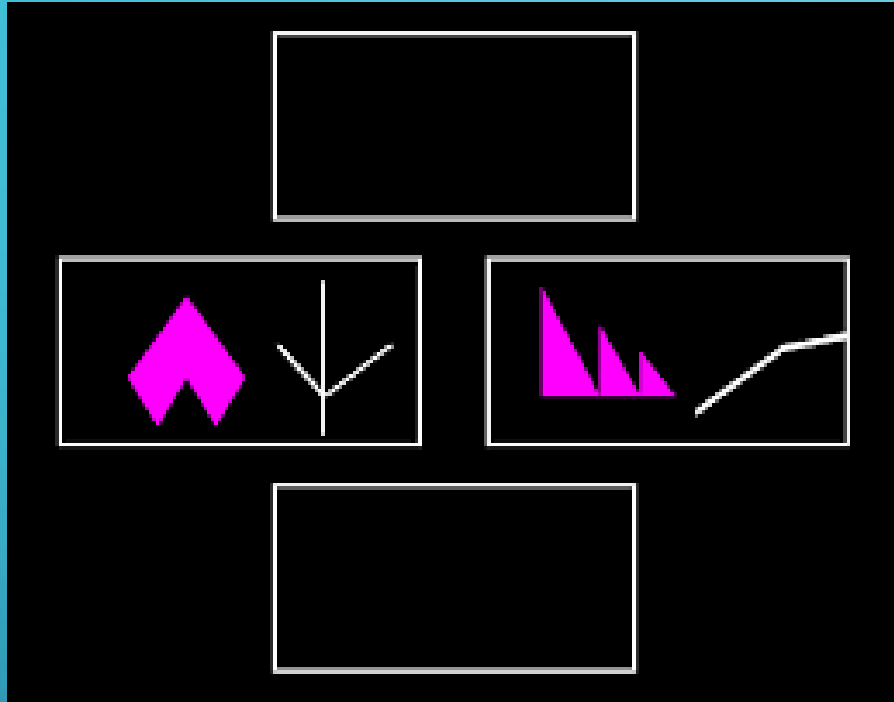
The image displays three columns of sorting tasks for the Wisconsin Card Sorting Test (WCST). Each column has a header and a corresponding set of cards.

- Sort By Color:** The header is "Sort By Color". The cards show two red circles on top and two red stars on the bottom.
- Sort by Number:** The header is "Sort by Number". The cards show one yellow star on top and three green crosses on the bottom.
- Sort By Shape:** The header is "Sort By Shape". The card shows one yellow star.



The image shows a software interface for the WCST. At the top, there are four cards: a red triangle, two green stars, three yellow crosses, and four blue circles. Below these is a selection area with two blue triangles and a "次へ" (Next) button. At the bottom, there is Japanese text: "それではまず練習してみましょう。4つのカードの内のどれかをマウスで選択してください。色、数、形のどれを選んだのか、声に出してお答えください。" (Let's first practice. Please select one of the four cards with the mouse. Tell me which one you selected by color, number, or shape.) and a "練習終了" (Practice End) button.

CANTAB IED



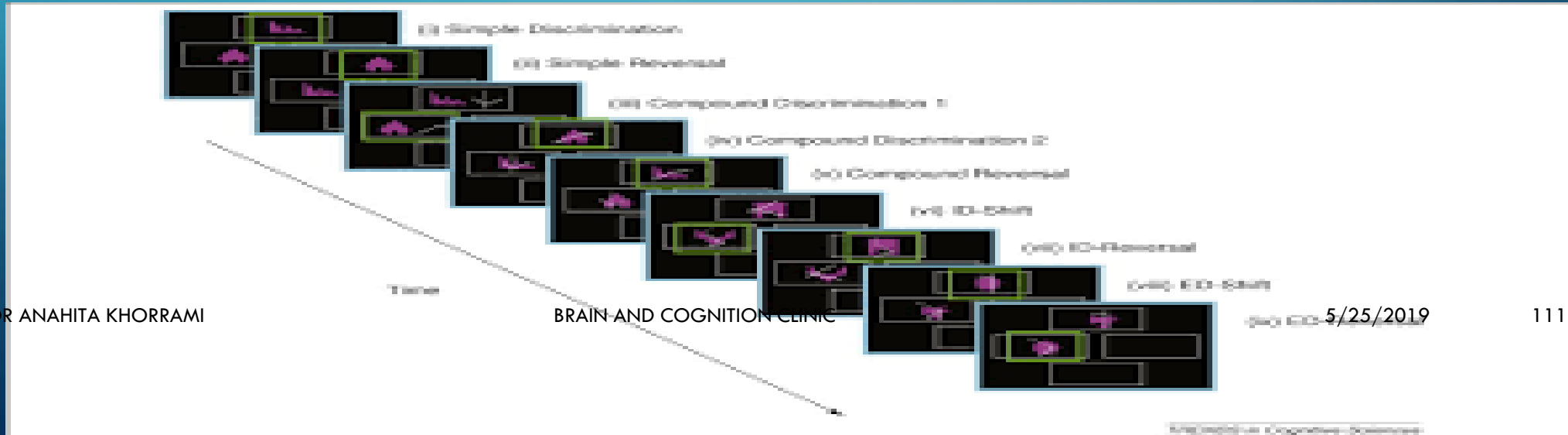
Simple Discrimination SD

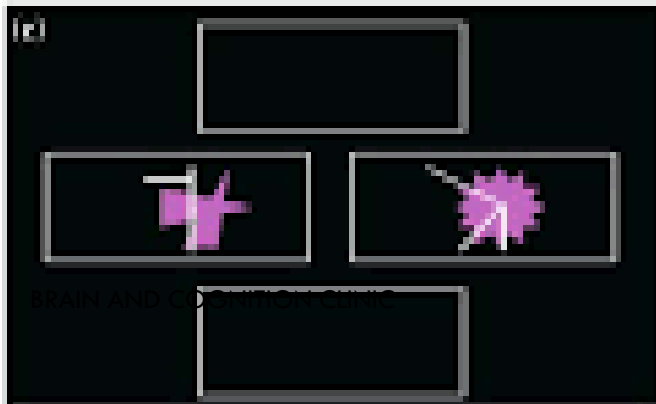
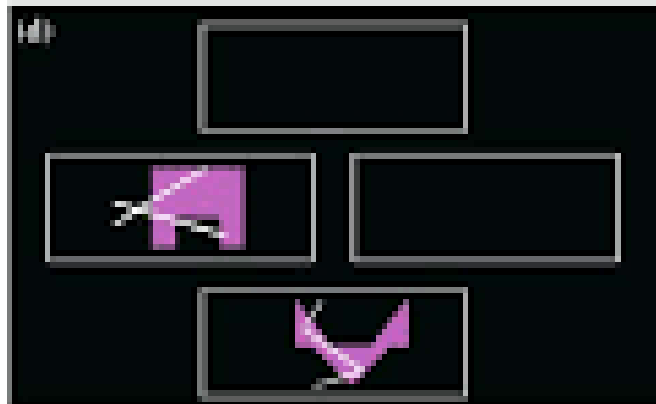
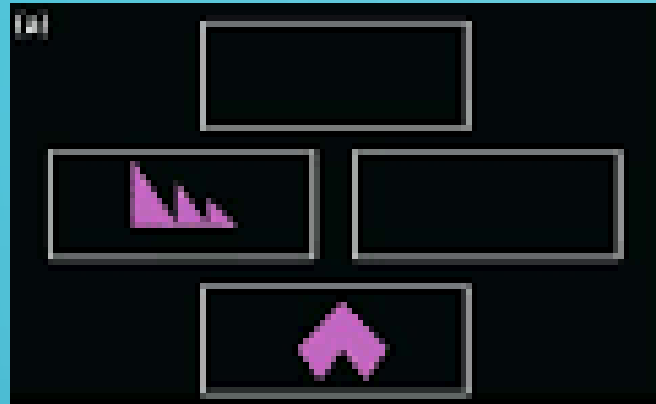
Compound Discrimination C_D

Compound Discrimination CD

Intradimensional Shift IDS

Extradimensional Shift EDS



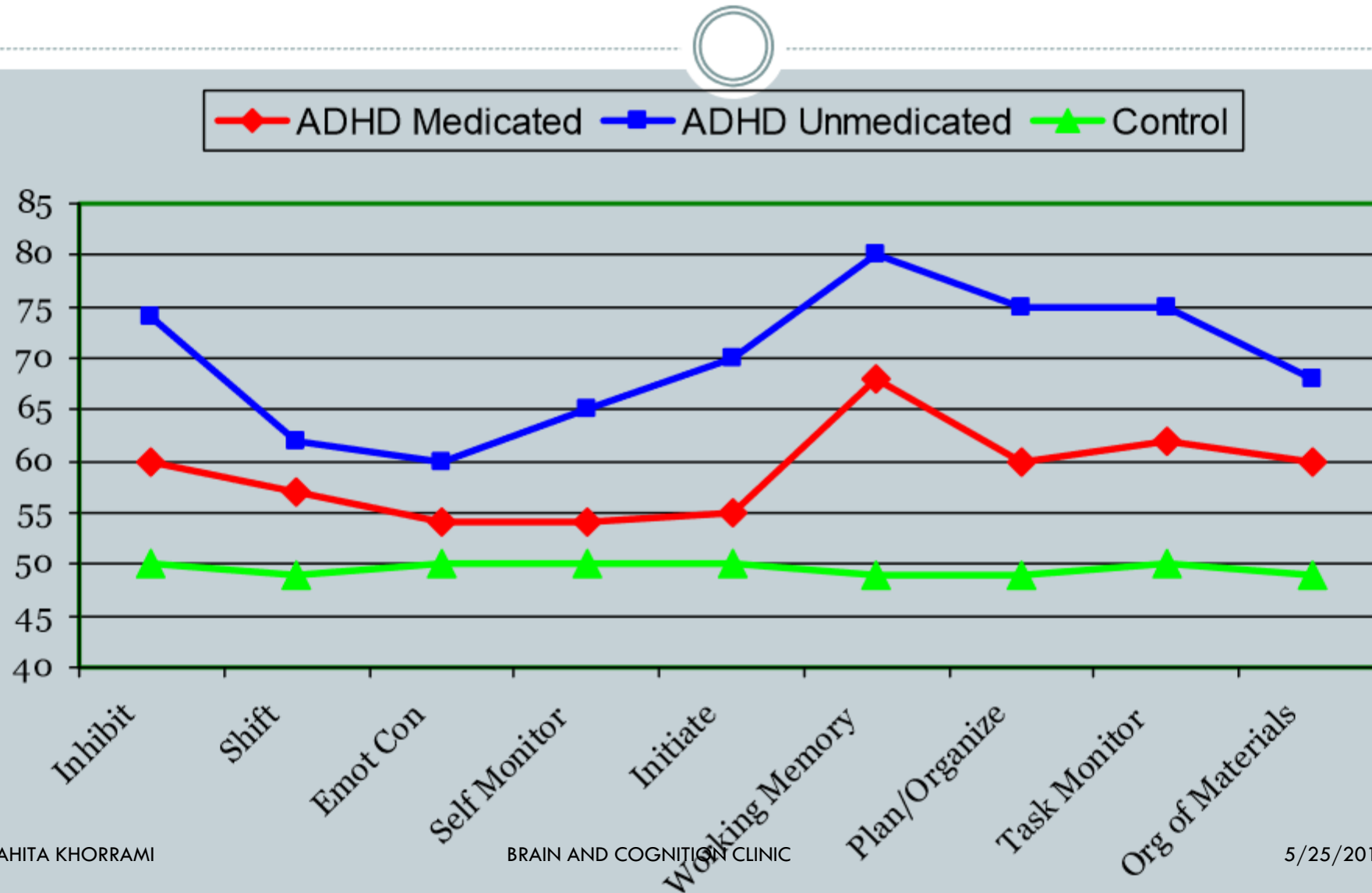


Initiating




- Ability to begin a task and independently generate ideas, responses, or problem solving strategies
- Test
 - Coding, Symbol Search, and Matrix (WAIS/WISC), Color Word and Trails Making (D-KEFS)
- BRIEF examples
 - Lies around the house a lot (couch potato)
 - Has good ideas but does not get the job done
 - Needs extensive reminders to begin a task
 - Has trouble getting started on tasks

BRIEF Scores in Adult ADHD



NONSPECIFIC TEST WHICH NEED ATTENTION



Medical & Science

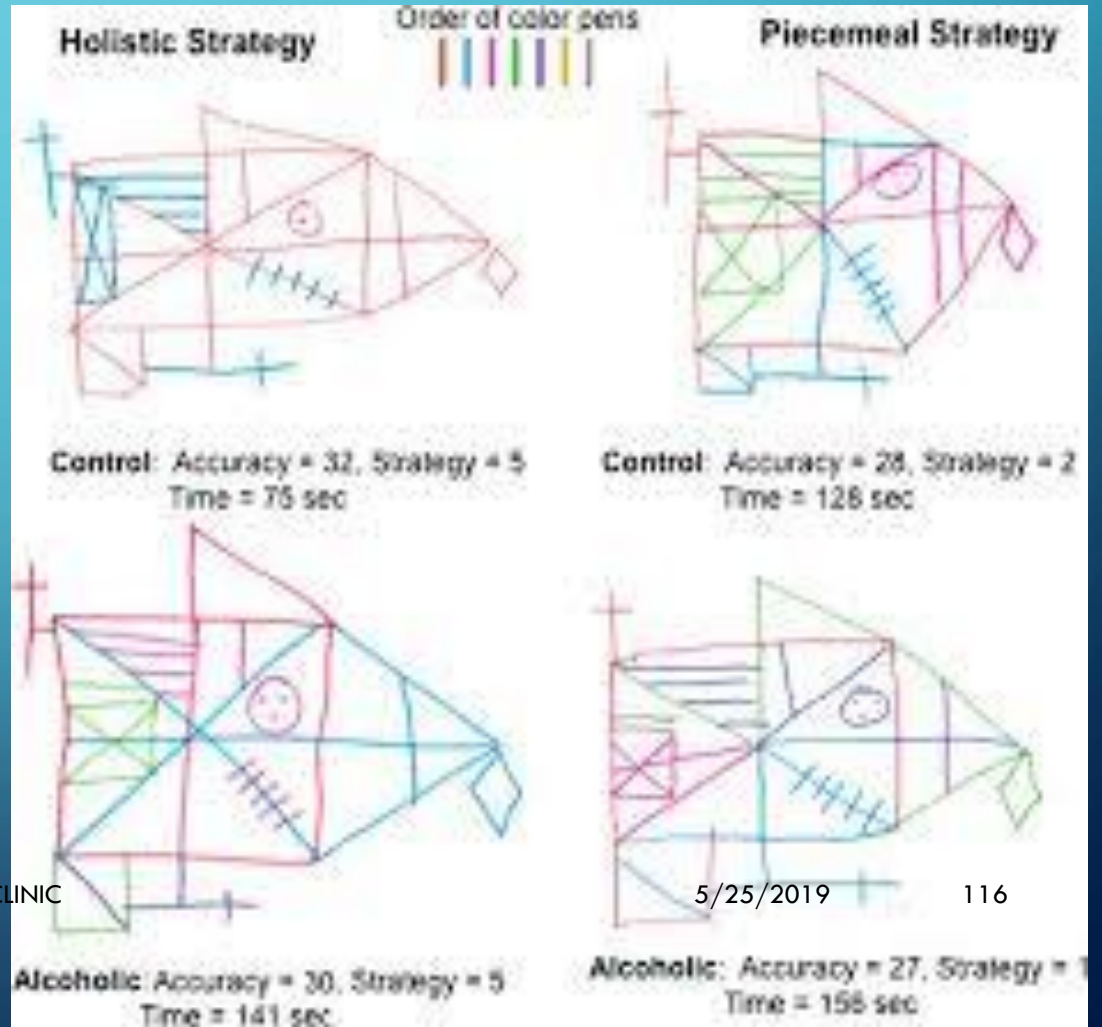
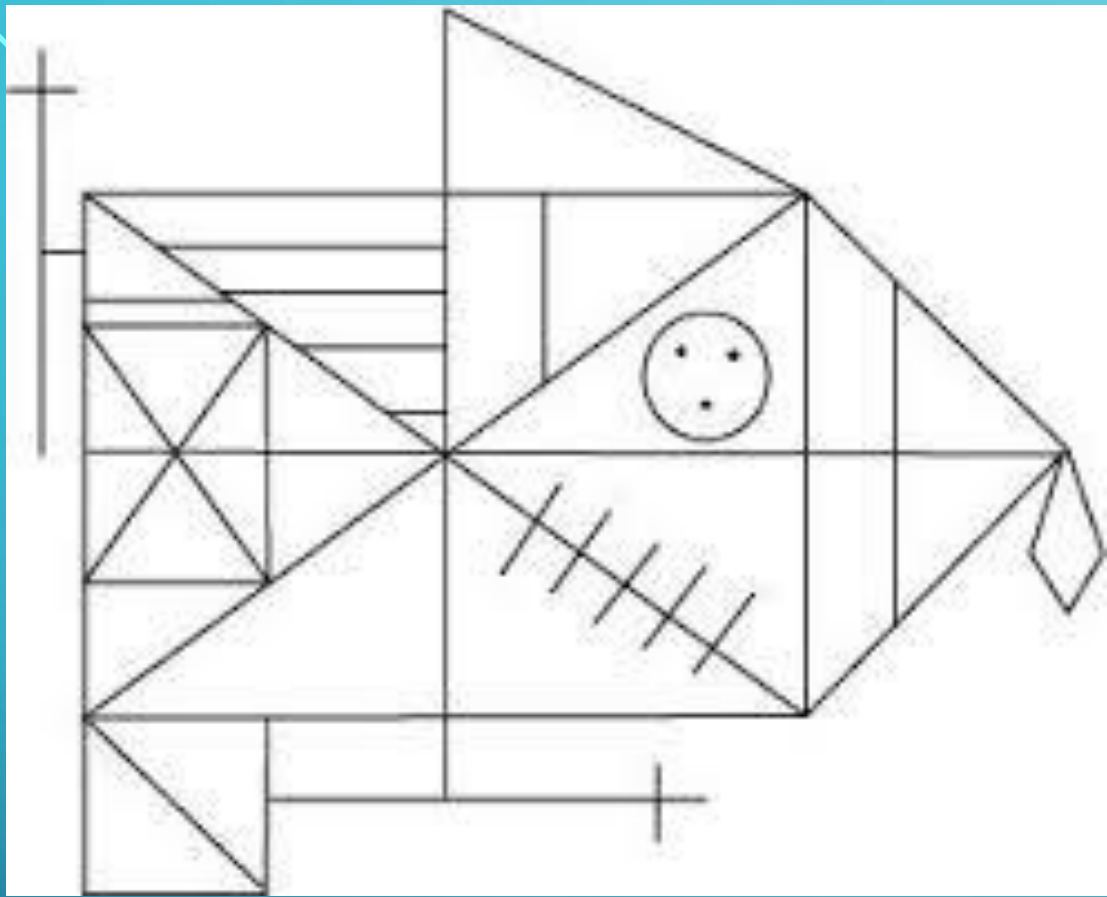
ROCFT

means

Rey-Osterrieth Complex Figure Test

by acronymsandslang.com

BRAIN AND COGNITION CLINIC





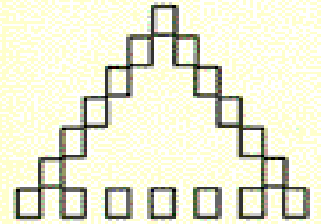
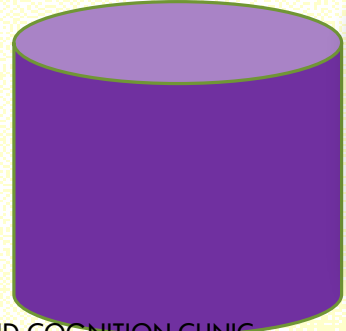

- **Visuospatial abilities, memory, attention, planning, and working memory**

CONDITIONS

- **Copy**: In the Copy condition, the examinee is given a piece of paper and a pencil, and the stimulus figure is placed in front of them. They reproduce the figure to the best of their ability. The test is not timed, but the length of time needed to copy the figure is observed. Some administrators use a series of colored pencils, in order to preserve a record of the order in which design elements were reproduced. However, because of concerns that the use of color changes the nature of the test and makes it easier for the subject to remember the figure, the current test manual suggests that this should not be done. Instead, the evaluator should take notes on the process the examinee uses. Once the copy is complete, the stimulus figure and the examinee's copy are removed from view.
- **Immediate recall**: After a short delay, the examinee is asked to reproduce the figure from memory.
- **Delayed recall**: After a longer delay (**20–30 minutes**), the examinee may again be asked to draw the figure from memory. Examinees are not told beforehand that they will be asked to draw the figure from memory; the **Immediate and Delayed Recall conditions are therefore tests of incidental memory**. Each copy is scored for the accurate reproduction and placement of 18 specific design elements. Additionally, the test administrator can note their qualitative observations regarding the examinee's approach to the task and the effectiveness of any apparent strategy use

LESIONS

Linguistic		
Target stimulus	Right-hemisphere patients	Left-hemisphere patients
Z ZZ Z Z Z Z Z Z Z Z Z		

Nonlinguistic		
Target stimulus	Right-hemisphere patients	Left-hemisphere patients
		

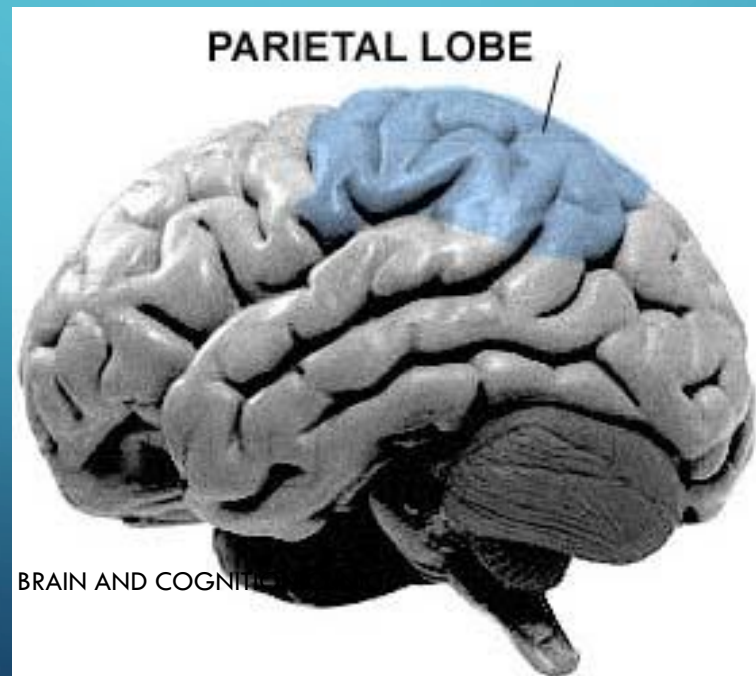
BRAIN AND COGNITION CLINIC

NEGLECT

- Results in one half of the visual field being ignored
- The ignored side is contra-lateral to the brain insult
- The person is capable of seeing things to the neglected side if they shift their head position to bring the item to the other side of the
visual field

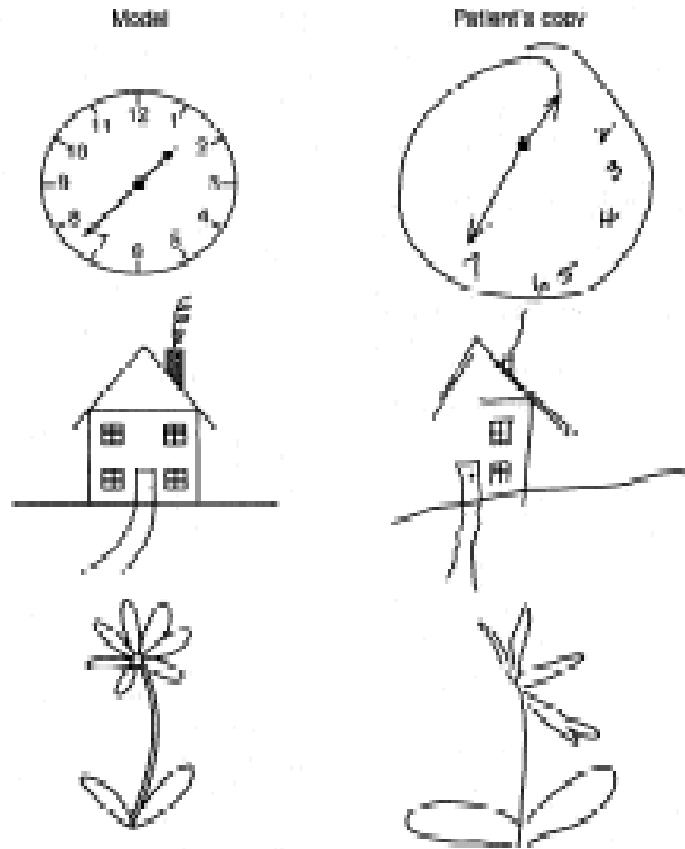
NEGLECT

Results from damage to the right parietal lobe

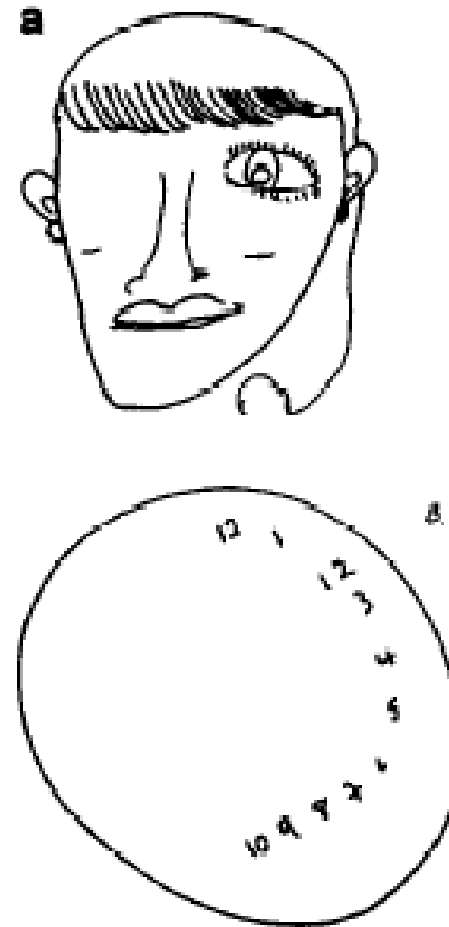


NEGLECT

Copying:

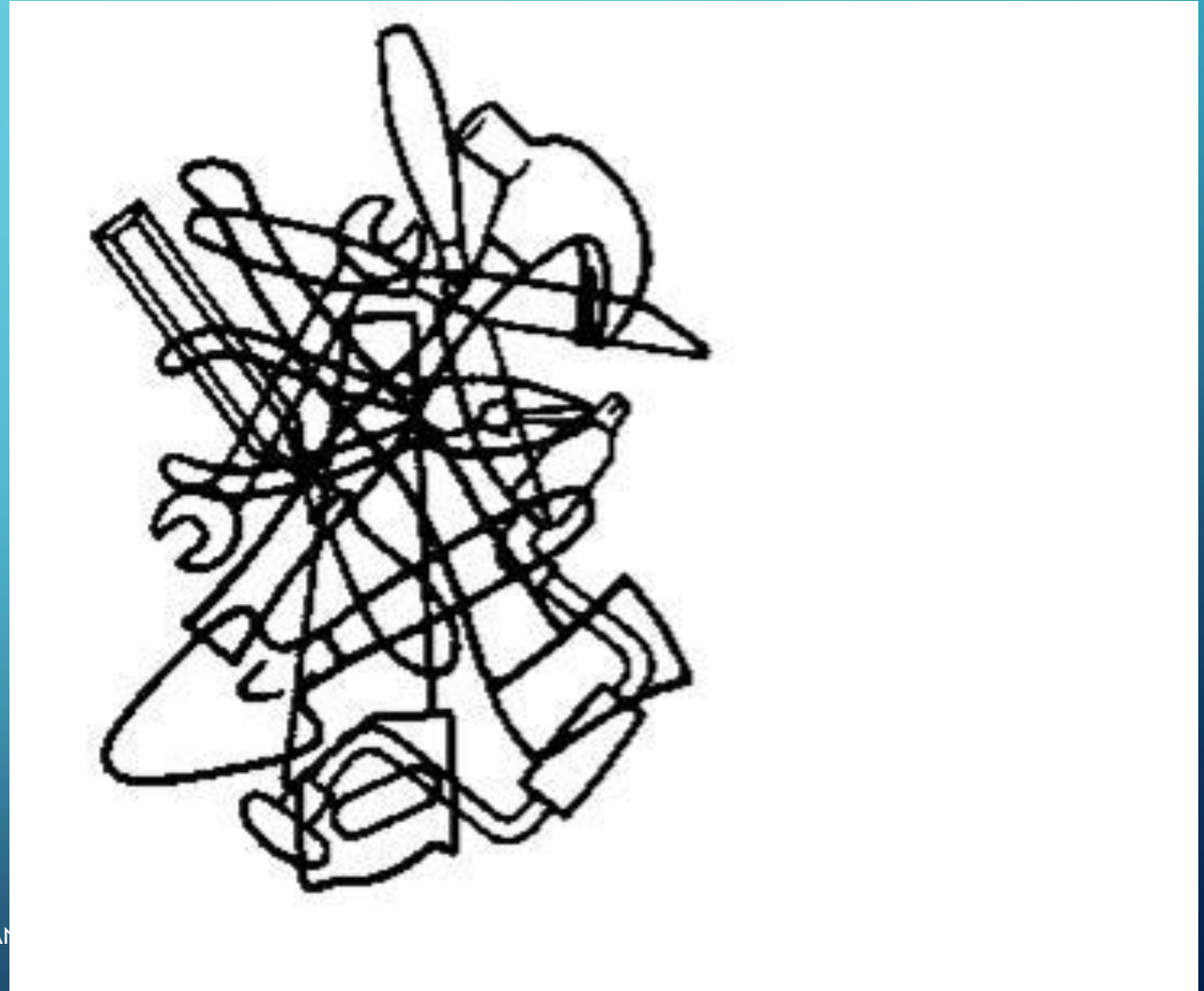


Spontaneous drawing:

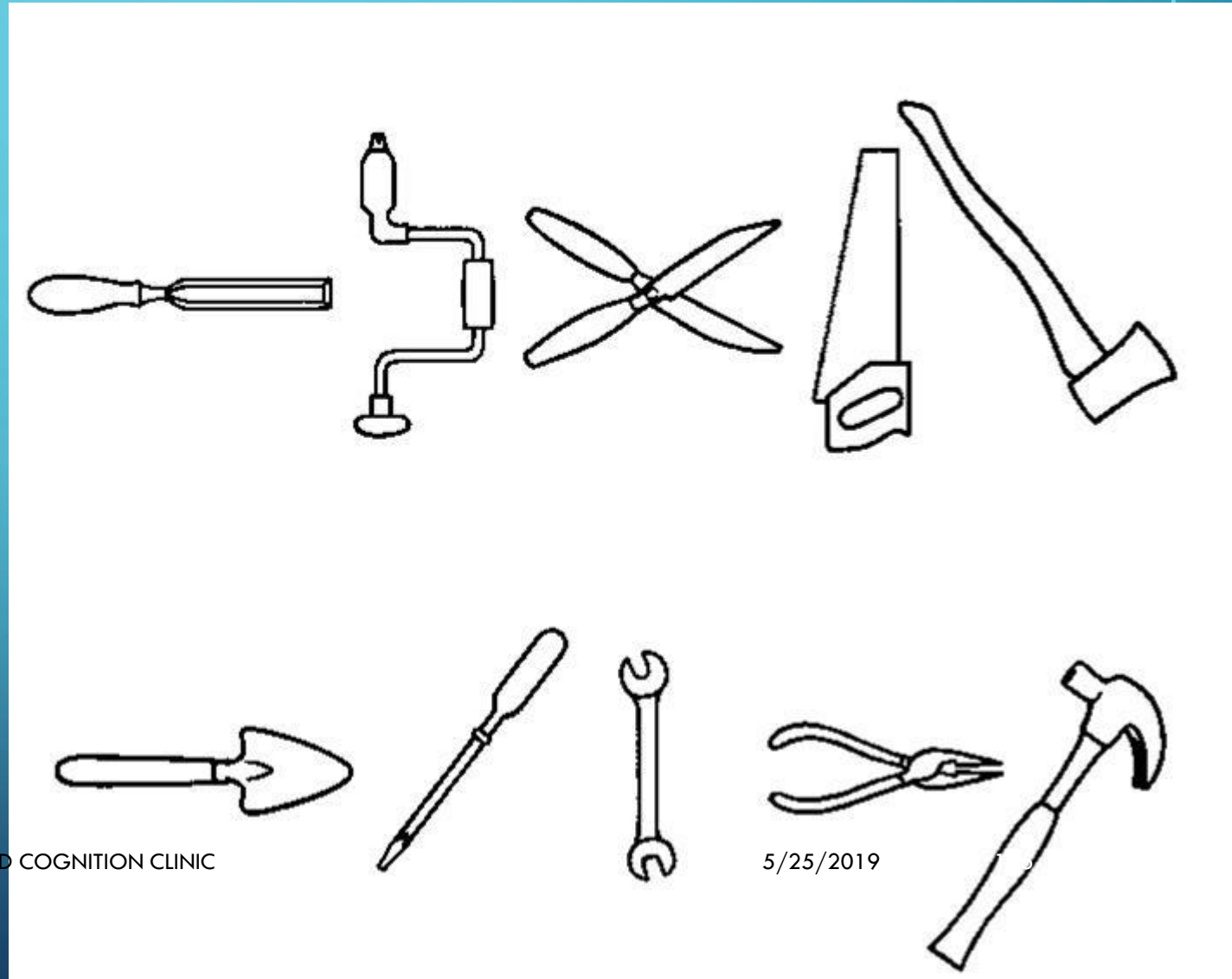


OBJECT BASED ATTENTION

The embedded figures test – task is to find all the objects in this figure.



The objects in the embedded figures test stimulus



Dissociation of working memory impairments and attention-deficit/hyperactivity disorder in the brain

Aaron T. Mattfeld,^{a,b,*} Susan Whitfield-Gabrieli,^a Joseph Biederman,^{c,d} Thomas Spencer,^{c,d} Ariel Brown,^{c,d} Ronna Fried,^{c,d} and John D.E. Gabrieli^{a,d}

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Abstract

Go to:

Prevailing neuropsychological models of attention-deficit/hyperactivity disorder (ADHD) propose that ADHD arises from deficits in executive functions such as working memory, but accumulating clinical evidence suggests a dissociation between ADHD and executive dysfunctions. This study examined whether ADHD and working memory capacity are behaviorally and neurobiologically separable using functional magnetic resonance imaging (fMRI). Participants diagnosed with ADHD in childhood who subsequently remitted or persisted in their diagnosis as adults were characterized at follow-up in adulthood as either impaired or unimpaired in spatial working memory relative to controls who never had ADHD. ADHD participants with impaired spatial working memory performed worse than controls and ADHD participants with unimpaired working memory during an n-back working memory task while being scanned. Both controls and ADHD participants with unimpaired working memory exhibited significant linearly increasing activation in the inferior frontal junction, precuneus, lingual gyrus, and cerebellum as a function of working-memory load, and these activations did not differ significantly between these groups. ADHD participants with impaired working memory exhibited significant hypoactivation in the same regions, which was significantly different than both control participants and ADHD participants with unimpaired working memory. These findings support both a behavioral and neurobiological dissociation between ADHD and working memory capacity.

Keywords: ADHD, n-Back, fMRI, Longitudinal, Working memory

1. Introduction

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“JOINT ATTENTION” FOR FUTURE SEARCH IS YOUR TASK

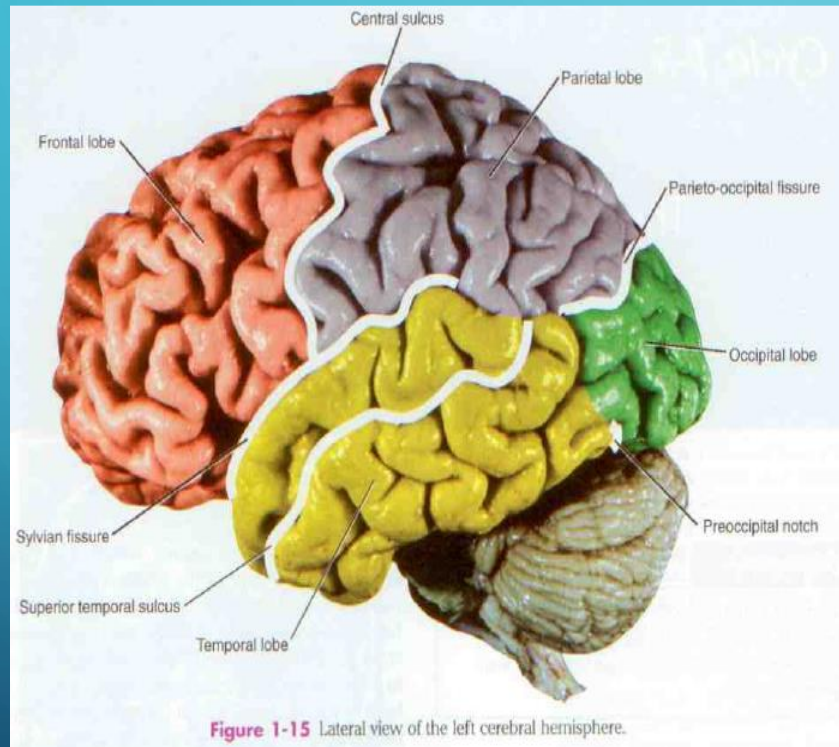
SOCIAL JOINT ATTENTION



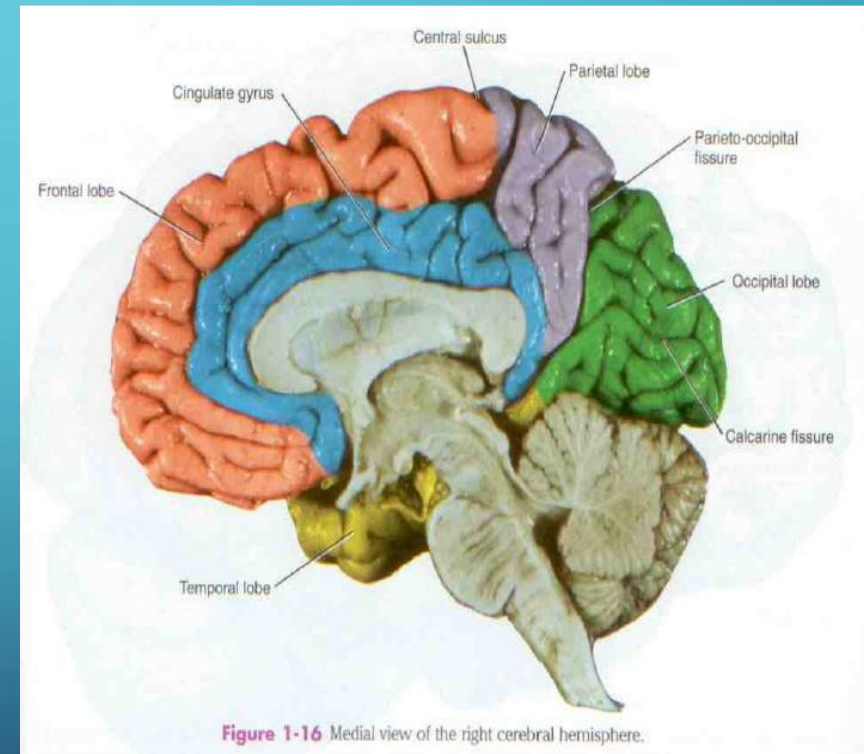
DR ANJITA KHORRAMI BRAIN AND COGNITION CLINIC
Initiate Joint Attention – IJA (emerges 6-9 months) **Responds to Joint Attention (RJA)** (emerges 3-6 months) 128

ADHD: NEUROANATOMY REVIEW

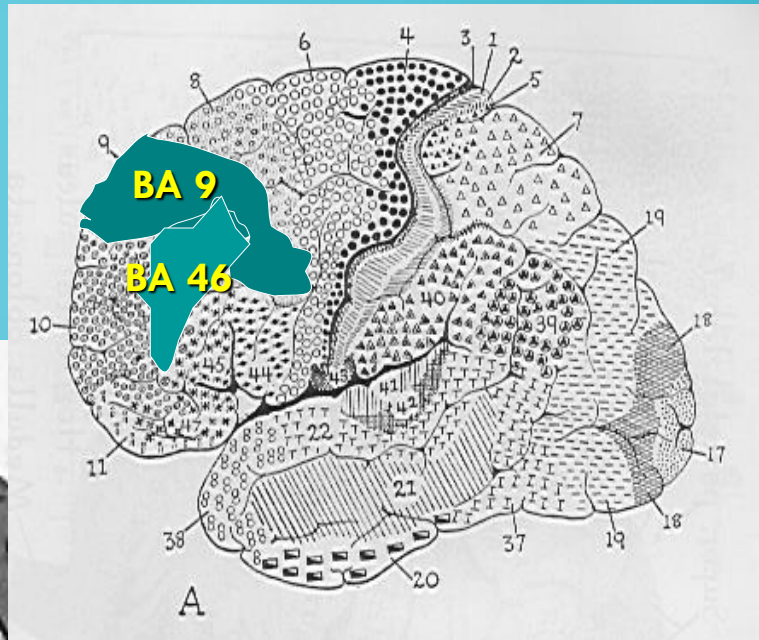
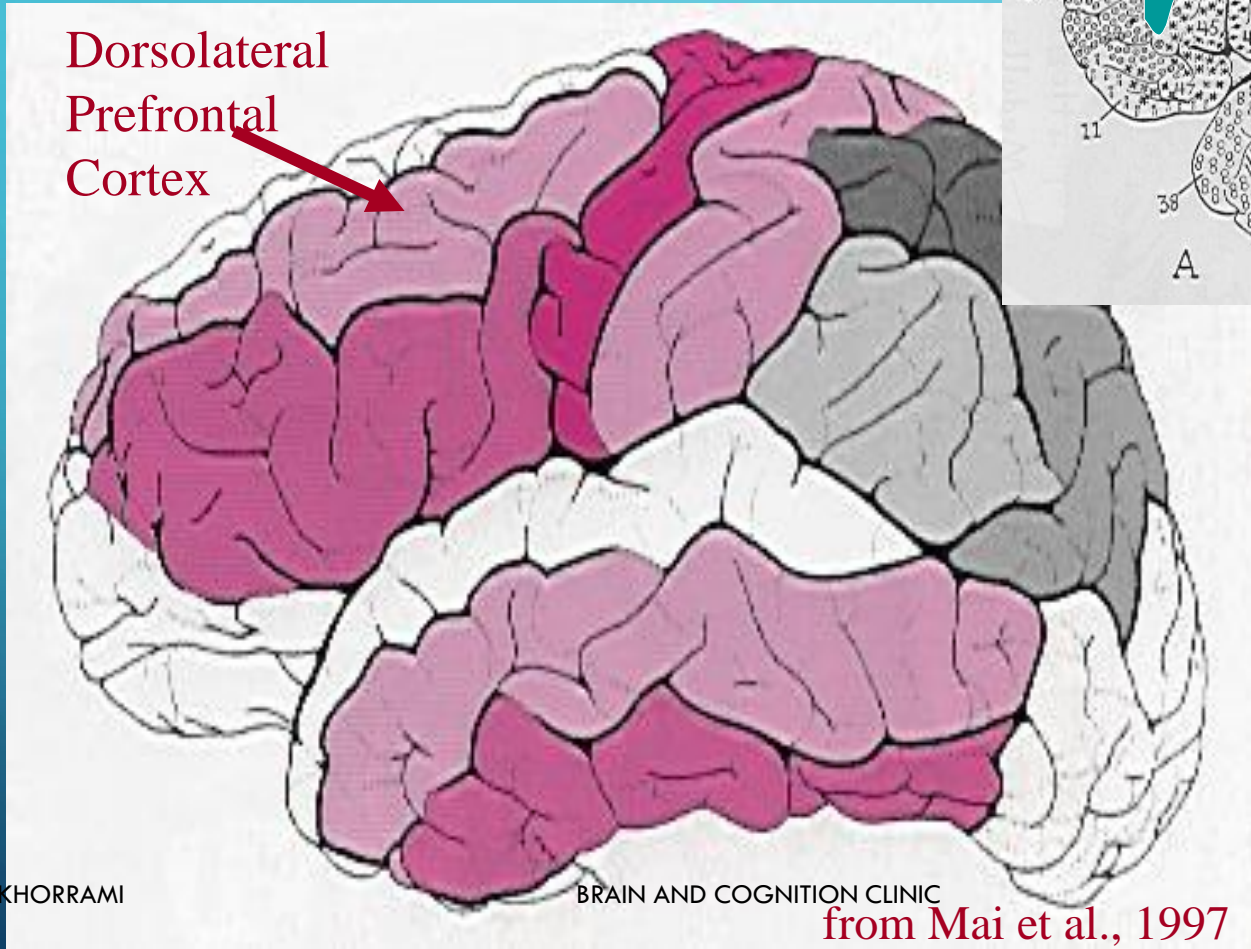
LATERAL VIEW



MEDIAL VIEW

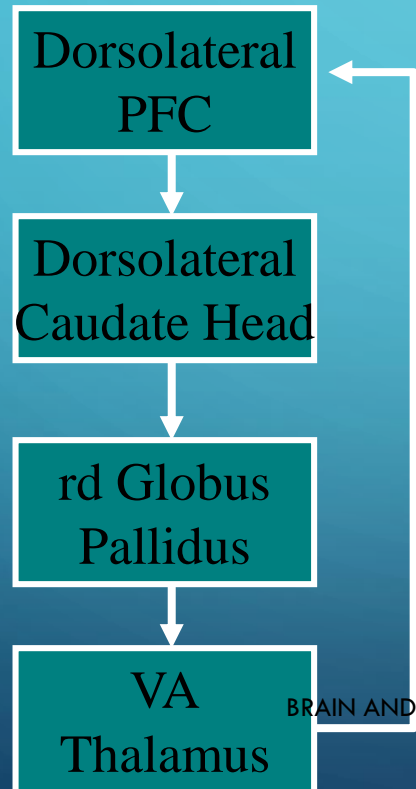


Dorsolateral
Prefrontal
Cortex

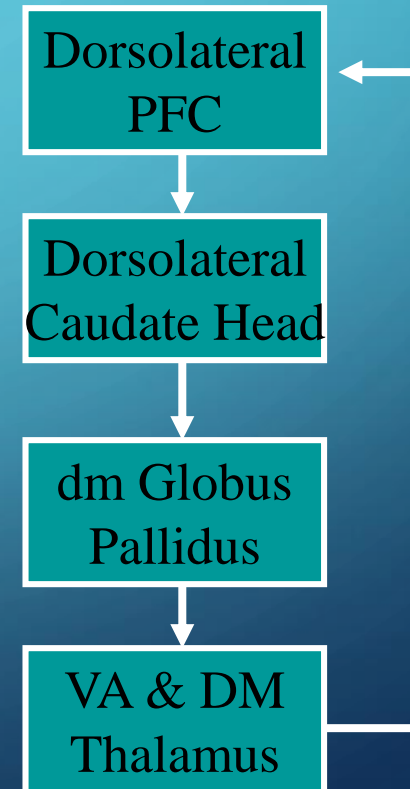


Dorsolateral Prefrontal Cortex: Basal Ganglia Connections

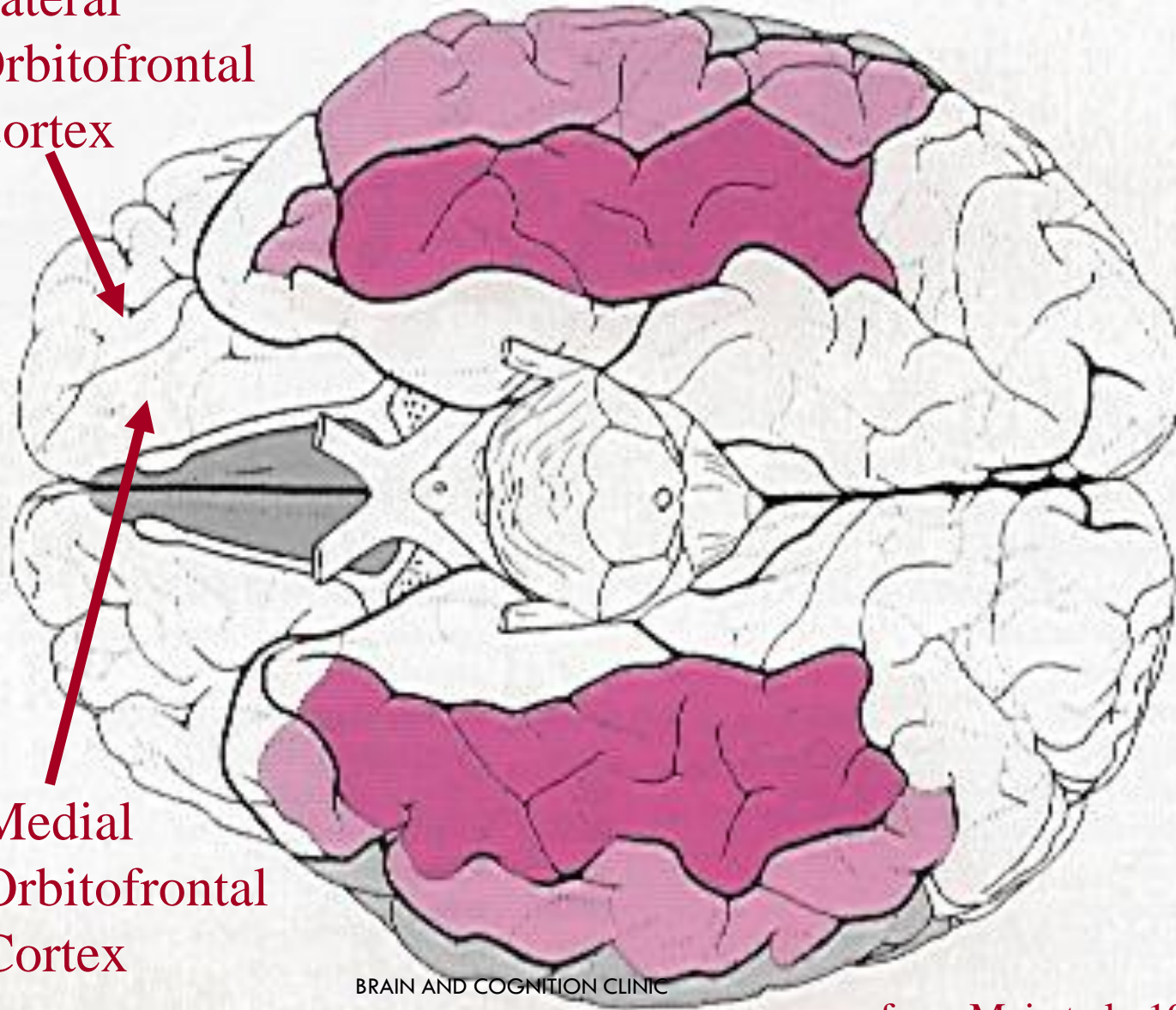
Dorsolateral Prefrontal (BA9) Loop



Dorsolateral Prefrontal (BA 46) Loop



Lateral
Orbitofrontal
Cortex



Medial
Orbitofrontal
Cortex

Orbitofrontal Cortex: Basal Ganglia Connections

Lateral Orbitofrontal Loop

Lateral
OFC

Ventromedial
Caudate Nuc.

Globus
Pallidus

Ventral Ant.
Thalamus

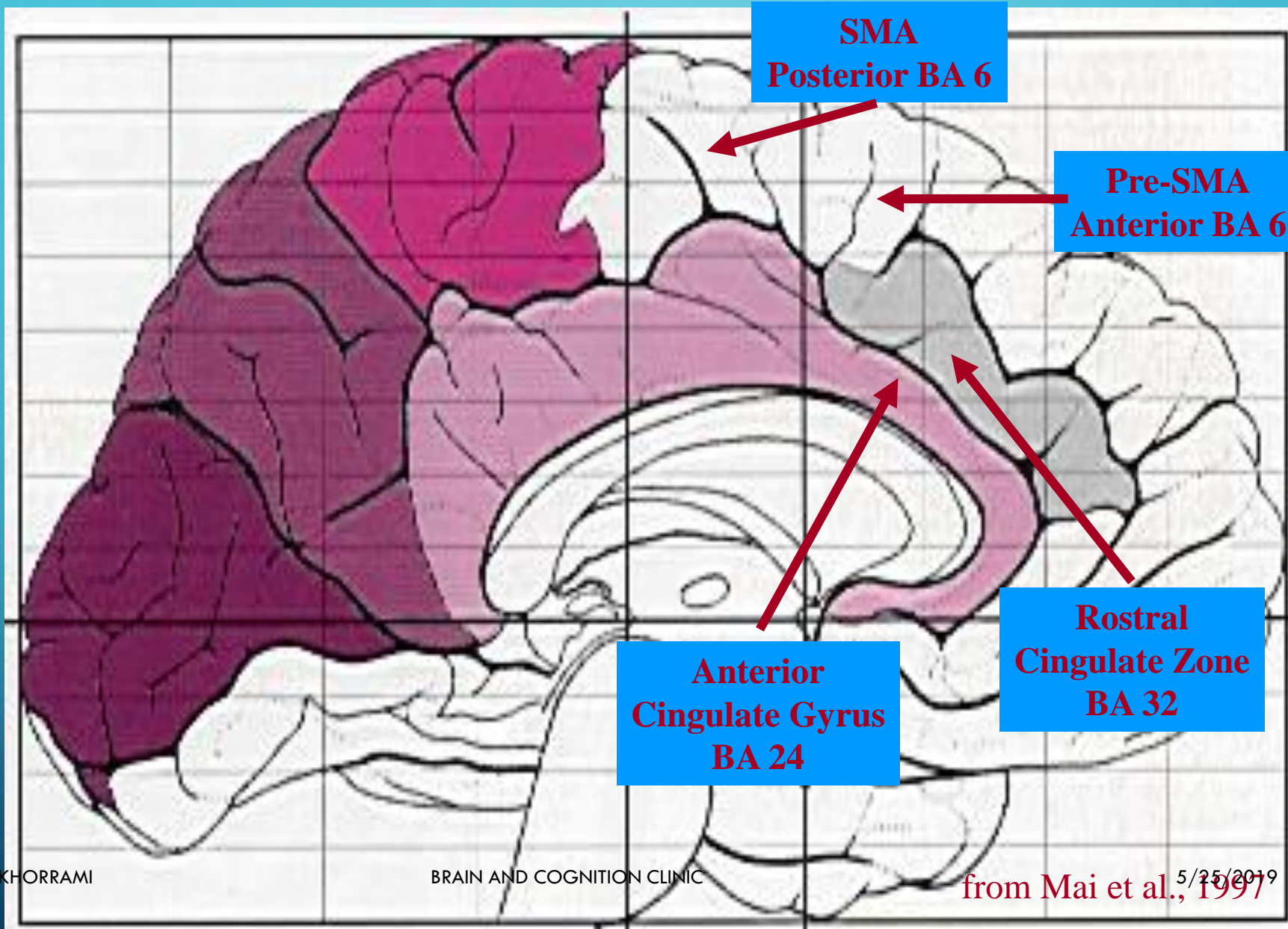
Medial Orbitofrontal Loop

Medial
OFC

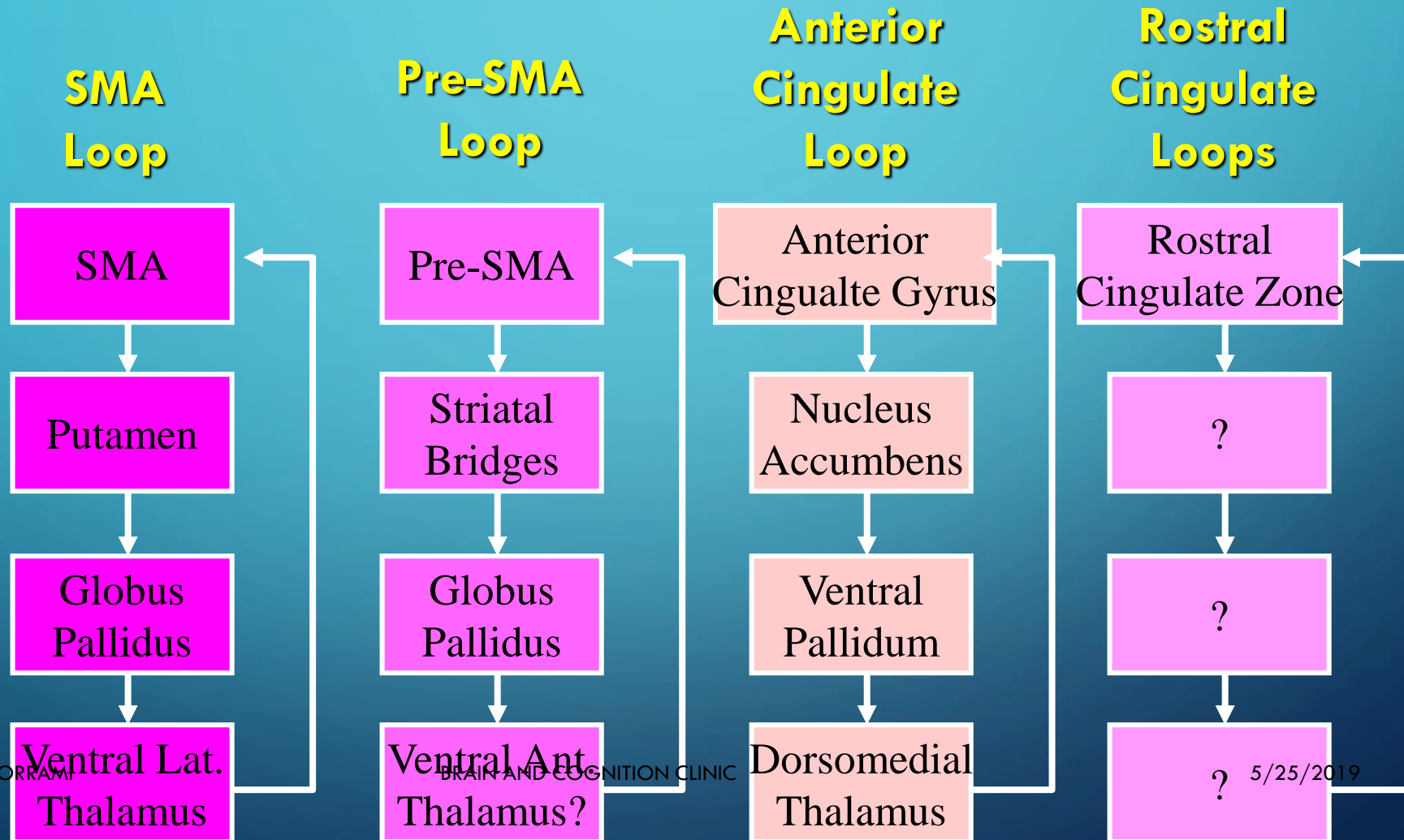
Nucleus
Accumbens

Globus
Pallidus

Ventral Ant.
Thalamus



Medial Frontal Cortex: Basal Ganglia Connections



BOREDOM

- **Boredom** is the **emotional and physical state of an individual** when they have nothing particular to do and have become **uninterested in their surroundings**.
- While for most people boredom is a **temporary state** that can easily be alleviated by a change of environment or in circumstances, it **can be a chronic and pervasive stressor for others**. *Boredom can weigh heavy on an individual's health and well-being.*
- *Being bored at work can lead to acute problems such as **slacking off to serious accidents** when **safety depends on alertness**. In terms of behavior, boredom has been **linked to impulse control** such as **overeating binge eating, drug and alcohol abuse and gambling**.*
- *Though it is clear boredom can lead to serious consequences, there still remains little to no research regarding the study of boredom.*

- Psychological scientist John Eastwood, of York University in Ontario, Canada, and colleagues at the University of Guelph and the University of Waterloo hope to understand **the mental process that causes boredom** and create a **precise definition of boredom**. Their hope is to find a definition that can be applied across a variety of theoretical frameworks.
- Through research across psychological science and neuroscience, researchers defined boredom as, "**an aversive state of wanting, but being unable, to engage in satisfying activity.**"

- They also found when **individuals are bored** it is because:
- We have **difficulty** paying attention to the internal information (e.g., **thoughts or feelings**) or **external information** (e.g., **environmental stimuli**) required for participating in satisfying activity
- We're aware of the fact that we're **having difficulty paying attention**
- We believe that the **environment is responsible for our aversive state** (e.g., "this task is boring," "**there is nothing to do**")
- *essm*

• THANK YOU FOR ATTENTION