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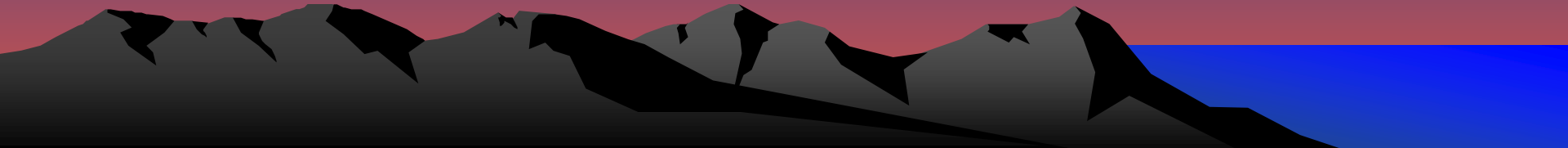
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# Presenter Disclosure – 2019

## Speaker (Honoraria):

- Yachad, Jewish Federation for Disabled Children, Baltimore, MD
- Melissa Institute, Coral Gables, FL
- West Suffolk School District, Long Island, NY
- Curry Ingram Academy, Brentwood, TN
- Learning at the Beach Pediatrics Conference, VCU Medical Center, Virginia Beach, VA
- Montgomery County Intermediate Unit, Norristown, PA
- Medical College of Wisconsin, Door County Institute, Egg Harbor, WI
- Australian Conference on Neurodevelopmental Disorders, Launceston, Tasmania
- Rawson Saunders School, Austin, TX
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- Activa Foundation, Madrid, Spain
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- Ironshore Pharmaceutical Co. – Speaker
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# ADHD From A to Z: History, Diagnosis, Nature, and Executive Functioning

**Russell A. Barkley, Ph.D.**

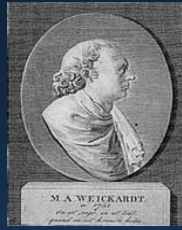
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Websites: [www.RussellBarkley.org](http://www.RussellBarkley.org);  
[www.Ahdlectures.com](http://www.Ahdlectures.com)

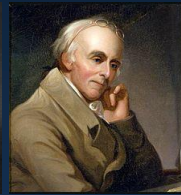
A silhouette of a mountain range is visible at the bottom of the slide, set against a background that transitions from a deep blue at the top to a reddish-pink sunset glow, and finally to a solid blue at the very bottom.

# Early History of ADHD<sup>1</sup>



1770-75

German M. A. Weikard describes ADHD-like syndrome in first medical textbook



1809 & 1812

British J. Haslam and American B. Rush describe a few cases of impulsive and inattentive children



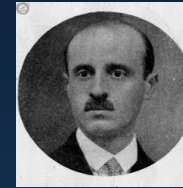
1867

British physician H. Maudsley reports cases of impulsive children



1902

British physician G. F. Still describes multiple clinical cases of an ADHD-like syndrome "defects in moral control"



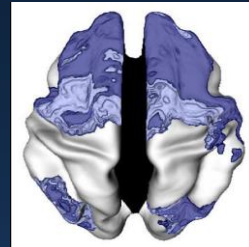
1917

In Spain, Dr. Rodriguez-Lafora reports on children with ADHD-like symptoms "the unstaibles"



1937

U.S. physician C. Bradley reports first trials of stimulants to manage ADHD-like symptoms



1960s-Now<sup>2</sup>

Research increases dramatically on every aspect of ADHD



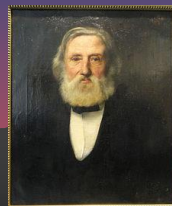
1798

Scottish physician A. Crichton describes two attention disorders in his medical textbook – probably studied with Weikard



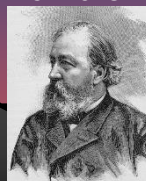
1844

German psychiatrist Heinrich Hoffman publishes stories of "Fidgety Phil" and "Johnny Head in the Air"



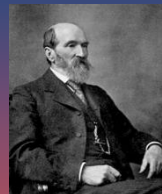
1885-95

French physician D. M. Bourneville describes hyperactive - impulsive children



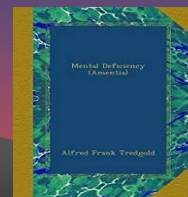
1899

Scottish physician T. Clouston does likewise



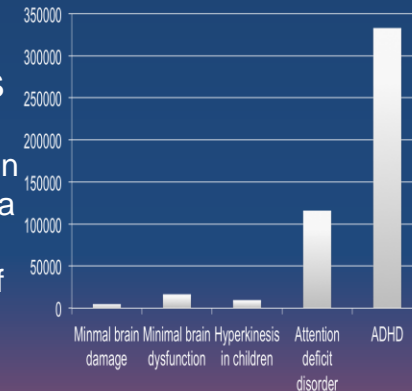
1908

English physician A. Tredgold confirms Still's reports; stresses its permanence



1917-1950s

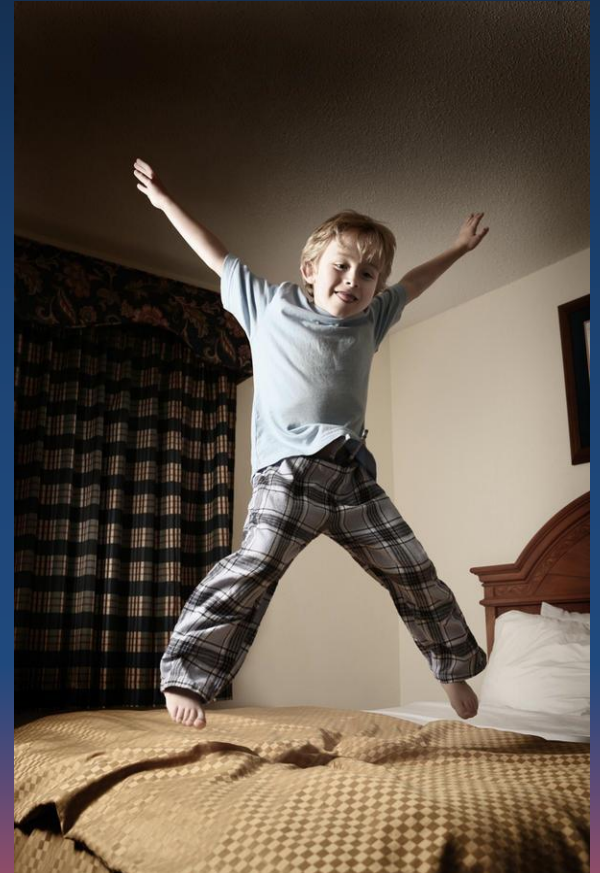
Various journal articles appear on hyperkinesis as a secondary consequence of various brain disorders (e.g. encephalitis, epilepsy, head trauma)



Google Scholar Search Hits by Diagnosis As of 4/1/2017

<sup>1</sup>R. A. Barkley (2015) History. In R. A. Barkley (Ed.), *Attention Deficit Hyperactivity Disorder: A handbook for Diagnosis and Treatment* (4<sup>th</sup> ed.). New York: Guilford Publications. <sup>2</sup>From Shaw, P. et al. (2007). ADHD is characterized by a delay in cortical maturation. *Proceedings of the National Academy of Sciences*, 104, 19649-19654.

# Why is ADHD a Disorder?



# Because It's a Harmful Dysfunction

Jerome Wakefield defines mental disorders as:

- **Dysfunction**(s) in one or more evolved psychological adaptations (abilities) that are universal to the species (part of human design)
- That lead to **harm** to the individual, including increased mortality, morbidity, and impairment (ineffective functioning in major life activities)
- ADHD easily meets both criteria; so it is a disorder
- But if the dysfunction is on a continuum and not categorical, at what point does it become a disorder? When it causes harm – adverse consequences - for the individual (the environment kicks back)
- A useful distinction emerges here:
  - **Symptoms** are the cognitive and behavioral expressions or manifestations of the disorder
  - **Impairments** are the adverse consequences arising from them

# Distinguishing Symptoms from Impairments

## Disorder

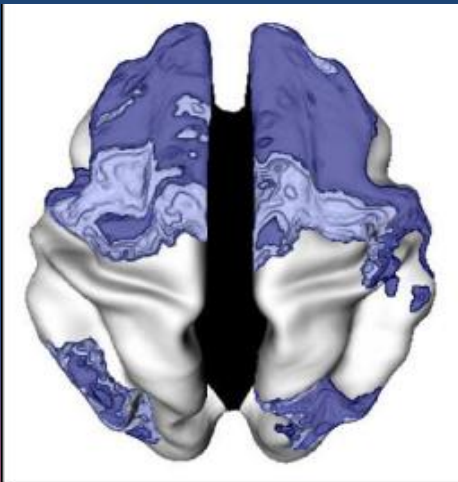
Neuro-genetic origins

## Symptoms

Cognitive-behavioral expressions

## Impairments

Consequences of symptom expression in the natural ecology



- Inattention
- Hyperactivity
- Impulsivity
- Deficient Executive Functioning

Adverse effects on major life activities, and morbidity or mortality risks – it is the environment “kicking back”

Brain image from Shaw, P. et al. (2007). ADHD is characterized by a delay in cortical maturation. *Proceedings of the National Academy of Sciences*, 104, 19649-19654.

# ADHD Varies by Setting

## ***Better Here:***

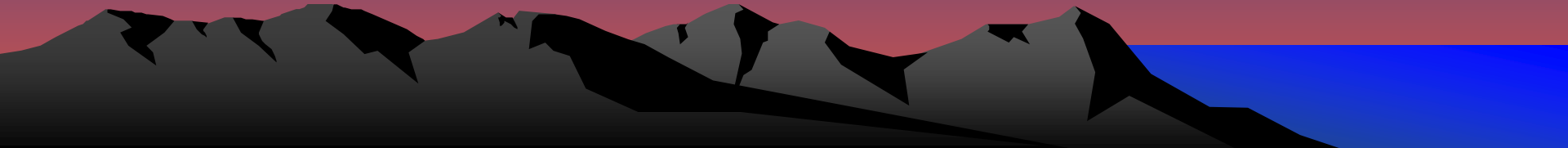
- Fun \_\_\_\_\_
- Immediate \_\_\_\_\_
- Frequent \_\_\_\_\_
- High \_\_\_\_\_
- Early \_\_\_\_\_
- Supervised \_\_\_\_\_
- One-to-one \_\_\_\_\_
- Novelty \_\_\_\_\_
- Fathers \_\_\_\_\_
- Strangers \_\_\_\_\_
- Clinic Exam Room \_\_\_\_\_

## ***Worse Here:***

- Boring
- Delayed Consequences
- Infrequent Feedback
- Low Salience
- Late in the Day
- Unsupervised
- Group Situations
- Familiarity
- Mothers
- Parents
- Waiting Room

# Prevalence (United States)

- 2-5% of children (using DSM-III or III-R)
- 5.5-8% of children (using DSM-IV or 5)
  - Adding Inattentive Type nearly doubles prevalence over III-R
- 4-5% of adults (~12 million in US)
- Varies by sex, age, social class, & urban-rural
  - 3:1 Males to females in children (5:1 in clinical samples)
  - 1.5:1 males to females in adults
  - More common in children; less so in adults
  - Somewhat more common in middle to lower-middle classes
  - More common in population dense areas
  - For instance, 12-15% of U.S. military dependents (DSM-III-R)
  - No evidence for ethnic differences to date that are independent of social class and urban-rural

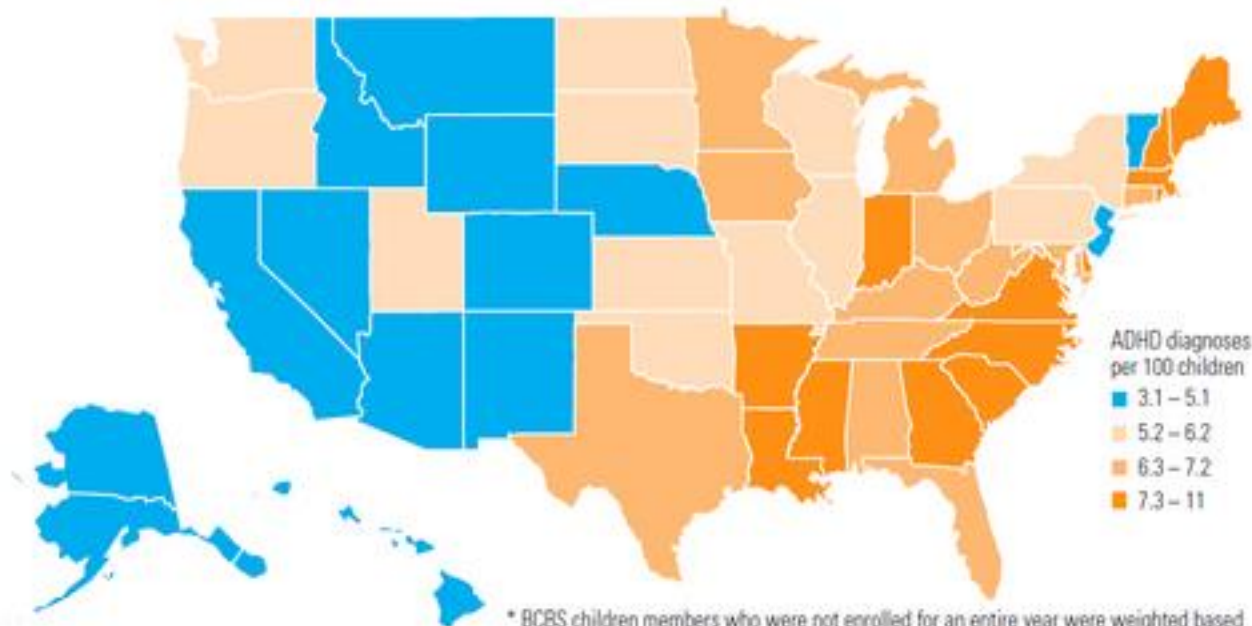


# US Prevalence in 2017

Blue Cross Blue Shield Assoc. recorded rates of diagnosis *USAToday*, 4-8-2019

MOST PREVALENT  
AMONG MIDDLE  
SCHOOL CHILDREN

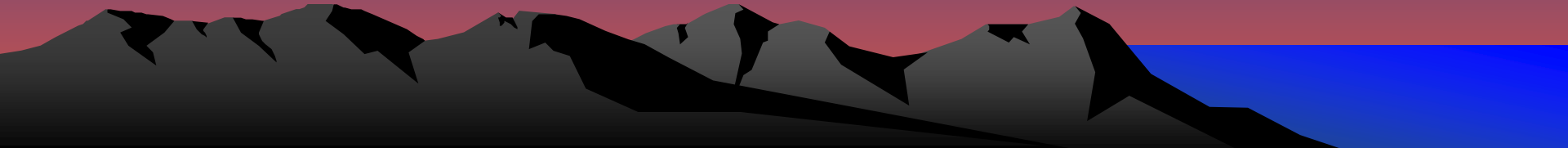
Age Group	2017 Diagnosis Rate
Preschool (2-5)	1.0%
Elementary School (6-10)	7.4%
Middle School (11-13)	9.0%
High School (14-18)	7.2%



\* BCBS children members who were not enrolled for an entire year were weighted based on the proportion of the year in which they were enrolled. For example, BCBS children members who were only enrolled for 6 months were counted as 0.5 BCBS children members.

# Persistence to Adulthood

- 70-80% persistence into adolescence
- Young Adulthood (age 20-26)
  - 3-8% Full disorder (self-report using DSM3R)
  - 46% Full disorder (parent reports using DSM3R)
  - 66% - Using 98th percentile of severity (parent report)
  - 85-90% remain functionally impaired
- Adulthood (mean age 27)
  - 14-35% recovered from disorder
  - 44-55% still fully disordered (diagnosable)
  - 15-30% highly symptomatic but not diagnosable

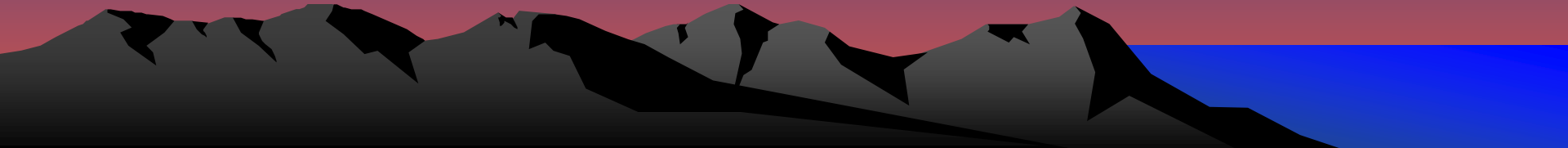


# DSM-V Criteria for ADHD

- Manifests 6+ symptoms of either inattention or hyperactive-impulsive behavior (5 for adults)
- Symptoms are developmentally inappropriate
- Have existed for at least 6 months
- Occur across settings (2 or more)
- Result in impairment in major life activities
- Developed by age 12 years
- Require corroboration of self-reports via another source of information
- Are not best explained by another disorder
- 3 Presentations: Inattentive, Hyperactive, or Combined

# Changes from DSM-IV to DSM5

- Symptom list remains the same (18) but with parenthetical clarifications for teens and adults
- Symptom threshold for children and teens remains the same (#6) but is reduced for adults (#5)
- Age of onset raised to age 12 years
- Requires corroboration of self-reports
- Replaces subtypes with “presentations”
- Permits overlap with autistic spectrum



# Other Issues DSM5 Failed to Address

- Inattention list is mislabeled
  - Include executive functioning (working memory)
- Symptoms of impulsiveness or poor inhibition are chiefly verbal
  - needed to add poor impulse control generally and motor, cognitive, and affective/motivation specifically
- Symptoms of poor executive emotion self-regulation are important central features but receive no mention
- Symptoms and wording are not appropriate past childhood – parenthetical clarifications may help but not enough
  - Need more items for adult stage of disorder

# More Issues

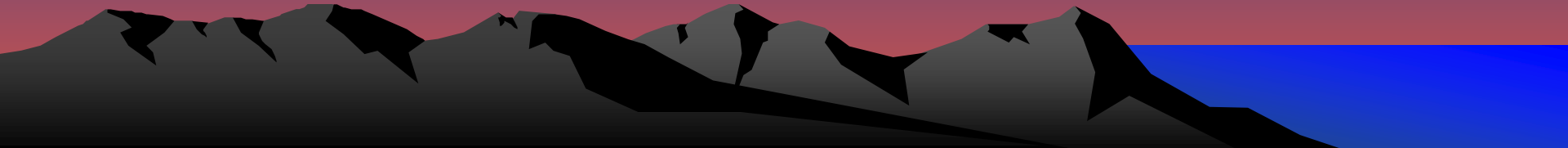
- Symptom threshold (6) not appropriate past childhood – adjustment to 5 for adults helpful but not enough
  - May have to adjust thresholds down to 4 of 9 if > age 17 and higher than 6 if < 4 yrs
- Threshold for children based mainly on boys (3:1)
  - May need to be lower for girls; use rating scales
- Duration may be too short for preschoolers:
  - try 1 year or more
- Requires cross-setting occurrence of symptoms that implies need for parent-teacher agreement
  - Instead, blend reports of both and use history of cross setting impairment

# Advances in Understanding the Symptoms of ADHD

The two dimensions of neuropsychological deficits are in:

## 1. **Hyperactivity-Impulsivity** (Executive Inhibition)

- Deficient motor inhibition (restless, hyperactive)
- Impaired verbal inhibition (excessing talking, interrupting)
- Impulsive cognition (difficulty suppressing task irrelevant thoughts, rapid decision making;
- Impulsive motivation (prefer immediate gratification, greater discounting of delayed consequences)
- Emotion dysregulation (impulsive affect; poor “top down” emotional self-regulation)
- Restlessness decreases with age, becoming more internal, subjective by adulthood

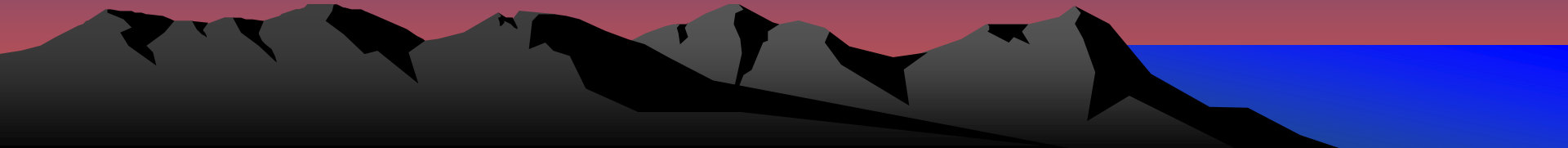


# More on ADHD

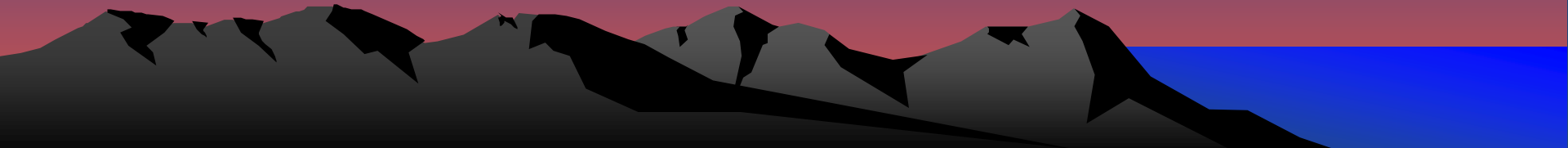
**Inattention:** But 6 types of attention exist – not all are impaired in ADHD. What is?

## Executive Attention (& Functioning)

- Poor persistence toward goals, tasks, and the future (can't sustain attention/action over time)
- Distractible (impaired resistance to responding to goal-irrelevant external and internal events)
- Deficient task re-engagement following disruptions (skips across uncompleted tasks)
- Impaired working memory (forgetful in daily activities, cannot remember what is to be done)
- Diminished self-monitoring



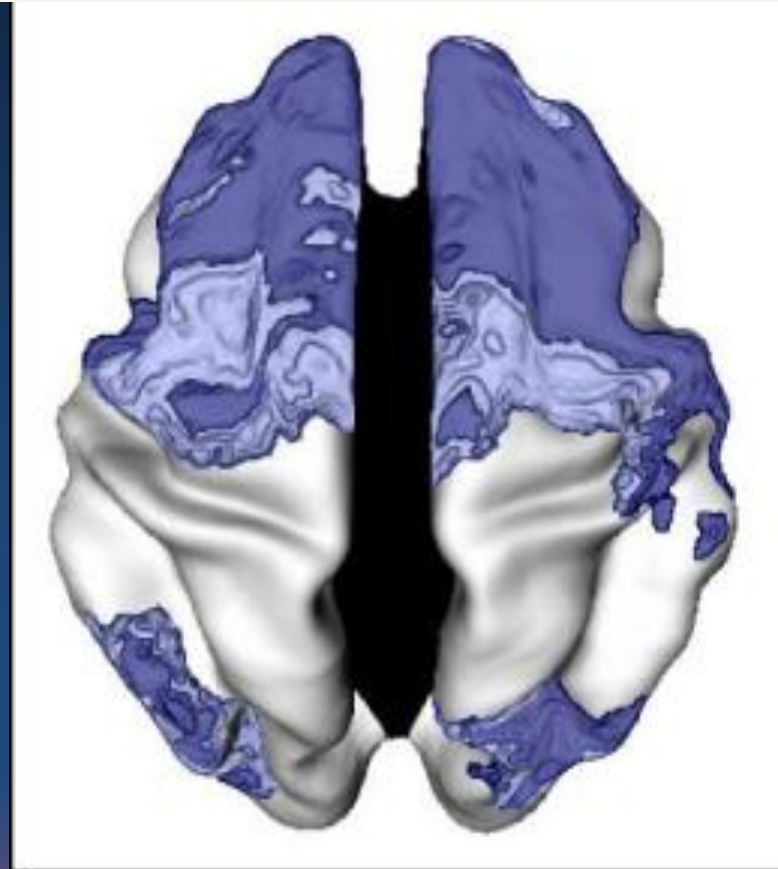
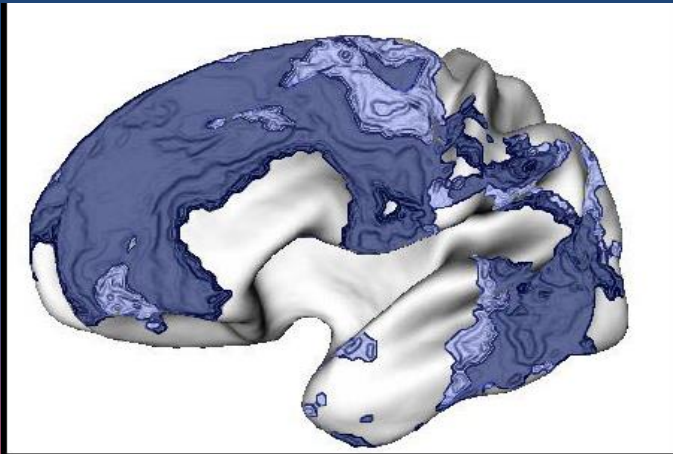
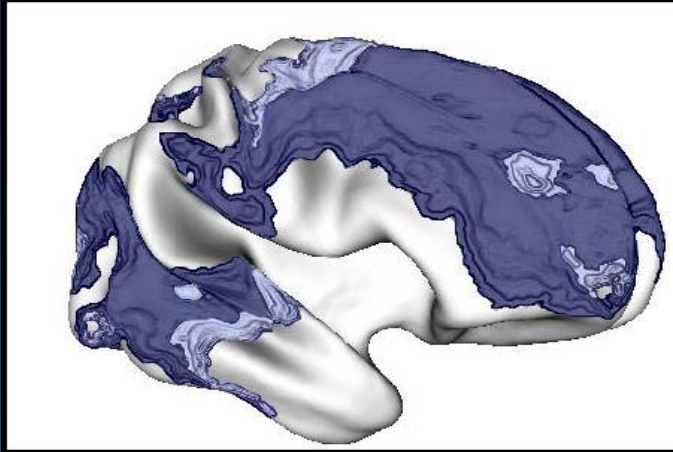
# ADHD is a Disorder of Self-Regulation and Executive Functioning



# Delayed brain growth in ADHD (3 yrs.)

From Shaw, P. et al. (2007). ADHD is characterized by a delay in cortical maturation.

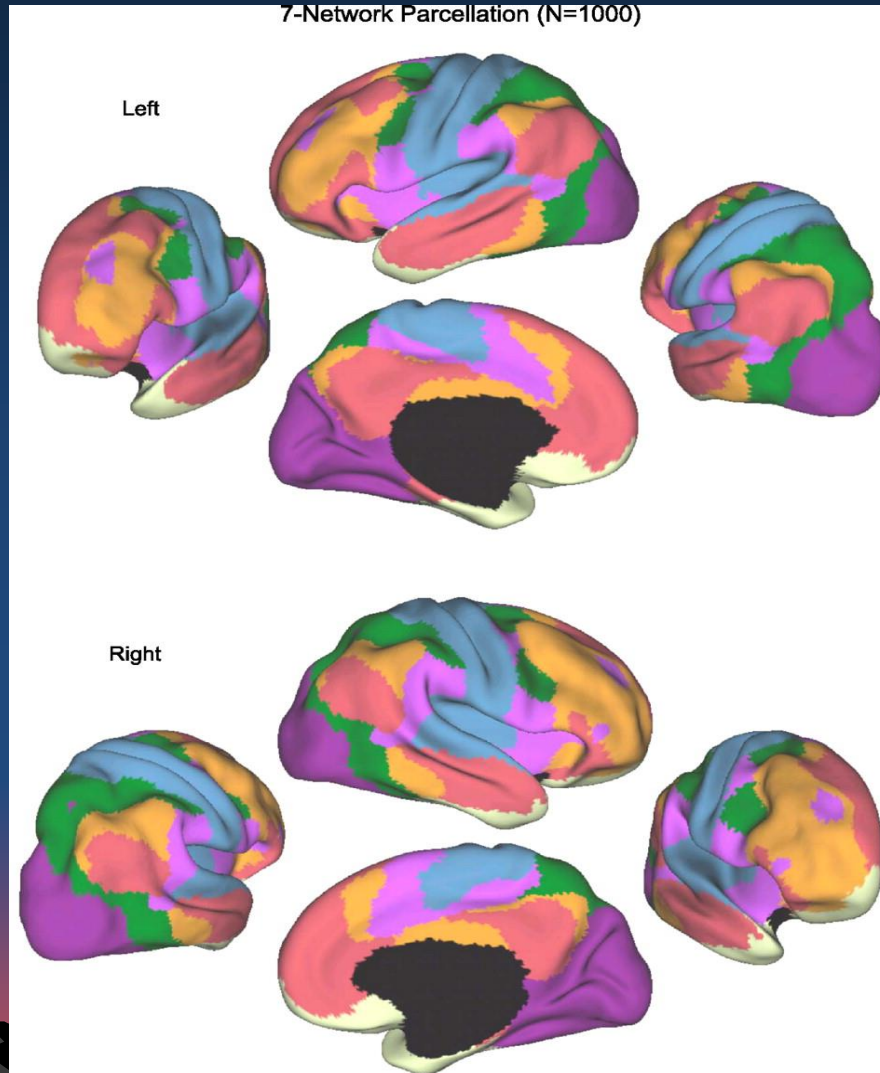
*Proceedings of the National Academy of Sciences, 104, 19649-19654.*



Greater than 2 years' delay  
0 to 2 years delay

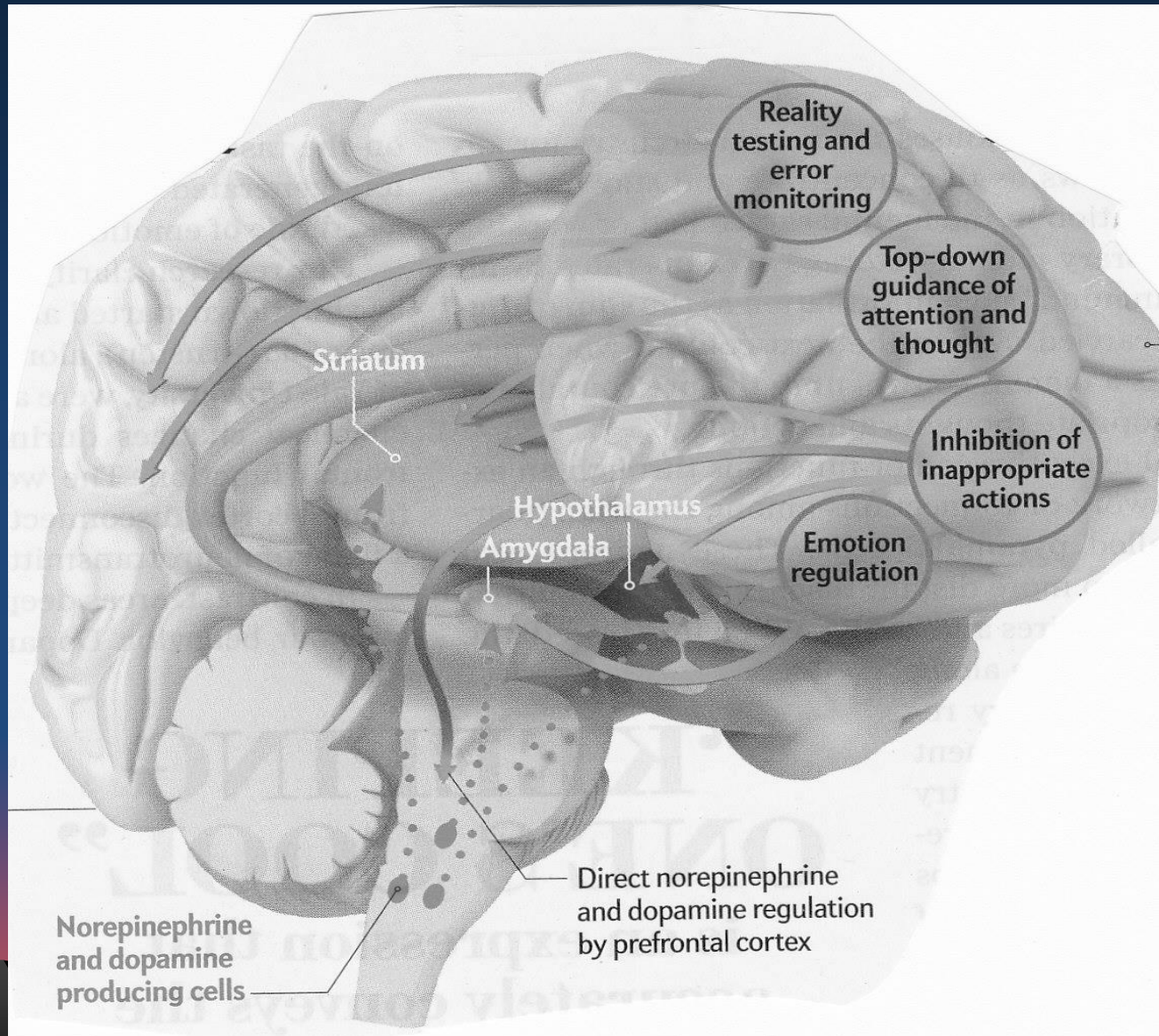
Ns: ADHD=223; Controls = 223

# The 7 Functional Brain Networks Based on Connectivity



- Purple (Visual)
- Blue (Somatomotor)
- Green (Dorsal Attention)
- Violet (Ventral Attention)
- Cream (Limbic)
- Orange (Frontoparietal)
- Red (Default)

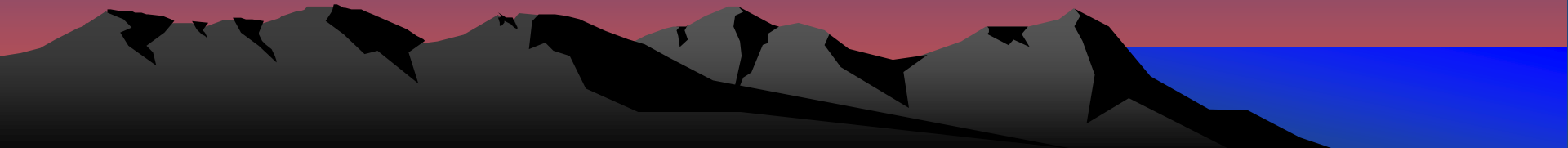
# Executive Brain Networks



# The Frontal Parietal Cortical Network Can Be Usefully Fractionated into Four EF Reciprocal Sub-networks: All are Implicated in Self-Regulation and in ADHD

- The frontal-striatal-thalamic circuit: Associated with deficits in response suppression, freedom from distraction, mental representations that guide behavior (working memory), manipulation of mentally held information (organization, planning, and problem-solving), and responding to novelty. Typically known as the “cool” or “**what**” EF network
- The frontal-cerebellar circuit: Associated with motor coordination deficits, but also with problems with the automaticity of actions, the anticipation of rewards, and the rate, rhythm, force, and especially timing and timeliness of behavior and thought. I call it the “**when**” EF network.
- The frontal-limbic circuit: Associated with symptoms of emotional self-regulation, motivation deficits, hyperactivity-impulsivity, and proneness to reactive aggression, known as the appraisal, “**hot**” or “**why**” EF network
- The frontal-cingulate-parietal network: Associated with deficits in self-awareness, performance monitoring, and error detection.

# Building a Theory of EF: Linking Inhibition, Self-Control, and the Executive Functions



# What is EF?

- EF is self-regulation. Self-regulation is
  - A self-directed action
  - Intended to change impending behavior
  - So as to alter the probability of a delayed consequence
- An executive function can be defined as a major type of action-to-the-self (a type of self-regulation)
- Each likely develops by behavior being turned on the self and then internalized (privatized, inhibited)
- They likely develop in a step-wise hierarchy - Each needs the earlier ones to function well

# Sequential Development of the 7 EFs

**Planning & Problem-Solving (Self-Directed Play)**

**Motivation Regulation (Self-Directed Motivation)**

**Emotion Regulation (Self-Directed Emotions)**

**Verbal Working Memory (Self-Speech)**

**Nonverbal Working Memory (Self-Directed Sensing)**

**Inhibition (Self-Restraint)**

**Self-Awareness (Self-Directed Attention)**

Age – Neurological Maturation

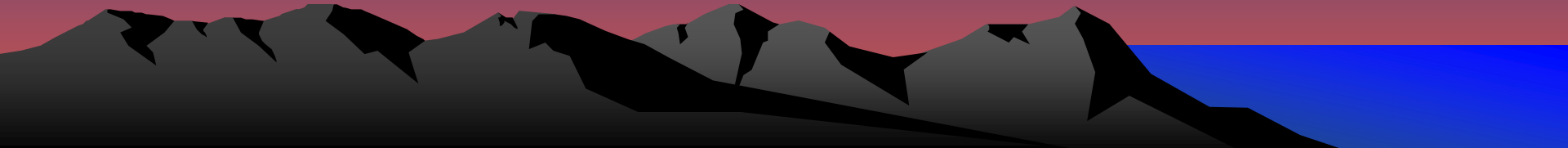


# The EFs Create Four Developmental Transitions in What is Controlling Behavior

- External → Mental (private or internal)
- Others → Self
- Temporal now → Anticipated future
- Immediate → Delayed gratification  
(Decreased Temporal Discounting of Delayed Consequences)

# Understanding ADHD

- ADHD disrupts the 7 EFs and so the major domains of EF in daily life thereby creating a disorder of self-regulation across time
- ADHD can be considered as “Time Blindness” or a “Temporal Neglect Syndrome” (Myopia to the Future)
  - It adversely affects the capacity to hierarchically organize behavior across time to anticipate the future and to pursue one’s long-term goals and self-interests (welfare and happiness)
  - It’s not an Attention Deficit but an Intention Deficit (Inattention to mental events & the future)

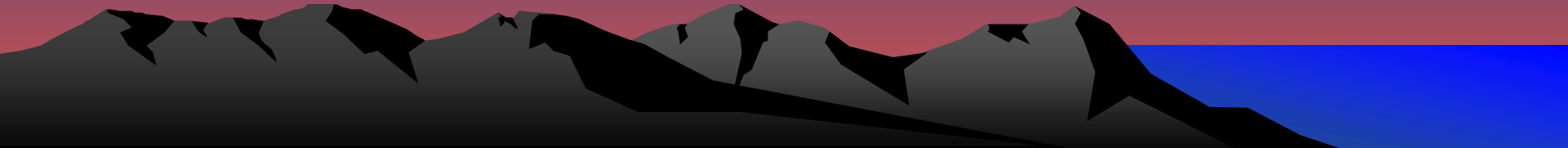


# Understanding ADHD

It's a Disorder of:

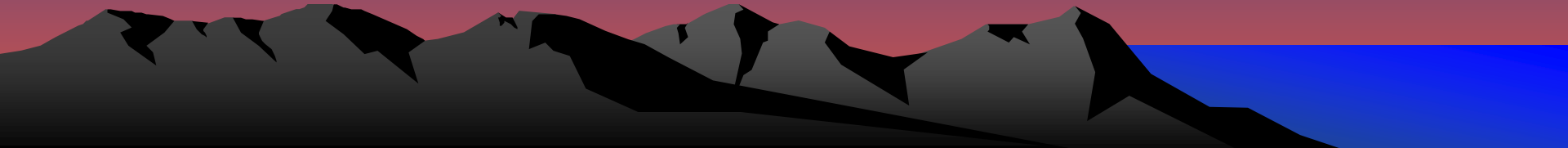
- Performance, not skill
- Doing what you know, not knowing what to do
- The when and where, not the how or what
- Using your past at the “point of performance”

The point of performance is the place and time in your natural settings where you should use what you know (but may not)



# The Value of the Concept of Delayed Executive Age in ADHD

- ADHD appears to delay EF development by 25-40%, or an average of 30%
- Use this estimate to understand a child's executive age or EA (chronological age minus 30%)
- Adjust expectations to match this EA
- Determine new responsibilities and freedoms based on their EA not their CA
- Provide accommodations or scaffolding to support the child at this EA



# Implications for Treatment

- Teaching skills is inadequate
- The key is to design prosthetic environments around the individual to compensate for their EF deficits
- Therefore, effective treatments are always those at the “point-of-performance”
- The EF deficits are neuro-genetic in origin
- Therefore, medications may be essential for most (but not all) cases – meds are neuro-genetic therapies
  - They are also associated with neuro-protective effects (normalizing effects) on brain structure and functioning as well as on EF tasks
- But some evidence suggests some EFs may also be partly responsive to direct training, albeit temporary
- While ADHD creates a diminished capacity: Does this excuse accountability?
  - (No! The problem is with time and timing, not with consequences)

# More Treatment Implications

- Behavioral treatment is essential for restructuring natural settings to assist the EFs
  - They provide artificial prosthetic cues to substitute for the working memory deficits (signs, lists, cards, charts, posters)
  - They provide artificial prosthetic consequences in the large time gaps between consequences (accountability) (i.e., tokens, points, etc.)
  - But their effects do not generalize or endure after removal because they primarily address the motivational deficits in ADHD
- The compassion and willingness of others to make accommodations are vital to success
- A chronic disability perspective is most useful

# How can we compensate for EF deficits?

## By reverse engineering the EF system

- Externalize important information at key points of performance – offload working memory to other storage devices (lists, journals, computers)
- Externalize time and time periods related to tasks and important deadlines (timers, counters, apps)
- Break up lengthy tasks or ones spanning long periods of time into many small steps
- Externalize sources of motivation
- Externalize mental problem-solving
- Replenish the SR Resource Pool (Willpower)

