

**Overview of ADHD**  
**A Different Kind of Brain**  
South Pasadena Mar 12, 2016

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descansomedicalcenter.com  
dmcdl.com

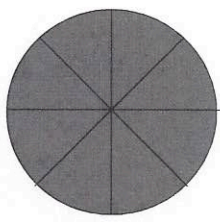

818.790.1587

**RESEARCH VS OPINION**

- STUDIED OR NOT
- REPEATED
- SIDE EFFECTS
- BENEFIT VS RISK
- LONG TERM EFFECTIVENESS

Smart

Dumb



**Eight Kinds of Intelligence**

**EIGHT KINDS OF INTELLIGENCE**

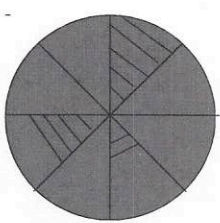

- MUSICAL
- LINGUISTIC
- LOGICAL-MATHEMATICAL
- SPATIAL
- BODILY-KINESTHETIC
- INTRAPERSONAL
- INTERPERSONAL
- NATURALISTIC

GARDNER, 1983

**TWO used in school**

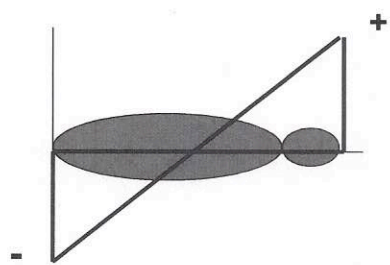
Smart

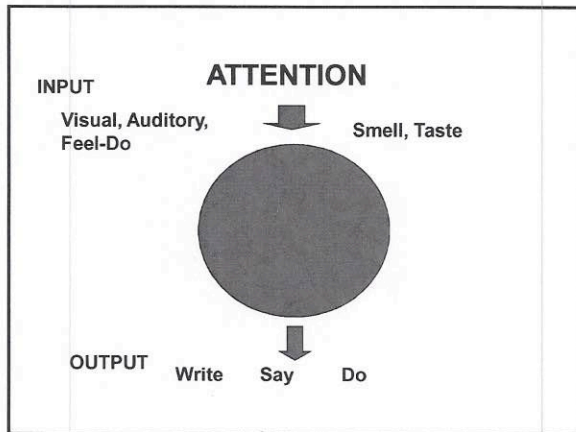
Dumb



**Eight Kinds of Intelligence**

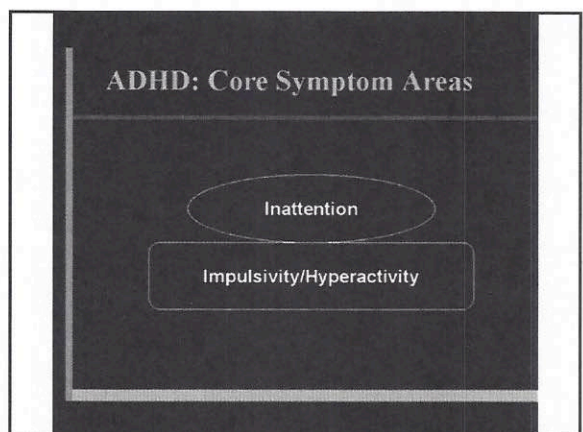
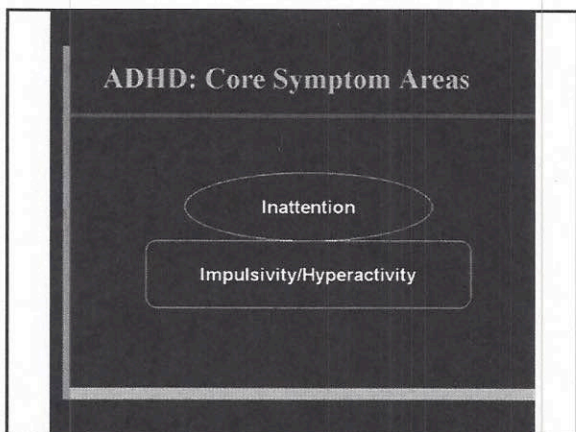
**THINK RANGE OF FUNCTION**





- ### Frontal Lobe Functions
- Attention
  - Motor Control
  - Inhibition
  - Executive Management
  - Management of Emotions

THE PINWHEEL



## ADHD: Core Symptom Area

**Inattention**

Six or more of the following - manifested often\*

- Inattention to details/ makes careless mistakes
  - Difficulty sustaining attention
  - Seems not to listen
  - Fails to finish tasks
- Difficulty organizing
  - Avoids tasks requiring sustained attention
  - Loses things
  - Easily distracted
  - Forgetful

\* DSM-IV, 1994

## ADHD: Core Symptom Areas

**Impulsivity/Hyperactivity**

Six or more of the following - manifested often\*

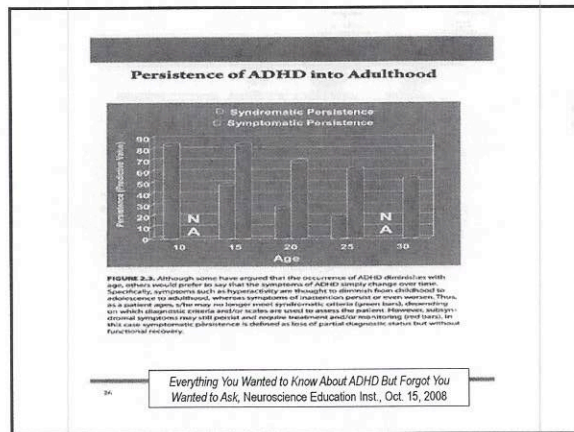
**Impulsivity**

- Blurts out answer before question is finished
- Difficulty awaiting turn
- Interrupts or intrudes on others

**Hyperactivity**

- Fidgets
- Unable to stay seated
- Inappropriate running/climbing (restlessness)
- Difficulty in engaging in leisure activities quietly
- "On the go"
- Talks excessively

\* DSM-IV, 1994



## Heterogeneity of ADHD

– DSM-IV subtypes

- Inattentive
- Hyperactive/impulsive
- Combined

– Genetic subtypes

- » D4
- » DAT
- » 5HT
- » Nepi

– Cognitive subtypes

- LD
- Executive function deficits subtypes
- Various attentional deficits (e.g. arousal, motivation, EF)

– Comorbid subtypes

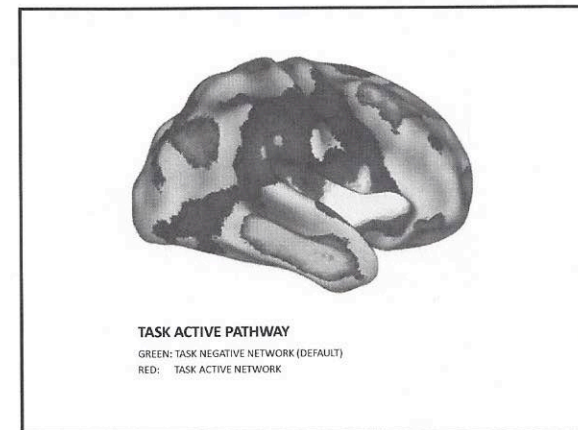
- » Disruptive Behavior disorders (CD/ODD)
- » Mood and anxiety disorders
- » Substance abuse

Courtesy: T. Spencer

## EXECUTIVE FUNCTION

### Executive Functions Associated with ADHD

Executive Function	Description
Activation	Organizing, prioritizing, and activating to work
Attention	Focusing, sustaining, and shifting attention to tasks
Effort	Regulating attention, sustaining effort, and processing speed
Emotion	Managing frustrations and modulating emotions
Memory	Utilizing working memory and accessing recall
Action	Monitoring and self-regulating action



### Default Mode Network (DMN)

- DMN or task-negative network (TNN) is a network of brain regions that are active when the individual is not focused on the outside world and the brain is at wakeful rest
- During goal-oriented activity, the DMN is deactivated and another network, the task-positive network (TPN) is activated
- Negative correlations exist between TPN & TNN. They are "intrinsically anticorrelated"

### ADHD: Historical Timeline

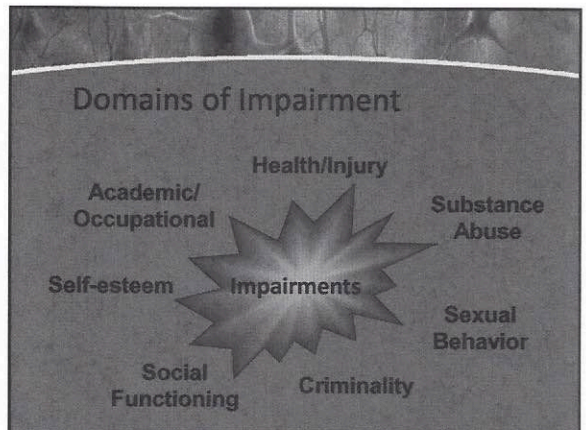
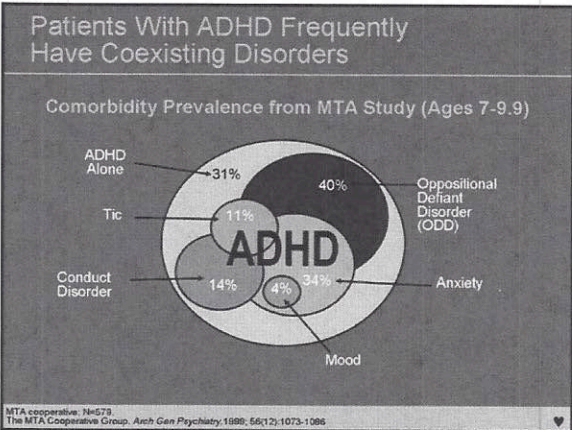
Timeline of ADHD diagnoses:

- 1902: ADHD-like syndrome first described
- 1930: Minimal Brain Damage
- 1960: Minimal Brain Dysfunction
- 1968: Hyperkinetic Reaction of Childhood (DSM-II)
- 1980: Attention Deficit Disorder + or - Hyperactivity (DSM-III)
- 1987: Attention Deficit Hyperactivity Disorder (DSM-III-R)
- 1994: Attention Deficit/Hyperactivity Disorder (DSM-IV)



**SLOVENLY PETER**  
 OR  
**CHEERFUL STORIES**  
 AND  
**FUNNY PICTURES**  
 FOR GOOD LITTLE FOLKS  
  
 WITH ILLUSTRATIONS  
 BASED ON THE ORIGINAL BY  
**HEINRICH HOFFMANN**  
  
 AS PUBLISHED BY  
**THE JOHN C. WINSTON CO.,**  
 PHILADELPHIA, 1915

### THE STORY OF JOHNNY LOOK-IN-THE-AIR

Once, with head as high as ever,  
 Johnny walked beside the river,  
 Johnny watch'd the swallows trying  
 Which was cleverest at flying.  
 Oh! what fun!  
 Johnny watch'd the bright round sun  
 Going in and coming out;  
 This was all he thought about.  
 So he strode on, only think!  
 To the river's very brink,  
 Where the bank was high and steep,  
 And the water very deep;  
 And the fishes, in a row,  
 Stared to see him coming so.



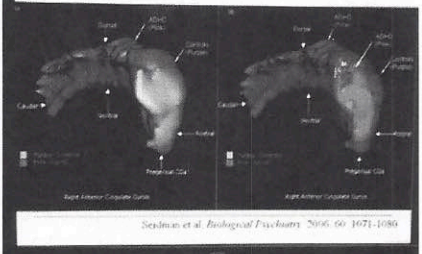
### Neuroimaging and ADHD

Normal control	ADHD
	

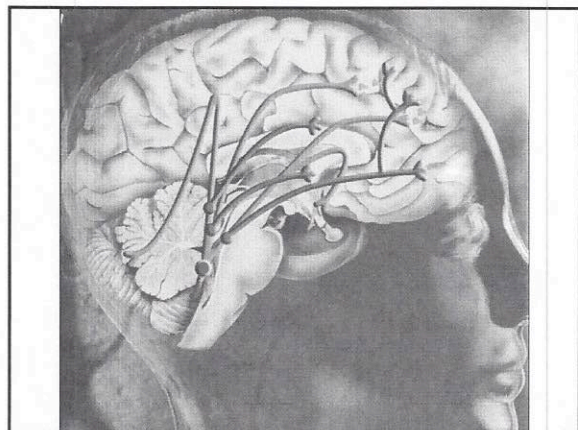
- fMRI shows decreased blood flow to the anterior cingulate and increased flow in the frontal striatum
- PET imaging shows decreased cerebral metabolism in brain areas controlling attention
- SPECT imaging shows increased DAT protein binding

MGH NMR Center & Harvard MIT CTRP. Adapted from Biederman et al. *Dev Psychiatry*, 1999; 45: 1542-1552

### Smaller Dorsal and Rostral ACC in ADHD

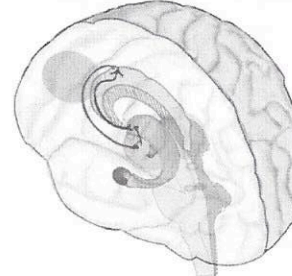


Sexton et al. *Biological Psychiatry*, 2006; 60: 1071-1080



### Hypothetical CSTC Loop for Selective Attention

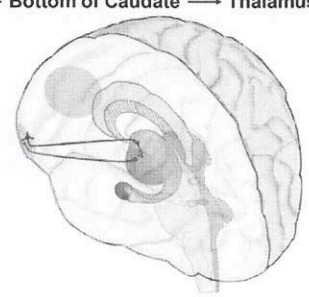
Dorsal ACC → Bottom of Striatum → Thalamus → ACC



Stahl SM. *Essential Psychopharmacology*, third edition. In press.

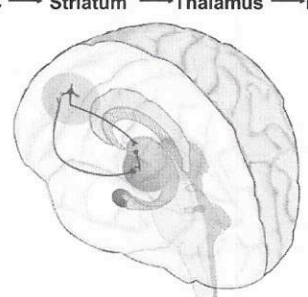
### Hypothetical CSTC Loop for Impulsivity

OFC → Bottom of Caudate → Thalamus → OFC

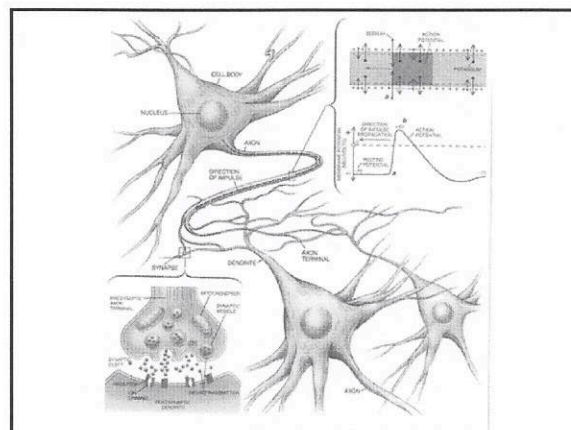
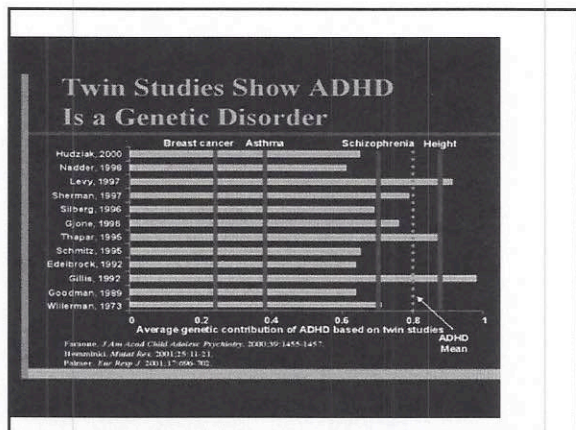
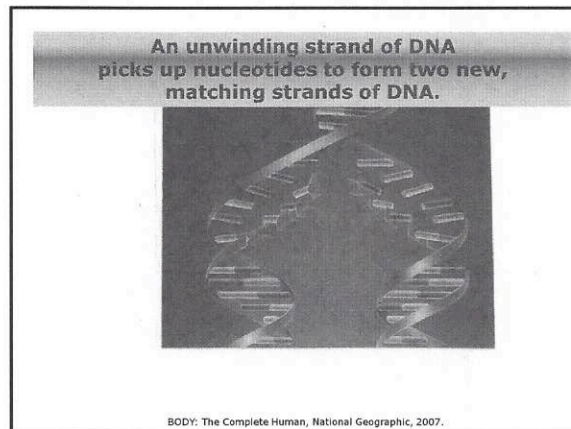
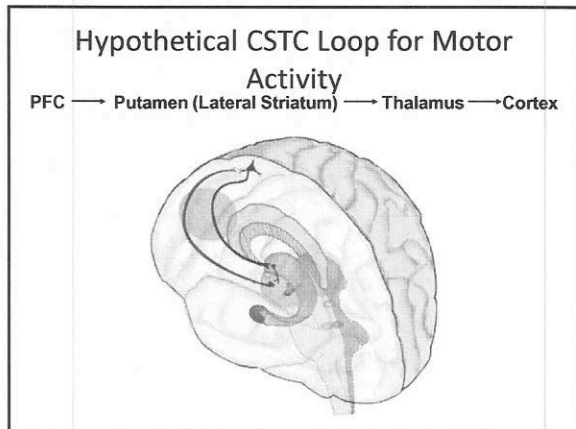


### Hypothetical CSTC Loop for Sustained Attention

DLPFC → Striatum → Thalamus → DLPFC



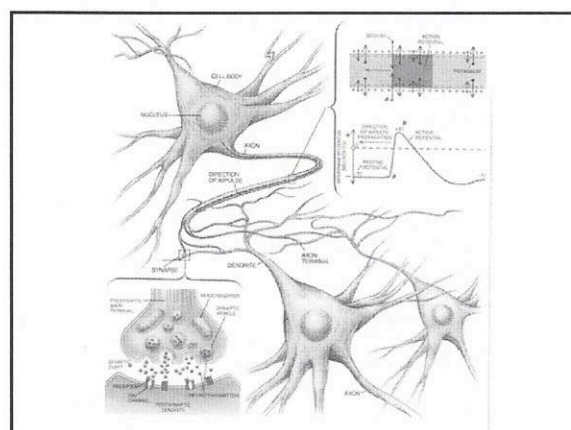
Stahl SM. *Essential Psychopharmacology*, third edition. In press.



### Molecular Genetics of ADHD

- Specific genes associated with ADHD
  - Dopamine receptor D4 gene (DRD4) on chromosome 11
  - Dopamine transporter gene (DAT1) on chromosome 5
  - D2 dopamine receptor gene
  - Dopamine-beta-hydroxylase gene
  - Uncertain about the association of noradrenergic genes
- There are several genes involved and their effects are cumulative

Sherman, C. et al. J. Am Acad Adolesc Psychiatry, 2000;39:1537-1592.  
Guzik, H. et al. Nature, 1995;379:606-612.



### ADHD FRUIT FLIES

NEURON DEC, 2009, ANDERSON, CAL TECH

- GLASS CONTAINER WITH AIR PUFF
- ISOLATE REACTIVE FLIES
- 20,000 GENES -ALL PRESENT IN HUMANS
- GENETIC PROFILE AND DETERMINED GENETIC VARIATION OF DEFICIENT DOPAMINE RECEPTORS CAUSED HIGH ACTIVITY LEVEL

### ADHD FRUIT FLIES

NEURON DEC, 2009, ANDERSON, CAL TECH

- DOPAMINE DEFICIENCY RESULTS IN NOT ONLY HYPERACTIVITY BUT DECREASED LEARNING
- ODOR PLUS ELECTRIC SHOCK—NO AVOIDANCE--PERSISTENCE
- DIFFERENT PATHWAYS  
HA DOES NOT CAUSE LEARNING DECREASE

### Fruit Flies

- Sitters vs scouts
- Dopamine deficiency
- Response to same medication used in humans to improve performance

### HONEY BEES

- Bees in a cage
- New flowers
- Some bees activate—Scouts
- Not the ones who do the boring pollen recovery tasks—foragers even if food plenty

### HONEY BEES

- Returning to the hive and head butt
- Scouting bee brains are built with low levels of dopamine
- The bees remember the flowers with caffeine for effectively

### Is ADHD An Advantage for Nomadic Tribesmen?

## IMPACT OF HAVING ADHD

### ADHD May Result in Performance Limitations

- Despite similar educational levels and IQ scores, non-medicated adults with ADHD display:
  - Significantly more academic difficulty in school (25% repeat a grade)
  - Lower levels of occupational advancement

Faraone S, et al. *Biol Psychiatry*. 2000;48:9-20  
Biederman, et al. *Am J Psychiatry*. 1993;150:1702-1708

### ADHD Affects Socialization

- Children are stigmatized by their behavior
  - Disruptive behavior
    - Troublemakers
    - Excessive talking
    - Unfocused, not responsive to others aggression
  - Immaturity and impulsiveness
    - Center of attention
    - Blurring out answers
- Adolescents continue to demonstrate social problems
  - Poor participation in group activities
  - Few friends
  - Vulnerable to antisocial groups, drug abuse

- Bad sportsmanship
- Cannot sit still
- Impulsive
- Breaks the rules
- Peer rejection

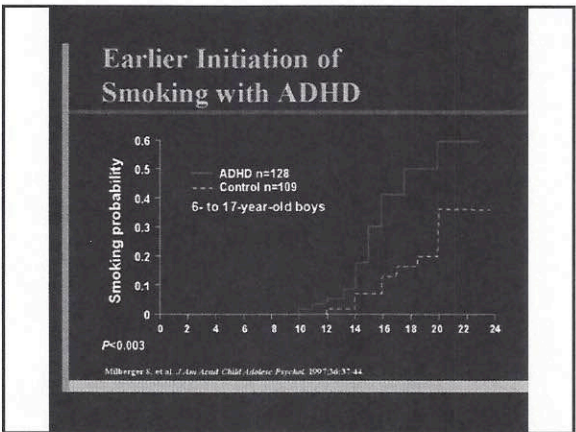
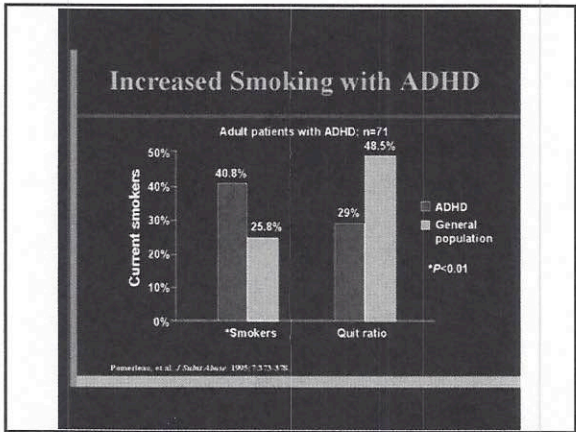
AACAP. *J Am Acad Child Adolesc Psychiatry*. 1997;36:855-8215  
Barkley RA. *J Am Acad Child Adolesc Psychiatry*. 1991;30:702-702

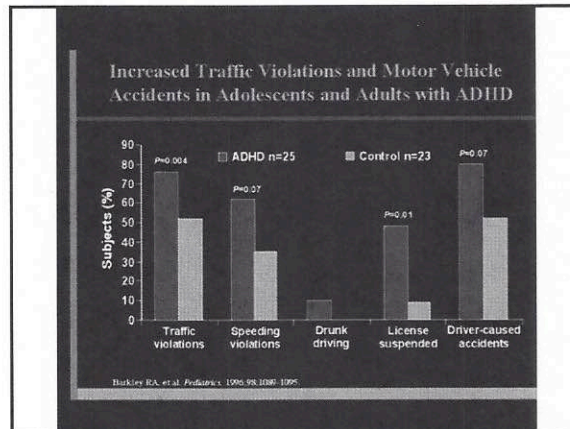
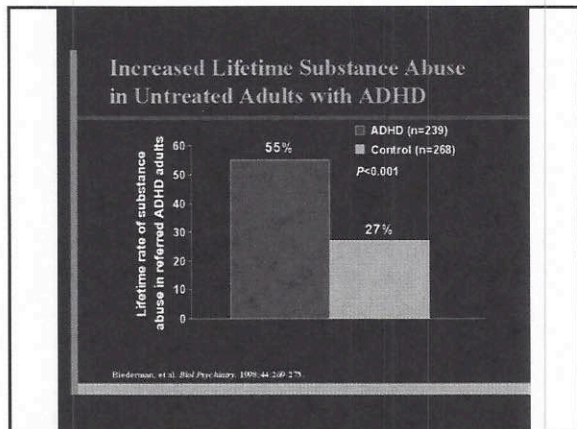
### How ADHD Affects Parents

- Increased stress
  - Worry
  - Frustration
- Lower self-esteem
  - Self-blame
  - Social isolation
- Increased employment disruption
- Increased marital disruption
- Increased alcohol/substance abuse

- Anxiety
- Anger
- Depression

Murphy D, Barkley R. *Am J Orthopsychiatry*. 1990;66:95-102

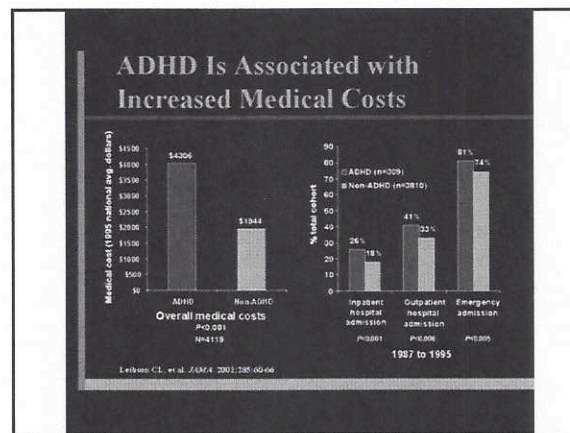




### Substance Abuse

- Many people with untreated ADHD try to self-medicate to improve functioning
- Smoking
  - ADHD adults smoke more and have more difficulty quitting
  - Children with ADHD start younger and smoke more
- Substance use disorders (SUDs)
  - Fear: stimulant therapy may lead to substance abuse
  - Fact: untreated ADHD is a significant risk factor for substance abuse in adolescence and adulthood
  - A longitudinal study found that ADHD medication was associated with an 85% reduction in risk for SUDs in ADHD youth
  - Stimulants are known to be associated with dependence and abuse in "at-risk" populations

*Biederman et al. Pediatrics. 1999; 104:e23  
Pechmann et al. J Subst Abuse. 1990; 1:103  
McBain et al. JAMA. 1997; 277:3038*



### Sexual Behavior

- Longitudinal follow-up at young adulthood of a cohort of children (ongoing Milwaukee follow-up study) with ADHD compared with controls
  - Sexual intercourse at earlier age (15 vs 16 years)
  - More sexual partners (19 vs 7)
  - More pregnancies (38% vs 4%)
  - More sexually transmitted diseases (17% vs 4%)
  - Tested for HIV (54% vs 21%)

*Barkley ADHD: A Handbook for Diagnosis and Treatment. New York: Guilford Press, 1998:203.*

**DISCOURAGEMENT**

BAD HAIR DAYS OVER AND OVER  
AND OVER

### MANAGEMENT

- BEHAVIORAL
- EMOTIONAL
- EDUCATIONAL
- MEDICAL

### ADHD MULTIMODAL TREATMENT STUDY 1999

### PILOT PARAMENTERS

- Conners scales
- Sustained attention in classroom
- Social Skill Ratings
- Positive Social Behaviors
- Parents knowledge of behavioral principles
- Parental practice of negative behaviors
- Positive parenting
- Children's self rating of well being
- Academics
- Homework check list

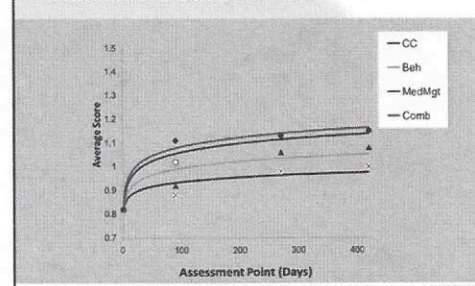
### MMT-FOUR ARMS

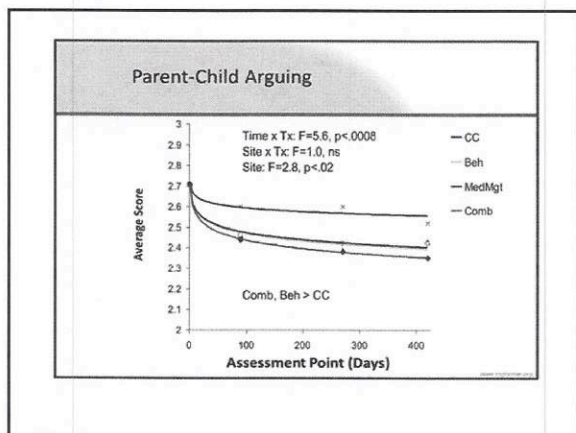
- COMMUNITY TREATMENT—ASSESS AND REFER
- INTENSIVE PSYCHOSOCIAL TREATMENT
- CLOSELY SUPERVISED AND ADJUSTED MEDICAL MANAGEMENT
- COMBINDED BEHAVIORAL AND MEDICAL TREATMENT

### MULTIMODAL TREATMENT STUDY 1999

- 600 entries—579 completions
- 7-9 years of age
- 6 sites/18 researchers
- 14 months with continuing follow-up
- Goal to evaluate long term effect and comparison of behavioral treatments
- Compare close monitoring vs. light supervision

Teacher SSRS Social Skills

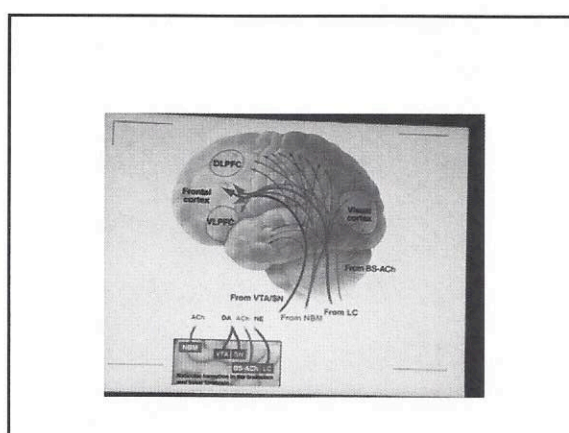
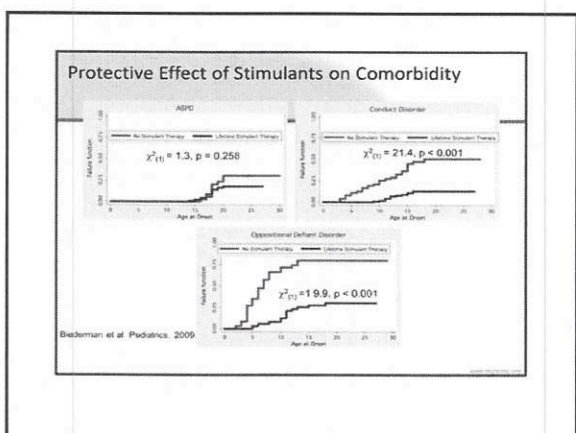
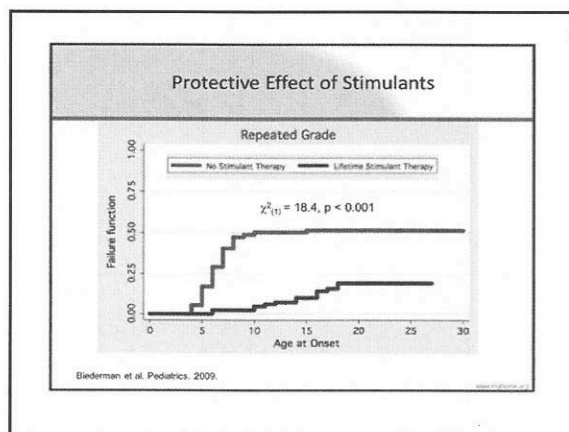
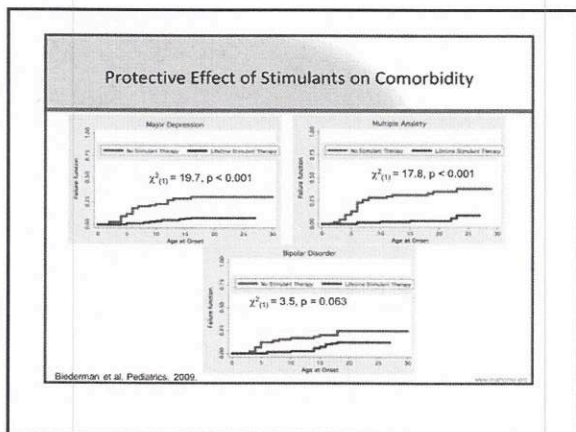


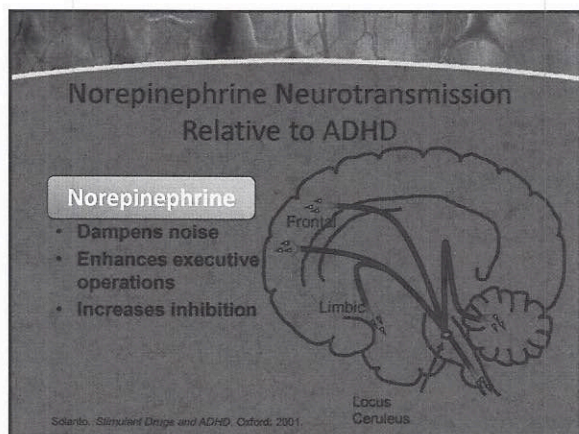
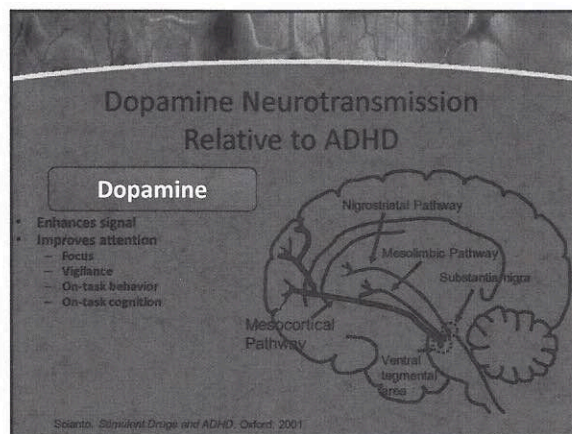
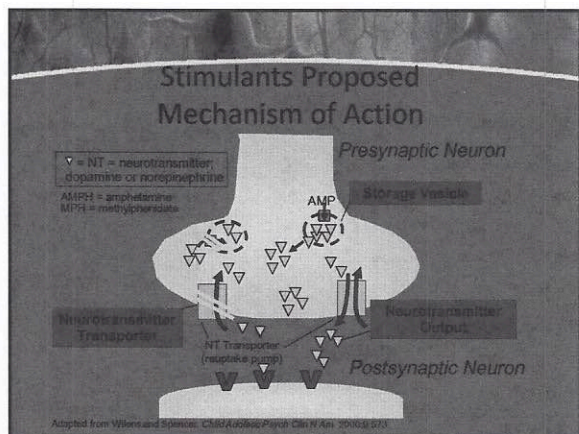


### Indirect Effects of Medication on Parents, Teachers and Peers

(Barkley et al., Cunningham et al.)

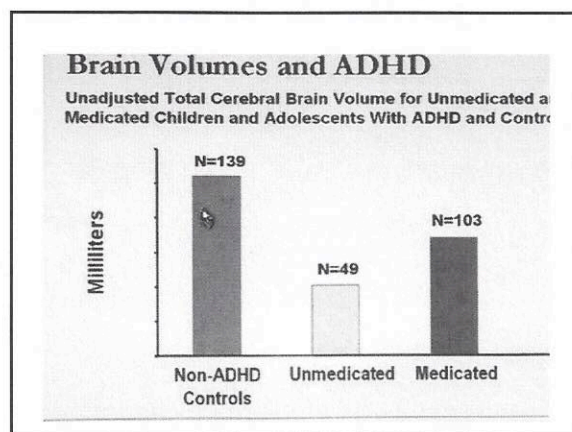
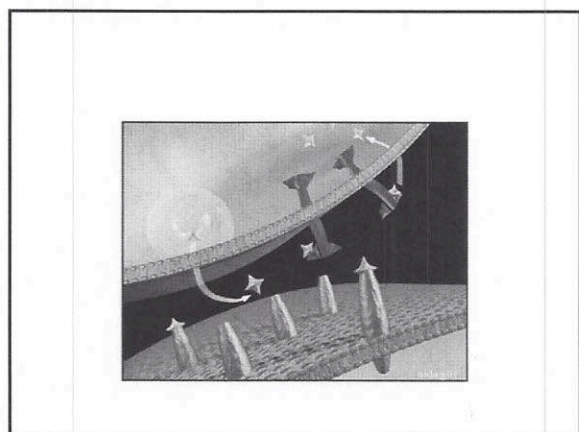
- **Social changes in Parents and Teachers**
  - (Barkley et al., Pelham et al., Whalen et al.)
  - Decreased rate of commands and degree of supervision
  - Increased praise and positive responsiveness
- **Social changes in Peers**
  - (Cunningham et al., Whalen et al.)
  - Decreased negative and aggressive behavior on stimulants
  - Leads to greater acceptance by peers
  - Leads to further positive benefit to the child





**MEDICATION EFFECT**

MEDICATIONS WORK TO ARTIFICIALLY RAISE THE NATURALLY OCCURRING NEUROTRANSMITTERS



### SELF TREATMENT

- DIETS
- SUPPLEMENTS
- NON PRESCRIPTION MEDICATIONS
- SLEEP
- EXERCISE
- BRAIN TRAINING
- ADJUSTING LIFE

### SELF TREATMENT

- CAFFEINE
- CHOCOLATE
- NICOTINE
- ALCOHOL
- POT
- METH, COCAINE

### NON RX MEDICATIONS

- CAFFEINE
- CHOCOLATE
- NICOTINE
- MARIJUANA
- METHAMPHETAMINE

### ADHD

PEOPLE WITH ATTENTION

DIFFERENCES ARE BUILT LIKE

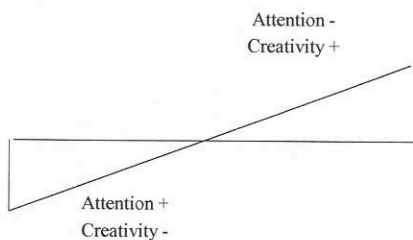
LION BRAINS

SCHOOL WAS BUILT FOR WATER  
BUFFALO BRAINS

### CREATIVE THINKING

- Divergent
- Connective Leaps
- Hyper focus
- Out of the Box
- Intuitive
- Foresight
- Multi-Tasking

**ATTENTION & CREATIVITY**



**Attention Deficit Hyperactivity  
Disorder**

**Get rid of  
DEFICIT and DISORDER**

**CDD**

**Creativity Deficiency Disorder**

**THE ANIMAL SCHOOL**

**DR. GEORGE H. REAVIS**