Treating ADHD

Primary Empirically Based Treatments:

- Psychostimulants
- Behavioral/Contingency Management
- Parent Training
Biological Influences, e.g., genetics

**NEUROBIOLOGICAL SUBSTRATE**

Behavioral Interventions

**CORE FEATURES:**
Inattention
Hyperactivity
Impulsivity

**SECONDARY FEATURES:**
Academic Underachievement
Social Skill Deficits
Poor Organizational Skills
Classroom Deportment
Cognitive Abilities

Pharmacological Treatment

**ENVIRONMENTAL/COGNITIVE DEMANDS**

**DSM-IV CLINICAL MODEL OF ADHD**
Attention Training
Mr. Attention

The Attention Training System

Inventor: M.D. Rapport, Ph.D. Manufactured by Gordon Systems Inc. P.O. Box 746, DeWitt, NY 13214
Psychostimulants

**Psychostimulants** were discovered serendipitously by an astute physician noting improved concentration and reduced motor activity in children administered Benzedrine who suffered postpneumoencephalography headaches.

Pneumoencephalography is an obsolete medical procedure used during the early 20th century that involved draining most of the cerebrospinal fluid from around the brain and replacing it with air, oxygen, or helium to enhance x-ray imaging.

Contemporary parent and classroom contingency management (behavioral) therapies, in contrast, were appropriated from the widespread application of operant conditioning principles used to improve the functioning of individuals with moderate to profound developmental and/or intellectual disabilities beginning in the 1960s (for a historical review, see Bijou, 1966).
PROGRAMATIC RESEARCH

Psychopharmacological Studies with ADHD: Effects on Behavior and Cognition:

- Rapport et al., 1985
- Rapport et al., 1986
- Rapport et al., 1987
- Rapport et al., 1988
- Rapport et al., 1988
- Rapport et al., 1989
- Rapport et al., 1991
- Rapport et al., 1995
- Rapport et al., 1996

Theoretical Studies:

- Rate Dependency, 1986
- Complex Reinforcement Schedules, 1988
- Delay of Gratification, 1986
- Law of Initial Values - Cardiovascular, 1988
- Contribution of Body Mass, 1989; 1997
- Serum Cholesterol, 1995
- Prediction Models of Response, 1997
- Conceptual Model of ADHD, 2000
METABOLISM OF METHYLPHENIDATE

◆ RAPIDLY ABSORBED

◆ SUBJECT TO SIGNIFICANT FIRST PASS ELIMINATION
  ➲ BIOAVAILABILITY OF 19-21%

◆ NO ACCUMULATION, MINIMUM BINDING
  TO PLASMA ALBUMIN

◆ $T_{1/2} = 2.5$ TO 4 HOURS [4-6 for SR preps]

\[
\text{Chemical Structure:}
\begin{align*}
\text{O} & \text{C} \quad \text{O} \quad \text{CH}_3 \\
\text{CH} & \quad \text{N} + \\
\text{H} & \text{H}
\end{align*}
\]
Psychostimulants such as methylphenidate (MPH) act primarily as dopamine and norepinephrine reuptake inhibitors, and to a lesser extent, as direct agonists that stimulate the release of dopamine and norepinephrine into the synapse.

The well-documented finding that both processes promote the availability of these neurotransmitters in cortical-subcortical pathways involving the frontal/pre-frontal cortex, temporal lobe, and basal ganglia is of particular relevance for the treatment of ADHD (cf. Dickstein, Bannon, Castellanos, & Milham, 2006, for a meta-analytic review).

These anatomical structures play a critical role in supporting executive functions (EF), an umbrella term for higher-order cognitive processes such as working memory, set shifting, and inhibitory control that enable goal directed behavior and novel problem solving (Garon, Bryson, & Smith, 2008; Miyake et al., 2000).
PHARMACOTHERAPY OF ADHD

- PRIMARY BEHAVIORAL EFFECTS:

  REDUCTIONS:
  - REDUCED GROSS MOTOR ACTIVITY
  - REDUCED IMPULSIVITY
  - REDUCED INATTENTIVENESS
  - REDUCED NON-COMPLIANCE
  - REDUCED AGGRESSIVENESS

  IMPROVEMENTS:
  - IMPROVE SOCIAL FUNCTIONING
  - IMPROVED PEER RELATIONSHIPS
  - IMPROVED ABILITY TO MODULATE THE INTENSITY OF THEIR BEHAVIOR
  - IMPROVED COMMUNICATION WITH OTHERS
  - IMPROVED RESPONSIVENESS TO OTHERS WITH FEWER NEGATIVE INTERACTIONS
  - IMPROVED PARENT-CHILD INTERACTIONS
PHARMACOTHERAPY OF ADHD

- PRIMARY COGNITIVE EFFECTS OF PSYCHOSTIMULANT:
  - Academic Assignments Completed
  - Academic Assignments Correct
  - Improved Vigilance
  - Reduced Cognitive Impulsivity
    - Improved Reflectiveness
  - Reaction Time - Improved & Less Variable
  - Improved Short-Term Memory - Moderate
  - Improved Learning of Verbal and Nonverbal Information - Moderate
  - Improved Use of Study Time

Nearly all effects are DOSE-DEPENDENT
COMMON TREATMENT EMERGENT EFFECTS - PSYCHOSTIMULANTS

1. COMMON:
   - APPETITE (ANOREXIA) AND WEIGHT LOSS
   - SLEEP DISTURBANCE (INITIAL INSOMNIA) IF LATE AFTERNOON DOSE IS ADMINISTERED.
   - IRRITABILITY
   - MILD NAUSEA OR STOMACH UPSET
   - COGNITIVE CONSTRICTION
   - OVERFOCUSED STATES (USUALLY SEEN AT HIGHER DOSAGES)

2. UNCOMMON (UNUSUAL)
   - HEADACHES
   - REBOUND EFFECTS (ESP. NOTED WITH DEXEDRINE)
   - MOODINESS
   - INCREASED TALKATIVENESS
   - SUPPRESSION OF ADAPTIVE BEHAVIOR AND MOOD/AFFECT (USUALLY SEEN AT HIGH DOSAGE RANGE)
   - BRIEF PSYCHOSIS
   - AGITATION
ZONES OF PEAK ENHANCEMENT

COGNITIVE

SOCIAL

EMERGENT

PERFORMANCE

EMERGENT SYMPTOMS

INCREASING DOSAGE

P

OPTIMAL COGNITIVE ZONE

0.5

OPTIMAL BEHAVIORAL ZONE

1.0
DOSE RESPONSE CURVES FOR LEARNING AND TEACHER RATED BEHAVIOR (ACTRS)

DOSE (MPH)

56
60
64
68
72

56
60
64
68
72

TEACHER RATINGS

PL
0.3
1.0

LEARNING

PERCENT CORRECT

ACTRS

6
9
12
15
18

6
9
12
15
18
J AM. ACAD. CHILD ADOLESC. PSYCHIATRY
ADHD N = 76
NC N = 25
*J AM. ACAD. CHILD ADOLESC. PSYCHIATRY*
ASSESSING PHARMACOLOGICAL RESPONSE IN CHILDREN WITH ADHD

TARGET BEHAVIORS

SOCIAL

COGNITIVE/ACADEMIC

DON'T FOGET THE DEAD MAN RULE!
IF A DECEASED INDIVIDUAL CAN PERFORM THE BEHAVIOR OR MEET THE CRITERIA, IT IS GENERALLY NOT AN APPROPRIATE TARGET FOR TITRATION

1. RESTLESS OF OVERACTIVE
2. EXCITABLE, IMPULSIVE
3. DISTURBS OTHER CHILDREN
4. SHORT ATTENTION SPAN
5. CONSTANTLY FIDGETING
6. EASILY DISTRACTED
7. EASILY FRUSTRATED
8. CRIES OFTEN AND EASILY
9. MOOD CHANGES QUICKLY
10. TEMPER OUTBURSTS, EXPLOSIVE
Summary of Rx Effectiveness

When administered in their most potent forms and carefully monitored, psychostimulant medication alone and combined with intensive, packaged behavioral treatment is associated with large magnitude reductions in inattention and hyperactivity/impulsivity symptoms (ES range = 1.53 to 1.89) for up to 24 months (Van der Oord, Prins, Oosterlaan, & Emmelkamp, 2008);

Psychosocial interventions used alone are associated with more moderate (ES range = .31 to .87) benefits (Abikoff et al., 2004; Lee, Niew, Yang, Chen, & Lin, 2012; Van der Oord et al., 2008).

These impressive reductions in core behavioral symptoms, however, are unaccompanied by significant or sustained improvements in ecologically valid academic and learning outcomes such as quiz and test grades, overall grade point averages, grade retentions, high school graduation rates, and standardized achievement test scores (Barkley, Fischer, Smallish, & Fletcher, 2006; Molina et al., 2009; Van der Oord et al., 2008)—highlighting the weak linkage between ADHD behavioral symptom expression and functional impairment (Gordon et al., 2006; Pelham et al., 2005).

In addition, no study to date has demonstrated sustained maintenance of medication-related behavioral changes beyond a 24-month time frame (Jensen et al., 2007; Molina et al., 2009).
Types of Individual Responders
LINEAR RESPONDER [70%]

PERCENTAGE

ACTRS

MEDICATION CONDITION

BASE  PL  5-MG  10-MG  15-MG  20-MG

= ATTENTION

= AES

= TEACHER RATING
THRESHOLD RESPONDER [13%]

- ● = ATTENTION
- ◇ = AES
- ▲ = TEACHER RATING

**Medication Condition**

- **BASE**
- **PL**
- **5-MG**
- **10-MG**
- **15-MG**
- **20-MG**

**Percentage**

- 0
- 10
- 20
- 30
- 40
- 50
- 60
- 70
- 80
- 90
- 100

**ACTRS**

- 0
- 5
- 10
- 15
- 20
- 25
MOST FREQUENTLY ASKED QUESTIONS BY PARENTS

- ARE PSYCHOSTIMULANTS ADDICTIVE?
- WILL PSYCHOSTIMULANTS STUNT MY CHILD’S GROWTH?
- SHOULD I GIVE MY CHILD MEDICATION WHEN HE OR SHE IS ILL?
- WILL PSYCHOSTIMULANTS MAKE MY CHILD A “ZOMBIE” OR CHANGE HIS OR HER “PERSONALITY”?
- WILL MY CHILD NEED A HIGHER DOSE WHEN HE OR SHE IS OLDER OR WEIGHS MORE?
- MORAL ISSUE: “DRUGS ARE BAD” [EYEGLASSES]
- WILL TAKING PSYCHOSTIMULANTS AS A CHILD MAKE MY CHILD MORE LIKELY TO USE ILLEGAL DRUGS AS AN ADOLESCENT?
- SHOULD I NOT GIVE MY CHILD THE MEDICATION ONCE IN A WHILE AND SEE IF THE TEACHER CAN TELL THE DIFFERENCE?
- HOW LONG WILL MY CHILD NEED TO TAKE MEDICATION?