Attention Deficit Hyperactivity Disorder (ADHD): A Review of Selected Research for Practitioners

Jan Montgomery-Pierce, MS, BCBA, LBA
Florida Institute of Technology
Why this Presentation on ADHD?

- Provide Behavior Analysts ADHD research overview
- Professional interest (work with foster care system and children diagnosed with ADHD in Florida from 1997 to 2008)
- Research and involvement as FABA President (2010) into mental health collaboration
- Personal interest (family members diagnosed)
**JABA Articles – Selected Mental Health Diagnoses (1980 – 2010)**

Frequency

**YEAR**

- ADHD
- Other
JABA Articles - Selected Mental Health Diagnoses (2000 - 2010)
How Diagnosed?  
Clinical Assessment of ADHD

• Clinical Interview:  
  – Developmental, social, educational and behavioral history

• Common Checklists and Rating Scales:  
  – Conners' Parent Rating Scales  
  – Child Behavior Checklist - wide range of symptoms (Achenbach)
Clinical Assessment of ADHD

• Common Checklists and Rating Scales (continued):
  – Conners' Teacher Rating Scales
  – Child Behavior Checklist/Teacher Report Form (Achenbach)
  – Child Attention Problems (CAP) Rating Scale monitors behavioral changes when child is taking medicine to treat ADHD.

A. 6 or more symptoms of Inattention or Hyperactivity-Impulsivity*

• **Inattention***: careless mistakes, difficulty sustaining attention, does not seem to listen, does not follow through, difficulty organizing, avoids, dislikes, tasks that require sustained mental effort, loses things, easily distracted, forgetful
  – * includes “often” in these descriptions
DSM-IV Diagnostic Criteria for ADHD (continued)

• **Hyperactivity**: fidgets with hands or feet or squirms in seat, leaves seat, runs about or climbs excessively, has difficulty playing or engaging in leisure activities quietly, ‘on go’ or often acts as if ‘driven by a motor,’ talks excessively

• **Impulsivity**: Blurts out answers before questions have been completed, difficulty awaiting turn, interrupts/intrudes on others

* includes “often” in these descriptions
DSM-IV TR Diagnostic Criteria for ADHD (continued)

B. Onset of these symptoms before age 7

C. Clinically significant impairment in social, academic, or occupational functioning

B. Impairment present in 2 or more settings

C. No co-occurrence of another mental disorder (that could better account for these symptoms)

– From DSM IV TR(2000)
Upcoming Change in ADHD Diagnostic Criteria

• One of major changes to come in ADHD diagnosis in approximately May of 2013 DSM V is that it will read “before the age of 12” rather than “7”

• Potential to increase the number of children diagnosed with this disorder
Prevalence of ADHD

• Diagnosis from 2003–2007 increased 21.8 percent among children aged 4–17 years, representing 5.4 million children. *

• It also affects estimated 4.4 percent of adults in United States in a given year.**

• Rates of ADHD diagnosis increased average of 3% per year from 1997 to 2006 & average of 5.5% per year from 2003 - 2007.
ADHD

• “There are no laboratory tests, neurological assessments, or attentional assessments that have been established as diagnostic in clinical assessment of Attention-Deficit/Hyperactivity Disorder.”
  –(DSM-IV-TR, page 88)
Correlational Effects

- Drug and alcohol abuse
- Failure in school
- Problems keeping a job
- Trouble with the law
- About half of children with ADHD may continue with troublesome symptoms of inattention or impulsivity as adults.
Parent Report

• Medication Treatment
  – As of 2007, parents of 2.7 million youth ages 4-17 years (66% of those with a current diagnosis) report their child was receiving medication treatment for the disorder.
  – Children aged 11-17 years of age were more likely than those 4-10 years of age to take medication, & boys are 2.8 times more likely to take medication than girls
Parent Report

• Peer Relationships
  – Parents of children with a history of ADHD report almost 3 times as many peer problems as those without a history of ADHD
  – Parents report that children with history of ADHD are almost 10 times as likely to have difficulties that interfere with friendships
In 2007, about what percentage of parents reported their ADHD diagnosed child was receiving medication?

1. 100%
2. 0%
3. No parents reported
4. 66%
ASR

• In 2007, about what percentage of parents reported their ADHD diagnosed child was receiving medication?
  1. 100%
  2. 0%
  3. No parents reported
  4. 66%
ASR

• About how many children have been diagnosed with ADHD according to figures from 2007?

1. One million
2. Five million
3. 20 million
4. 50 million
ASR

• About how many children have been diagnosed with ADHD according to figures from 2007?
  1. One million
  2. Five million
  3. 20 million
  4. 50 million
Why Behavior Analysis and ADHD? Is it Neurobiological?
According to the National Institute for Mental Health (NIMH) and other sources…

- “Convergent data from neuroimaging, neuropsychology, genetics and neurochemical studies consistently point to the involvement of the frontostriatal network as a likely contributor to the pathophysiology of ADHD.”
  – Italics and underline mine.
  – Curatolo, et al. (2010). The neurobiological basis of ADHD.
Differing Views in Behavior Analysis
Neurobiological Basis?

POSITION A:

—“There is no compelling evidence for a neurobiological basis of ADHD… no consistent causal neurobiological variable has ever been identified and no neuroimaging or continuous performance methods have ever proven useful in diagnosis given high rates of false positives and negatives.”
Differing Views (continued)

POSITION A (continued): “In practice, looking at ADHD as a medical issue, medication is prescribed by a doctor, but it serves only as a crutch without mending the bone - take the crutch away and the patient falls down (is this ultimately truly ethical patient care, and might this neurobiological conceptualization of ADHD distract the helping community from getting right to effective behavioral treatment that teaches new skills with lasting impact?)”
Differing Views in Behavior Analysis: Neurobiological Basis?

POSITION B:

“I would simply refer everyone to our best source of information on ADHD or any other mental health or clinical disorder, which is NIMH and CDC (Center for Disease Control).”

(in referencing that there “IS” compelling evidence for a neurobiological basis with stimulant medications viewed as a viable and effective alternative for the majority of children with true ADHD symptoms)
Differing View (continued)

Position B:

"Although there may be anatomical and biochemical differences between those with & without ADHD, the plasticity of nervous system suggests these can be altered by experience.

It is reasonable to assume behavioral inhibition may be taught

By teaching multiple exemplars of behavioral inhibition, a pattern of generalized self-control may emerge"
Russell Barkley, Ph.D.
Neuropsychological Model of ADHD

• Principal impairment:
  – Primary deficit in behavioral inhibition
  – Secondary Deficits in Executive Functions leading to Impulsive Bx and Lack of Self-Control

• According to Barkley, the core symptom of ADHD is *impulsivity*
Neuropsychological Model of ADHD

• Russell Barkley, Ph.D.:
• Implications for treatment of “impulsivity”
  – As a neurodevelopmental disorder, his recommendation is that it will best be managed medically

**Purpose:** 6-month rates of sleep-related problems & association with daytime inadvertent napping, inattention, hyperactivity/impulsivity, & oppositional symptoms in children & teens

**Participants:** School-based sample of 2463 1st - 9th graders

- **Instruments:**
  - Sleep Habits Questionnaire, Chinese Health Questionnaire, & Chinese versions of the Conners’ Parent & Teacher Rating Scales-Revised: Short forms.

- **Informants:**
  - mothers & teachers

• **Findings:**
  – Sleep deprivation & disruption impaired executive functioning, resulting in similar cognitive, behavioral profile of children with ADHD.
Findings (continued):

- Supported by reduction in ADHD symptoms following tx of sleep problems

- Findings imply importance of assessment of sleep problems in children with ADHD-related symptoms in addition to symptoms of ADHD.
# Sleep (average requirements)

<table>
<thead>
<tr>
<th>Age</th>
<th>Sleep</th>
<th>Age</th>
<th>Sleep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 18 mos.</td>
<td>16.5 hours</td>
<td>6 years</td>
<td>10.75 hours</td>
</tr>
<tr>
<td>2 years</td>
<td>13 hours</td>
<td>9 years</td>
<td>10 hours</td>
</tr>
<tr>
<td>3 years</td>
<td>12 hours</td>
<td>12 years</td>
<td>9.25 hours</td>
</tr>
<tr>
<td>4 years</td>
<td>11.5 hours</td>
<td>15 years</td>
<td>8.75 hours</td>
</tr>
<tr>
<td>5 years</td>
<td>11 hours</td>
<td>18 years</td>
<td>8.25 hours</td>
</tr>
</tbody>
</table>
ASR

• The current clinical assessment for ADHD involves:
  1. Blood testing
  2. Urine testing
  3. Neuro imaging
  4. Genetic testing
  5. Rating scales and/or checklists
ASR

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  1. Blood testing
  2. Urine testing
  3. Neuro imaging
  4. Genetic testing
  5. Rating scales and/or checklists
ASR

• According to the Neuropsychological Model of ADHD, the core symptom is:
  1. Lack of focus
  2. Impulsivity
  3. Nervousness
  4. Oppositional behaviors
According to the Neuropsychological Model of ADHD, the core symptom is:

1. Lack of focus
2. Impulsivity
3. Nervousness
4. Oppositional behaviors
ADHD and Medication

NIMH Funded Research and Follow-ups
# Methylphenidate and Other Meds
(meth il fen' i date)

<table>
<thead>
<tr>
<th>Brand Names</th>
<th>Other Meds</th>
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<tbody>
<tr>
<td>Concerta</td>
<td>Dextroamphetamine</td>
</tr>
<tr>
<td>Metadate</td>
<td>Dextedrine</td>
</tr>
<tr>
<td>Methylin</td>
<td></td>
</tr>
<tr>
<td>Ritalin</td>
<td>Dextroamphetamine sachharate/sulfate- Adderall</td>
</tr>
<tr>
<td>Daytrana- transdermal patch</td>
<td></td>
</tr>
<tr>
<td>Focalin- New Ritalin derivative</td>
<td>Pemoline- Cylert (needs liver function tests due to toxicity)</td>
</tr>
<tr>
<td>Attenade- Newest Ritalin derivative</td>
<td></td>
</tr>
</tbody>
</table>
Multimodal Treatment Study of Children with ADHD (MTA) 1999

• MTA Cooperative Group’s 3 questions:
  1. How do long-term medication and behavioral treatments compare with one another?
  2. Are there additional benefits when they are used together?
Multimodal Treatment Study of Children with ADHD (MTA) 1999

3. What is effectiveness of systematic, carefully delivered treatments vs routine community care?
Multimodal Treatment Study of Children with ADHD (MTA) 1999

- Four Treatment Groups – Random Assignments of 579 children
  1. Medication alone
  2. Intensive Behavioral Treatment alone
  3. Combined medication and Behavioral Treatment
  4. Community based care (control group)
Overall Findings: MTA Study (1999)

• Results:
  – All treatment found to be effective on an absolute basis as compared to control
  – Medication or Medication plus Behavioral tx were nearly equally effective and superior to:
    • Behavioral Treatment alone
    • Community based controls
Overall Findings: MTA Study
14 Month Endpoint

• % Normalized at 14 month endpoint compared to Classroom Controls
  – Classroom Controls 88%
  – Combination 68%
  – Medicine 56%
  – Behavior 34%
  – Community based care 25%
NIMH Multimodal Treatment Study of ADHD Follow-up: Changes in Effectiveness and Growth After End of Treatment (2004)

• From 14 - 24 months ADHD Symptom Ratings Results
  – Groups as a whole with greatest improvement at end of treatment phase (Comb and MedMgt) deteriorated during follow-up phase, but other 2 groups (Beh and CC) did not
MTA Follow-up: Changes in Effectiveness and Growth After End of Treatment (2004)

• Subgroup that consistently reported medication use showed reduced height gain compared with…

• Subgroup that never reported medication use which actually grew faster than predicted by population norms.
MTA Follow-up: Changes in Effectiveness and Growth After End of Treatment (2004)

- Restated long-standing view that stimulant meds provide symptomatic relief as long as administered but limited carryover effects when stopped *
- Effect of Bx smaller than effect of meds but was maintained, suggests that generalization occurred, perhaps because parents continued to implement learned practices.
Swanson et al. (2007) Growth Rates

Findings:

– Children with combined type ADHD were larger as a group before med treatment however showed stimulant meds related decreases in growth rates after start of treatment (reviewed last here at 36 months)
Swanson et al. (2007) Growth Rates

Consistent vs... Newly vs. Not*

Centimeters shorter than comparison group at 36 month follow-up

4.21

3.04
Swanson et al. (2007) Growth Rates (Summary)

• Greater med use produced better outcome at 14, and 24 month assessment points, but at 36 month assessment point- no significant effect of med use from overall baseline to 36 month follow-up.

• Post hoc analysis of 24 - 36 month change in symptom severity showed that med use over this follow up interval was related to deterioration rather than benefit.
Swanson et al. (2007) Growth Rates

• Conclusions (continued):
  – Doesn’t support hypothesis of growth rebound
  – Doesn’t support hypothesis of delayed maturation as stimulant naïve children had heights and weights above rather than below average at study initiation
  – Loss of relative superiority being related to maintenance of tx not confirmed*
ASR

• Which of the following is NOT a common medication used to treat ADHD symptoms?
  1. Concerta
  2. Metadate
  3. Viagra
  4. Ritalin
  5. Daytrana
Which of the following is NOT a brand name for Methylphenidate?

1. Concerta
2. Metadate
3. Viagra
4. Ritalin
5. Daytrana
ASR

- At the 14 month follow-up of the MTA study, what group showed the highest percentage of “normalization”?  
  1. Combination  
  2. Medicine  
  3. Behavior  
  4. Community based care
At the 14 month follow-up of the MTA study, what group showed the highest percentage of “normalization”? 

1. Combination 
2. Medicine 
3. Behavior 
4. Community based care
At 24 months after the MTA study, which groups deteriorated (ADHD symptoms) during the follow-up phase?

1. Combination & Behavior
2. Medicine & Community based care
3. Behavior & Medicine
4. Combination and Medicine
• At 24 months after the MTA study, which groups deteriorated (ADHD symptoms) during the follow-up phase?
  1. Combination & Behavior
  2. Medicine & Community based care
  3. Behavior & Medicine
  4. Combination and Medicine
Behavior Analysis Defining Impulsivity

• Choosing a smaller/lower quality reward available immediately over a larger/higher quality reward available after a delay.

• Choosing a smaller/lower quality reward available for less effort than a larger/higher quality reward available for greater effort.
Impulsiveness in ADHD: Behaviorally Speaking

• Children with ADHD prefer immediate rewards over delayed rewards.

• Children with ADHD prefer rewards that require less effort than rewards that require greater effort.
Behavioral/Medication Studies - ADHD

• Neef et al. (2005b). Medication effects on impulse control/self control measured by variables of reinforcement

• Neef et al. (2005a). Extension with tighter control

• LaRue et al. (2008). Medication effects on value of school social interaction
Neef et al. (2005a, 2005b) *JABA*

- 58 children – between groups design
- 4 children - double-blind, placebo-controlled, counterbalanced reversal design
- used computer-based math problems to assess impulsivity
- Compared those with ADHD who were & were not receiving medication & with typically developing children without ADHD.
Neef et al. (2005 a & b) JABA

• Responding favored problem alternatives that produced immediate reinforcement across medication & placebo conditions.

• Supports Barkley - ADHD mainly a problem of self control but both studies inconsistent with findings in the research literature on ADHD that medication improves impulse control (Barkley, 1997).

• Suggests meds may have little effect on objective measures of impulsivity.
LaRue et al. (2008) JABA

• Purpose:
  – To evaluate a clinic-based assessment for determining reinforcing value of social play for preschool children with a diagnosis of ADHD
  – To determine if procedures could be useful for further evaluation of medication effects on these behaviors.
LaRue et al. (2008) JABA

- **Subjects:** 5 children 4-6 years old, all prior diagnosis of ADHD
- Alternating courses of placebo and stimulant meds were provided by child psychiatrist.
- Reinforcer Assessment: Children placed criterion # blocks in a bucket to earn 1 of 3 coupons for “alone play”, “play with friends” and a “quiet time”
LaRue et al. (2008) JABA

- 1 ALWAYS selected play with friends
- 2 gradual increase in play with friends regardless of med dosage
- 1 gradual increase in play with friends with meds, gradual decrease at placebo dosage
- 1 decrease in play with friends as meds increased with increase in play alone choice

Stimulant meds may decrease or increase value of social activity for some children & with some doses.
LaRue et al. (2008) JABA

– If decreased, may be contraindicated for children who exhibit social deficits prior to meds
– If increased value, may make social skills training easier

Take Home: Individualized assessment may be necessary to identify idiosyncratic responses to stimulant meds across children and med doses.
Which of the following was found in Neef et al. (2005 a & b) with children diagnosed with ADHD?

1. Medication assisted children in waiting for reinforcement.
2. Children preferred largest rewards later.
3. Children were most influenced by immediacy.
4. None of these.
ASR

Which of the following was found in Neef et al. (2005 a & b) with children diagnosed with ADHD?

1. Medication assisted children in waiting for reinforcement.
2. Children preferred largest rewards later.
3. Children were most influenced by immediacy.
4. None of these.
LaRue et al. (2008) found that children on medication for symptoms of ADHD were more likely to choose to:

1. Play with friends
2. Play alone
3. Have a quiet time
4. Some chose play with friends and some chose play alone
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1. Play with friends
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Behavorial/Medication Studies - ADHD

• Kelley, Fisher, Lomas, & Sanders. (2006). Medication & behavioral treatment - effects on compliance

• Mace et al. (2009) combination meds/function based treatment needed

• Gulley et al. (2003) optimal treatment modification (meds &/or behavioral) through sequential evaluation

• Kayser et al. (1997) behavioral treatment instead of meds?
Medication’s effect on compliance

- Single subject design 11-year-old boy diagnosed with intellectual disability & ADHD
- 20 mg of Adderall© or placebo alternated in double-blind fashion in reversal design.
- Continuous demands during 10 minute sessions
Kelley et al. (2006) *JABA*

- 2 response options—destructive & appropriate bx—concurrently programmed to contact reinforcement during both drug & placebo conditions.
Results:

- More likely to engage in compliance for reinforcement with meds than placebo
- Presence of meds biased responding toward appropriate bx
- However, high levels of destructive bx & low levels of compliance occurred during prior functional analysis with med.
Kelley et al. (2006) *JABA*

- So, behavioral treatment and meds were **both necessary** to maintain low levels of destructive bx and high levels of compliance.
Mace et al. (2009) JABA

- **Subject:**
  - 16 year old boy diagnosed with ADHD & moderate intellectual disabilities
  - $\frac{1}{2}$ days received 36 mg of Concerta XL and half days received quasiplacebo
  - Single-blind placebo controlled study
Mace et al. (2009) *JABA*

- **4 conditions:**
  - high & low preference activity
  - divided attention
  - low attention

- **Target behaviors:**
  - Activity engagement & Activity changes –
  - rude vocalizations or gestures, inappropriate touching and physical aggression
Mace et al. (2009) *JABA*

- **Results:**
  - Meds **improved** all undesirable behaviors
  - Activity engagement was higher and activity changes occurred less often with meds
  - High-preference leisure activity evoked more activity engagement & fewer activity changes than the low-preference assignment regardless of med condition
Mace et al. (2009) *JABA*

**Discussion:**

- Meds reduced undesirable behaviors in several conditions but were **STILL** at unacceptable levels while attention was divided between adults & not directed towards child.
In Kelley et al. (2006), low levels of destructive bx and high levels of compliance were obtained by:

1. Behavioral treatment alone
2. Medication alone
3. Meds and behavioral treatment
4. Neither meds nor behavioral treatment
ASR

- In Kelley et al. (2006), low levels of destructive bx and high levels of compliance were obtained by:
  1. Behavioral treatment alone
  2. Medication alone
  3. Meds and behavioral treatment
  4. Neither meds nor behavioral treatment
In Mace et al. (2009) what is true about the environmental conditions effect on behavior?

1. Medications reduced undesirable behaviors to acceptable levels in all conditions.
2. Medications reduced undesirable behaviors to acceptable levels in no conditions
3. Medication reduced undesirable behaviors to acceptable levels in some conditions
In Mace et al. (2009) what is true about the environmental conditions effect on behavior?

1. Medications reduced undesirable behaviors to acceptable levels in all conditions.
2. Medications reduced undesirable behaviors to acceptable levels in no conditions.
3. Medication reduced undesirable behaviors to acceptable levels in some conditions.
Gulley et al. (2003) JABA

• **Participants:**
  – 4-year-old boy, 7-year-old girl, & 6-year-old girl all diagnosed with ADHD, prescribed stimulant medication

• **Target Bx:**
  – Out-of-seat behavior, inappropriate vocalizations & playing with objects, aggression, destruction of materials, & throwing objects also target bx for one child
Gulley et al. (2003) *JABA*

• **Behavioral treatments**: DRA, DRA + response cost & DRA + time-out evaluated as behavioral tx. Treatments selected based on empirical support in literature & inclusion in MTA study.

• **Medication treatments**: MPH based on weight for each child initially prescribed (10 – 15 mg)
Gulley et al. (2003) JABA

• Sequential evaluation:
  – Showed a change in dosage of medication was necessary for 1 child & necessary change in the behavioral tx was necessary for 2 of 3 children.
Gulley et al. (2003) JABA

• Results:
  – Individualized behavioral treatment decreased disruptive behavior equivalent to MPH for all 3 participants & demonstrated the need to evaluate behavioral treatments & med dosages on individual basis.
Kayser et al. (1997) JABA

• Participant:
  – 6-year-old boy - diagnosed with ADHD on MPH medication for 3 years

• Referring physician requested evaluation of effects of MPH & specifically asked for a behavioral intervention to replace MPH.
Kayser et al. (1997) *JABA*

**Problem behaviors:** Aggression, SIB & Sleep Disturbances (rocking)

- Escape identified as potential function

**Targeted tasks:** writing tasks, mathematical problems, and reading

- MPH and behavioral treatment studied with ABCB reversal design
Kayser et al. (1997) JABA

• Intervention:
  – Math problem worksheet with:
    a) Sequential prompting procedure,
    b) Attention and preferred activities on a FR1 schedule on compliance
    c) For Sleep: Escape extinction - No specific procedures were used to increase his sleep; nursing staff simply put child to bed on a regular schedule
Kayser et al. (1997). JABA
Kayser, et al. (1997). *JABA*
American Academy of Pediatrics (2011)

• Recommendations for treating children diagnosed with ADHD consist of use of both psycho-stimulants & behavioral interventions (over age 6) to help control symptoms.

• Recommendations for use of both psycho-stimulants and behavioral interventions are consistent with majority of literature available on tx of ADHD.
American Academy of Pediatrics (2011)

Although best practice indicates a combination is best, in applied practice treatment for symptoms of ADHD typically consists of psycho-stimulants alone according to the literature...
Numerous discussions on both sides due to side effects and efficacy. Ultimately it comes down to individual child, guardian and treatment team as to what decision will be acceptable in terms of benefit/cost ratio. Behavior Analysts must speak/work in terms of our area of expertise – *specific observable, measurable behaviors!*
ASR

• In Kayser, et al. (1997), the percentage of sleep increased due to:
  1. Child was taken off MPH
  2. Child was placed on MPH
  3. Child was placed on structured sleep schedule
  4. Could be 1 and/or 3
ASR

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  2. Child was placed on MPH
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  4. Could be 1 and/or 3
Behavioral Focus Studies - ADHD

- Kodak, Kodak, Grow, & Northup (2004) function based treatment for elopement
- Stahr, Cushing, Lane, Fox, (2006) Efficacy of a function based intervention for off task behavior
- McDowell, & Keenan (2001) increased fluency for endurance
- Azrin, et al. (2006) activity as reinforcement
- Bloh (2009) increasing self-control & generalization
Kodak, et al. (2004) *JABA*

- **Participant:**
  - 5 year old diagnosed with ADHD

- **Elopement:**
  - running more than 1 m away from designated area during kickball game on open field

- **Functional analysis:**
  - indicated that elopement was reinforced by attention
Kodak, et al. (2004) JABA

• Treatment:
  – consisted of NCA and time-out contingent on elopement.

• NCA:
  – consisted of praise and tickles & was provided approximately every 15s.

• Time-out:
  – consisted of 30 s in penalty box
Kodak, et al. (2004) JABA
Stahr et al. (2006) *Journal of Positive Behavior Interventions*

- 9 year old boy - ADHD diagnosis & speech & language impairment
- Welbutrin medication for anxiety related diagnosis
- Descriptive functional assessment completed for “off-task” behavior & inappropriate requests for help during Language & Math classes - indicated maintained by attention & escape from tasks.
Stahr et al. (2006) *Journal of Positive Behavior Interventions*

- Function-based intervention: communication system, self-monitoring component & extinction

- **Taught:**
  A. Child to seek assistance unobtrusively
  B. Child to regulate own bx
  C. Teachers, paraeducator & therapist to ignore undesirable bx
Stahr et al. (2006) *Journal of Positive Behavior Interventions*

- **Results:**
  - *Increased* task engagement & completion, & appropriate requests,
  - *Decreased* off task, inappropriate requests
McDowell, & Keenan (2001) JABA

• **Participant:**
  – 9 year-old-boy diagnosed with ADHD & 5 mg of MPH 3x per day

• **Dependent variables:**
  – number of letter soundsidentified correctly and incorrectly per minute and the time spent on task.
Baseline: 4 ten minute sessions, 26 cards letters A-Z, on floor randomly. Cards contained upper & lowercase letter & word & picture that began with letter. No practice/instruction, just feedback at end

Intervention: Fluency goals & practicing all letter sounds with teacher feedback & error-correction procedure before timing corrects/incorrects
The intervention resulted in an immediate increase in correct responses & a decrease in incorrect responses.

Child remained on task for 100% of these sessions. Time on task increased from 50-60% at baseline to 100% when fluent in task
McDowell, & Keenan (2001) JABA

Percentage of sessions spent on task
Azrin et al. (2006) *Behavior Modification*

- Age-appropriate reinforcers found to be effective in promoting attentiveness and calmness in children with ADHD diagnosis

- **Subject:**
  - 4 year old boy with diagnosis ADHD comorbid with autism, no meds

- **DV:**
  - “attentive calmness”
Azrin et al. (2006) *Behavior Modification*

- **IV:**
  - Scheduled period of physical activity as reinforcer for attentive calmness

- **Results:**
  - Attentive Calmness increased from an average 3 seconds to 60 seconds.
Azrin et al. (2006) *Behavior Modification*

"Jimmy"

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Initial Session</th>
<th>Reconditioning</th>
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<tbody>
<tr>
<td>Attentive Sitting (mean no. of secs/trial)</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>Various Procedures</td>
<td></td>
<td></td>
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<tr>
<td>Descriptive Praise Only</td>
<td>10</td>
<td></td>
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<tr>
<td>Non-Contingent Delivery of Activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No Intervention (Baseline)</td>
<td>0</td>
<td>10</td>
</tr>
</tbody>
</table>

*Activity as Reinforcer*

First, a few words:

“Self-Control” vs “Self Management”

- **Participants:** Three boys 10 – 14 diagnosed with ADHD
- **Natural baseline:**
  - Asked to wait as long as possible before consuming preferred edible
Bloh (2009) The Behavior Analyst Today

• **Choice baseline:**
  – Participant asked to choose between his small immediate (one bite-size Snickers®/ Starburst®) and a large delayed reinforcer (two Snickers®/ Starbursts®).

• **Self-Control Training:**
  – "Do you want [small item] now, or would you like [large item] in a little while?"
Self Control Training: Incremental delays increased every session. During the delay concurrent activity involved symmetry matching (pictures to their word equivalents).

Generalization Setting: individualized…

- Replicated findings of increased self-control through progressive delays & participation in concurrent activities.
ASR

• McDowell, & Keenan (2001) found that practicing letter skills before timings for correct and incorrect letter sounds in combination with reinforcement for meeting or beating past results produced:
  1. Increases in fluency and time on task
  2. Increases in fluency but not time on task
  3. Increase in time on task but not fluency
  4. No increases in time on task or fluency
ASR

• McDowell, & Keenan (2001) found that practicing letter skills before timings for correct and incorrect letter sounds in combination with reinforcement for meeting or beating past results produced:

1. Increases in fluency and time on task
2. Increases in fluency but not time on task
3. Increase in time on task but not fluency
4. No increases in time on task or fluency
ASR

• Azrin et al. (2006) successfully used what as a reinforcer for “attentive calmness”?
  1. Grab bag with small toys and edibles
  2. Activity on playground
  3. NCA
  4. Candy Bars
ASR

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Social Skills in Children Diagnosed With ADHD

• Children diagnosed with ADHD often exhibit inattentive, impulsive, & inappropriate social bx (e.g., bossy, uncooperative) associated with negative peer relations including social rejection.

• Research states SS may be more resistant to treatments of meds and traditional behavioral interventions
Behavioral Focus Studies - ADHD

• Social Skills:
  – Also LaRue, et al. (2008) Medications effects on school social interaction in children with ADHD.
Hupp et al. (2002) *Behavior Modification*

- 5 children aged 4 – 7 years, diagnosed with ADHD, 3 on stimulant medication

**Purpose:**

1. Replicate previous studies on sportsmanlike bx with stronger design
2. Tokens vs Delayed rewards comparison
3. Tracking 3 on meds vs placebos for effect on targeted bx
Hupp et al. (2002) *Behavior Modification*

- **Design:**
  - multiple baseline reversal design
  - (compared to A-B prior design)
- **Sportsmanlike Bx:**
  - praising, applauding, high fiving or other ways of “encouraging” players
Hupp et al. (2002) *Behavior Modification*

**Findings:**

1. Replication: all 5 children showed increases in sportsmanlike bx overall
2. Delayed rewards did NOT increase sportsmanlike bx while tokens plus praise plus delayed reward DID.
3. Meds did not increase sportsmanlike bx (but decreased disruptive bx in classroom)
Hupp et al. (2002) *Behavior Modification*

- **Drawback:**
  - No fading or generalization due to short summer program, no generalization demonstrated
Problem:
- Social Skills (SS) programs lacking in Generalization

Purpose:
- replicate a program for increasing sportsmanlike and attentive behaviors in ADHD-diagnosed children
- demonstrate generalization of these behaviors to a nontraining setting.
O'Callaghan et al. (2003) *Behavior Therapy*

- **Participants:**
  - 2 boys, 2 girls diagnosed with ADHD with low levels of sportsmanlike & attentive behavior at a 6 week summer camp
O'Callaghan et al. (2003) Behavior Therapy

• Dependent Variables:
  – Sportsmanlike*
  – Attentive bx -"ready position." (a) standing within 10 feet of the base, (b) head & eyes facing toward home plate, and (c) both hands on knees or thighs

* Defined as in Hupp et al., (2002) study
O'Callaghan et al. (2003) *Behavior Therapy*

**Design:**
- Multiple-baseline-across-participants

**Training:**
- Kickball diamond set up
- Experimenter & research assistant as coaches
- Training in morning, games in afternoon
O'Callaghan et al. (2003) *Behavior Therapy*

- **Training sessions:**
  - Modeling appropriate social skills followed by feedback and reinforcement for performance.

- **Token economy system** like Hupp, et al. (2005).

- **Generalization Sessions:**
  - Started when target bx’s occurred at 75% training intervals for 6 consecutive data points
O‘Callaghan et al. (2003) Behavior Therapy

• Stokes and Baer (1977)

Examples:

• **Train with Multiple exemplars.** Rotate trainers, staff & peers participating in training setting

• **Program Common Stimuli:**
  - Occasionally use same trainers in games as used in training
O‘Callaghan et al. (2003) Behavior Therapy

More examples:

Use Indiscriminable contingencies:
schedule of token reinforcement faded on intermittent schedule

Training loosely: introduce and withdraw programming techniques in training session
O'Callaghan et al. (2003) *Behavior Therapy*

- Regular game data were collected at a separate location during a scheduled "recess" time near the end of the camp day.
- No token economy in place
O'Callaghan et al. (2003) *Behavior Therapy*

**Results:**

- In training setting, increase (~80%) in attentive & sportsmanlike bx with token system
- Increased rates of SS in training sessions maintained even as reinforcement schedules thinned & faded completely
O'Callaghan et al. (2003) *Behavior Therapy*

- Generalization programming produced significant gains in game setting for all children,
- Response variability and no one generalization programming technique yielded consistent results for all children.
- But, efforts to systematically program for social skills generalization resulted in increases of 40% to 50% without arbitrary contingencies in generalization setting.
ASR

• In Hupp et al. (2002) which of the following increased sportsmanlike behavior?
  1. Medications
  2. Tokens plus praise plus delayed reward
  3. Delayed rewards
  4. All of the above
ASR

• In Hupp et al. (2002) which of the following increased sportsmanlike behavior?
  1. Medications
  2. Tokens plus praise plus delayed reward
  3. Delayed rewards
  4. All of the above
Behavioral Focus Studies – ADHD

• Instructional Control:

  – Neef et al. (2004) modeling vs instructions on sensitivity to reinforcement schedules
  – Falcomata et al. (2008) Contingency Specifying (CS) vs Incomplete Instructions (II)
Neef et al. (2004) *JABA*

- **Participants:**
  - 3 typically developing children & 3 children with ADHD whose academic responding showed insensitivity to reinforcement schedules
  - Children were tasked with earning X points in Y time to obtain 1 of 5 preferred prizes according to VI VI schedules (solving computer math problems)
Neef et al. (2004) *JABA*

- **No Instruction Baseline:**
  - Children attempt contacting reinforcement with VI schedules to complete math problems
  - All 6 exhibited undermatching i.e. less time on schedule that provided most reinforcement
Neef et al. (2004) *JABA*

- **Modeling:**
  - Experimenter chose schedules and performed problems as talked out loud to obtain points to exchange for reinforcement

- **Instructions:**
  - Experimenter gave the participant specific instructions for earning the most points with concurrent schedules in effect
Neef et al. (2004) JABA

• Results:
  – No difference in children with & without ADHD
  – Instruction & modeling interventions quickly produced patterns of response allocation to maximize reinforcement
  – Responding established by modeling more sensitive to change in reinforcement schedules (less rigid–better generalization)
Falconomata et al. (2008)  *JABA*

**Setting:** University Lab school or elementary school

**Participants:**
- Three, 7 year-old boys diagnosed with ADHD

**Dependent Variable:**
- Latency from instruction to inappropriate vocalizations or out of seat behavior
Falcomata et al. (2008) *JABA*

**Design:**

- Alternating treatments across reinforcement, extinction, & reinforcement + increasing response requirements conditions to evaluate effects of Contingency-Specifying Instructions (CSIs) & Incomplete Instructions (IIIs).
Falcomata et al. (2008) JABA

• Reinforcement
  – CSI sessions during reinforcement were initiated with instruction, “Sit and wait quietly, and you might get a coupon”
  – II sessions during reinforcement were identical to CSI sessions during reinforcement except that therapist provided instruction, “Sit and wait quietly.”
Falcomata et al. (2008) JABA

Extinction

- CSI sessions during extinction same as CSI sessions during reinforcement but no reinforcement if child met goal
- II sessions during extinction were same as CSI sessions during extinction except that the therapist provided instruction, “Sit and wait quietly.”
Falcomata et al. (2008) *JABA*

- For 2/3 children sessions during reinforcement + increasing response requirement were same as sessions during reinforcement except as each participant reached target goal, goal was increased systematically in each condition.
Falcomata et al. (2008) *JABA*

• **Results:**
  – Instructional control was achieved with CSI, which resulted in maintenance of appropriate bx in absence of reinforcement for all 3 children
  – Instructional control not achieved with II.
Falcomata et al. (2008) JABA

Take Home: CSIs may be useful:

• To maintain appropriate classroom behavior without reinforcement as a goal.
• When there are challenges to treatment integrity
• If consequences for appropriate behavior are likely to be inconsistent.
ASR

• In Neef, et al. (2004), which of the following was more flexible in the allocation of responding when reinforcement schedules changed?

1. Instructions
2. Modeling
3. Instructions & Modeling
4. Neither were flexible
In Neef, et al. (2004), which of the following was more flexible in the allocation of responding when reinforcement schedules changed?

1. Instructions
2. Modeling
3. Instructions & Modeling
4. Neither were flexible
In Falcomata et al. (2008) when no reinforcement was provided, which technique yielded instructional control?

1. Contingency specifying instructions
2. Incomplete instructions
3. Both
4. Neither
In Falcomata et al. (2008) when no reinforcement was provided, which technique yielded instructional control?

1. Contingency specifying instructions
2. Incomplete instructions
3. Both
4. Neither
Behavioral Focus Studies - ADHD

• Variables Impacting Performance:
  – Belke, & Garland (2007) Magnitude of Reinforcement
Influence of instructions on FA

- **Participant**: 5-year-old girl at a summer program for children diagnosed with ADHD
- **Target behaviors**:  
  - Inappropriate vocalizations,  
  - out-of-seat behavior, destruction, aggression
Northup et al. (2004) *JABA*

• **Functional analysis:**
  – An initial assessment consisted of attention (reprimand), escape, and control conditions alternated in a multi-element design.
Control: therapist helped child complete simple puzzles child chose. NCA provided approximately every 30 s as praise & approving statements.

Initial Attention & Escape: Therapist presented task and said “stay in your seat and work quietly. If you [any target behavior] I will have to remind you.” (if target then “You need to work quietly”).
Northup et al. (2004) *JABA*

• **Escape:**
  – “If you [any target behavior] you might need to take a break.”
  – If target behavior, then said “take a break” (turned chair, 30 seconds)
  – Due to High Rates of Target Bx in Escape condition, 2 additional conditions conducted
Northup et al. (2004) *JABA*

- **Time-out:**
  - “If you [any target behavior] you will be in time-out” & said “time-out” in neutral tone contingent on target bx

- **No instructions:**
  - No additional instructions were given in no-instructions condition, & therapist made no comment following target bx.
Northup et al. (2004) *JABA*

Figure 1. Rates of inappropriate behavior during initial functional analysis conditions and pairwise comparisons between time-out and escape conditions and time-out and no-instructions conditions.
Belke & Garland (2007)  *JEAB*

**Magnitude of Reinforcement?**

**Subjects:** 2 groups of mice

- **Selectively bred** (based on high daily wheel running rates) versus **Control** mice

- Studied Lever-pressing response reinforced by brief opportunity to run 90 s, 30 min, and 90 s

- Trials ending after obtaining 20 reinforcers or after 1 hour.
Belke & Garland (2007) JEAB

Selected vs Control Mice

% Mice Obtaining 20 Reinforcers

Wheel Running Reinforcer Duration

- 90 Second
- 30 minute
- 90 second

Belke & Garland (2007) JEAB
Belke & Garland (2007) *JEAB*

- Why important? High-running mice share features common to ADHD.
  - Hyperactive vs. nonselected mice, even when in cages without wheels
  - Ritalin, improves hyperactivity in selected mice
  - Selected mice show a particular learning deficit vs. controls - may be function of inattention.
Belke & Garland (2007) JEAB

• Importance (continued)
  – Reduced dopamine function & altered activity in prefrontal cortex that occur in ADHD have been observed in selected mice

Take Home? Seems to agree with research that children diagnosed with ADHD have higher reward threshold relative to typically developing children…
Choice Effects?

Participant: 7-year-old boy diagnosed with ADHD on 15 mg of Ritalin daily

Classroom setting

Undesirable Behavior: Noncompliance, away from desk, disturbing others, staring off & not doing work

ABAB Design: used to evaluate effects of choice making on undesirable bx
Powell & Nelson (1997) JABA

• Baseline no-choice phases:
  – Worked on same assignment as class.

• Choice phases:
  – Choice of 3 language arts assignments from class.

• No-choice condition:
  – Not given a choice of academic assignments.
Figure 1. Percentage of intervals rated as containing undesirable behaviors across conditions.
The Belke & Garland (2007) study with mice may imply that magnitude of reward necessary for a child with ADHD is:
1. The same as for a child without ADHD
2. Less than for a child without ADHD
3. Greater than for a child without ADHD
4. No correlation with a child without ADHD
ASR

• The Belke & Garland (2007) study with mice may imply that magnitude of reward necessary for a child with ADHD is:
  1. The same as for a child without ADHD
  2. Less than for a child without ADHD
  3. Greater than for a child without ADHD
  4. No correlation with a child without ADHD
Behavioral Focus Studies - ADHD

• Peer Mediated Treatment:
  – Grauvogel-MacAleese & Wallace (2010) extension on peer mediated treatment
Peer Mediated Treatment

- 3 boys with ADHD, ages 6, 8 & 10, and
- 3 male peers ages 7, 9 & 10
- **Target Behavior:** “Off-task behavior”
  - talking about subjects unrelated to homework, leaving or falling out of his seat, wandering around room, leaving the homework area, hiding behind objects and crawling under tables
Grauvogel-MacAleese & Wallace (2010) JABA

- **Multiple baseline design** across participants, with a reversal for one participant used to evaluate treatment

- **Correct response:** Scored when peer gave attention contingent on off-task bx during peer-attention condition, provided attention noncontingently during control condition, & ignored off-task bx & provided attention for on-task bx during treatment sessions.
Grauvogel-MacAleese & Wallace (2010)

JABA

• Incorrect response:
  – Scored if peer delivered attention when he should not have or if he ignored prompt to deliver attention.
During treatment:
- Peer provided statements of praise and help if participant was on task.

If participant engaged in off-task behavior, peer discontinued praise & help until participant was on task again (i.e., extinction).

Baseline & treatment:
- Homework worksheet assigned by teacher.
Peer Mediated Treatment

- **Participants**: 3, 10-year-old children diagnosed with ADHD
- **Dependent variables**: Off-task behavior and number of math problems completed
- **Functional Analysis**: Showed all exhibited elevated levels of off-task behavior in alone and peer-attention conditions.
Flood et al. (2002) JABA

Treatment:

• Children told they & confederate peer (CP) would work on math & CP gave continuous social approval if child on-task
• If off-task behavior, CP prompted child to engage in on-task behavior
• If child did not resume on-task behavior, CP withdrew eye contact & verbal interaction until child resumed on-task bx (the extinction component of DRA)
Flood et al. (2002) JABA
In Grauvogel-MacAleese & Wallace (2010), peers of children diagnosed with ADHD implemented ________ successfully?

1. Differential Reinforcement & time-out
2. Differential Reinforcement & extinction
3. Shaping & time-out
4. Shaping & extinction
• In Grauvogel-MacAleese & Wallace (2010), peers of children diagnosed with ADHD implemented successfully:
  1. Differential Reinforcement & time-out
  2. Differential Reinforcement & extinction
  3. Shaping & time-out
  4. Shaping & extinction
In Flood, et al. (2002), DRA plus prompting resulted in successful reduction of off-task behavior for:

1. All three children
2. No children
3. 2 of the three children
4. 1 of the three children
ASR

In Flood, et al. (2002), DRA plus prompting resulted in successful reduction of off-task behavior for:

1. All three children
2. No children
3. 2 of the three children
4. 1 of the three children
Barry & Haraway (2005)
Self-Management and ADHD: A Literature Review. *The Behavior Analyst Today*

- Behavioral *self management* including self-monitoring, self-regulation, self-control, self-talk, and reinforced self-evaluation
- Review of 3 cognitive behavioral studies (with inconclusive results*)

Behavioral “self-management” included reinforcement, response costs, contingency management of bx with self-monitoring, behavioral goals, operational definitions of behaviors, data based self-assessment, & data recording with reliability measures
Barry & Haraway (2005) *The Behavior Analyst Today*

From the reviews, components of behavioral self-management that may contribute to beneficial effects:

a. Immediate auditory and/or written prompts for self-recording

b. Individual or group contingency reinforcement,

c. Child choice of reinforcement,

d. Daily practice & instruction,
Barry & Haraway (2005) *The Behavior Analyst Today*

(continued):

e. Operational definitions of behaviors & goals

f. Reliability of (compare teacher & student info)

g. Specific skill instruction

h. Monitored acquisition of skill

i. Possible combo of tx with meds
Barry, & Haraway (2005) *The Behavior Analyst Today*

- Considerations:
  - Generalization of tx problematic
  - Maintenance issues with behavioral change with ADHD population - Long term support strategies needed?
  - Given numbers with ADHD prescribed meds, parents and professionals, including physician working with child, collaborate to coordinate & monitor interventions.
ADHD Summary

• First:
  • Neurodevelopmental?
  • Collection of categories/behaviors that significant persons or professionals in the life of an individual have noticed/reported with the intent of obtaining a diagnosis to obtain assistance
ADHD Summary

So regardless of position on neurobiological or not, behavior analysts and the Center for Disease Control and the National Institute of Mental Health are in agreement that behavioral techniques can make a distinct and significant positive impact on the behaviors exhibited by children diagnosed with ADHD and should be included as part of best practice treatment.
ADHD Summary

• Second:
  – Behavior analytic techniques with or without medications… focus on behaviors and teamwork with other professionals involved
ADHD Summary

• Third:
  – There may be some “person variables” specific to individuals diagnosed with ADHD such as:
    • Stronger preference for immediate vs delayed rewards
    • Sensitivity to larger quantity of reinforcer
ADHD Summary

Other studies with children diagnosed with ADHD have used behavioral techniques that were shown to be effective regardless of whether the child was diagnosed with ADHD or not - e.g., like children with or without ADHD diagnoses able to generalize problem solving best with strategies (modeling) vs. specific tactics (instructions).
ADHD Summary

• Take Home:
  – The scientifically based behavioral techniques of influencing behavior including functional assessments and research based interventions are similar if not identical to the behavioral techniques used with other diverse populations including children who are typically developing and those with developmental disabilities.
References


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