

The Single and Combined Effects of Three Intensities of Behavior Modification and Four Intensities of Medication in a Summer Treatment Program Classroom

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INTRODUCTION

- Behavior Modification and stimulant medication are evidence-based treatments for attention-deficit/hyperactivity disorder (ADHD; Pelham, Wheeler, & Chronis, 1998).
- The combination of behavior modification and stimulant medication is also an evidence-based treatment for ADHD (Pelham & Waschbusch, 1999).
- Prominent researchers and authorities in the field have stated stimulant medication is the most effective intervention for ADHD, and stimulant medication alone should be a first line treatment for ADHD, with the combination of behavior modification and medication yielding no incremental benefit (Jadad et al., 1999; Klein & Abikoff, 1997; Miller et al., 1998; MTA Cooperative Group, 1999).
- In contrast to this view, empirical studies (e.g., Pelham et al., 1993), case studies (e.g., Atkins, Pelham, & White, 1989; Hoza, Pelham, Sams, & Carlson, 1992; Northup et al., 1999), and literature reviews (DuPaul & Eckert, 1997; Fabiano et al., in preparation; Pelham & Murphy, 1986) all document the effectiveness of behavior modification for treating ADHD, and demonstrate that there is an incremental benefit of combining treatments.
- Because of controversy in the field, more studies of single and combined treatments for ADHD are needed.

LIMITATIONS OF COMBINED TREATMENT STUDIES TO DATE

- Currently combined treatment studies for ADHD are limited by a number of reasons.
- Endpoint assessments in large clinical trials of combined treatment (i.e., Klein & Abikoff, 1997; MTA Cooperative Group, 1999) were conducted when medication was active and behavior modification was faded, resulting in a biased comparison of treatments.
- Few studies have manipulated the intensity of both treatment modalities. Most studies manipulated the intensity of stimulant medication (e.g., Carlson et al., 1992; Kolko et al., 1999; Pelham et al., 1993), but manipulations of behavior modification have been generally limited to the presence of behavior modification versus the absence of such procedures.
- Currently no large studies exist that manipulated the intensities of both behavioral and stimulant medication treatments using more than two levels of intensity in each modality (See Abramowitz et al., 1992 or Hoza et al., 1992 for an example of such a study). Such studies are sorely needed given that the effects of combined treatment are interactive (Pelham & Murphy, 1986) and the use of high intensity treatment in either modality tends to minimize combined treatment effects (MTA Cooperative Group, 1999; Pelham et al., 2000).
- This study was conducted to address the limitations of existing studies, and it includes multiple intensities of single and combined behavioral and medication treatments, actively implemented. The results presented herein are the results from the academic classroom and extend the findings on the effectiveness of single and combined treatments for ADHD from earlier studies in this setting (Carlson et al., 1992; Chronis et al., in press; Kolko et al., 1999; Pelham et al., 1993). Companion papers present results on the treatment effects in the same sample in the STP/recreational setting (Pelham et al., 2003) and the home setting (Gnagy et al., 2003).

PARTICIPANTS AND SETTING

Participants: Forty-four boys and 4 girls between the ages of 5 and 12 entered the investigation. All participants were enrolled in the 2002 summer treatment program (STP) for children with ADHD conducted at the University at Buffalo. Participants were required to meet DSM-IV diagnostic criteria for ADHD, to have an estimated full-scale IQ of at least 80, and to have no documented adverse response or nonresponse to methylphenidate. Parents and children provided informed consent and the University at Buffalo Health Sciences IRB approved the protocol. The sample was 79% Caucasian and 21% African-American, Hispanic, Native American, or mixed race. Table 1 presents descriptive and diagnostic information on the sample.

One child's parents withdrew from the study after two days because of their concerns about possible side effects of the medication. A second boy's late-afternoon dose was reduced in the 0.6 mg/kg condition because of evening side effects. The remainder of the participants completed the study.

Setting: Each day as part of the nine-hour STP day, children attended an academic classroom for two hours (Pelham et al., in press; Pelham, Greiner, & Gnagy, 1997; Pelham & Hoza, 1996). The classroom was staffed by a classroom teacher and an aide who assisted the children with classroom activities and seatwork, corrected work, implemented the behavior modification procedures, and recorded all occurrences of classroom rule violations. During the classroom period, children worked on individual seatwork assignments in the areas of reading, math, and language arts for 30 minutes, peer tutoring activities in reading (Fuchs, Mathes, & Fuchs, 1993), and individualized computer assignments. This report contains information collected during the 30 minute seatwork period of the classroom.

PROCEDURES

Design: The current investigation consisted of two within-subjects factors: medication (placebo, 0.15 mg/kg MPH i.d., 0.3 mg/kg MPH i.d., and 0.6 mg/kg MPH i.d.) and behavior modification (no behavior modification, NBM; low-intensity behavior modification, LBM; and high-intensity behavior modification, HBM). Medication was randomly assigned within each child and varied daily on Monday-Fridays for the nine-week STP. Behavioral treatment was varied in three-week blocks with order of the three conditions randomized by group of children. Thus, each participant had 3-4 days in each medication X behavioral treatment condition.

MEASURES

Frequency of Classroom Rule Violations

Each day, the teacher and aide recorded the frequency of violations for classroom rules (Be respectful of others, Obey adults, Work quietly, use materials and possessions appropriately, Stay in your assigned seat or area, Raise your hand to speak or ask for help, Stay on task).

Academic Completion Measure

The percentage of seatwork completed each day was collected and recorded. Work was set at a level such that children completed approximately 50% of the total assigned work with at least 80% accuracy each day.

Table 1. Participant Characteristics

Participant Characteristics	Mean	SD
Item		
Age in years	9.35	1.97
Full Scale IQ	106.97	14.31
DSM-IV items endorsed		
Inattention	7.88	1.67
Hyperactivity/Impulsivity	6.96	2.50
Oppositional/Defiant	4.63	2.30
Conduct Disorder	1.40	1.53
Overall Impairment - Parent	4.89	1.11
Overall Impairment - Teacher	4.37	1.62

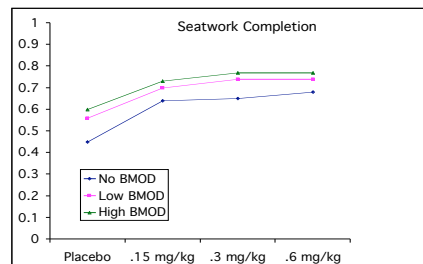
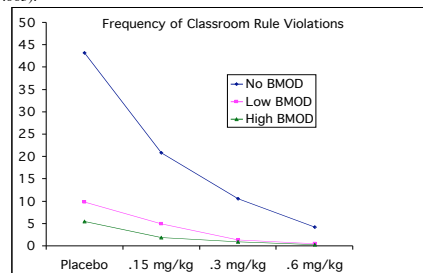
Table 2. Characteristics of BMOD Conditions

Behavior Modification Component	No BMOD	Low BMOD	High BMOD
Activity Rules	Do not review; give feedback after violation	Review; give feedback after violation	Review; give feedback after violation and cost points
Social Reinforcement	Give at a ratio of 1:3	Give at a ratio of 5:1	Give at a ratio of 5:1
Social Honors	None	Daily honor insignia	Daily honor insignia with privileges
Time out	None/suspension and send home procedure	Fixed time sitout with noncontingent release; suspension	Fixed time sitout with contingent release; suspension
Daily Report Card (DRC)	None	None	As needed
Individualized Behavioral Programs	None	None	As needed
Group Contingencies	None	None	As needed
Honor Roll	None	None	As needed
Classroom Specific Procedures	Contingent on board or behavioral feedback	Contingent on board or behavioral feedback	Contingent on board or behavioral feedback
Field Trips	Noncontingent	DRC	DRC + Points

RESULTS

• Means for frequencies of classroom rule violations and percent of seatwork completed are presented graphically in the figures below. To investigate the efficacy of the single and combined treatment effects in the classroom setting, a 3 (BMOD: No, Low, High) X 4 (Medication: Placebo, .15 mg/kg, .3 mg/kg, .6 mg/kg) repeated measures MANOVA was computed, using frequency of classroom rule violations and percentage of seatwork completed as dependent measures. Results indicated a main effect of BMOD $F(6, 172) = 6.66, p < .001$, a main effect of medication $F(18, 742) = 3.28, p < .001$.

• Univariate tests were significant for BMOD and medication for frequency of rule violations and seatwork completed ($p < .01$). Univariate tests were significant for rule violations in the BMOD X Medication interaction ($p < .005$).



Effect sizes for the single and combined treatment conditions were calculated by subtracting each treatment mean from the mean of the No BMOD/placebo condition and dividing by the standard deviation of the No BMOD/placebo condition (Cohen, 1990). Effect sizes are displayed in the table below.

Classroom rule violations effect size	No BMOD Low BMOD High BMOD		
	No BMOD	Low BMOD	High BMOD
Placebo	***	0.51	0.59
.15 mg/kg methylphenidate	0.37	0.62	0.66
.30 mg/kg methylphenidate	0.48	0.66	0.68
0.60 mg/kg methylphenidate	0.57	0.68	0.69

Classroom assignment completion effect size	No BMOD Low BMOD High BMOD		
	No BMOD	Low BMOD	High BMOD
Placebo	0.42	0.63	0.63
.15 mg/kg methylphenidate	0.79	1.08	1.21
.30 mg/kg methylphenidate	0.83	1.25	1.38
0.60 mg/kg methylphenidate	0.96	1.29	1.33

DISCUSSION

• The results of this study have important implications for public policy and treatment practices. Unlike other studies where the BMOD treatment was faded (e.g., MTA Cooperative Group, 1999), or the intensities of BMOD (e.g., Kolko et al., 1999) or stimulant medication (Pelham et al., 2000) were limited, this study is the first to investigate the effectiveness of varying intensities of BMOD and MED alone and in combination.

• The results of the single effects of each treatment and the combined treatment will be discussed in turn.

BMOD

• BMOD procedures resulted in substantial improvement in classroom rule violation frequency (ES = .51 and .59) for Low and High BMOD, respectively.

• Likewise, BMOD procedures resulted in substantial improvement in academic productivity (ES = .42 and .63 for Low and High BMOD).

• When the high BMOD was implemented, there was a little benefit of adding medication for improving classroom behavior.

• Importantly, the STP classroom procedures are not complex, and can be easily replicated in both regular and special education classrooms (e.g., Fabiano & Pelham, 2003; Pelham & Waschbusch, 2003), evidencing the ecological validity of the behavior modification procedures.

• These results also place other studies of BMOD in an appropriate context. In this study, the true effects of BMOD are observed, because a No BMOD condition was ensured. This is not possible in other studies of BMOD in natural environments (e.g., MTA Cooperative Group, 1999) because of the high rates of background BMOD present in classrooms (Fabiano et al., 2002) that minimize BMOD effects.

Medication

• Used alone, medication effects in the classroom were approximately linear for improving classroom rule violations. On the academic productivity measure, a low dose of stimulant medication resulted in an approximate increase of 20% more work completed (ES = .79). Increasing the dose of medication resulted in slight increases in productivity.

Combined Behavior Modification and Medication

• Low BMOD combined with a low dose of medication (.15 mg/kg) was equivalent to a high dose of medication or high behavior modification used alone.

• Most improvement in combined treatments occurred with the low doses of treatment, with increasing doses of either BMOD or medication resulting in modest improvement.

• To obtain the same effects of a low dose of medication (on average 10 mg per day) combined with a behavioral treatment, four times as much medication was required (on average 40 mg per day) if the medication was used alone.

Clinical Implications

• These results suggest that in contrast to prior reports and reviews (see Limitations of Combined Treatment Section), behavioral interventions and combined treatments are clearly efficacious and result in substantial effects in classroom department/academic productivity. These results suggest behavioral interventions should be a component of all classroom treatments for ADHD.

• Furthermore, the use of behavioral interventions eliminates the need for, or drastically reduces, the dose of stimulant medication needed to obtain behavioral improvement in the classroom.

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