Methylphenidate effects on children with Attention Deficit Hyperactivity Disorder: Self-report of symptoms, side-effects, and self-esteem

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Abstract:

Examined the effects of methylphenidate (MPH) on the self-report ratings of 24 children with Attention Deficit Hyperactivity Disorder (ADHD). Children provided ratings of ADHD symptoms, side-effects, and self-esteem in a double-blind, placebo-controlled evaluation of three MPH doses (.16 mg//g, .29 mg//g, .42 mg//g). Mothers and teachers completed ratings of ADHD symptoms and side-effects. Children reported significant improvements in ADHD symptoms with medication in an analogous fashion to parent and teacher ratings. Regardless of dose, children reported some side-effects to be more severe than did parents or teachers. Children reported marginally significant increases in side-effect severity with MPH vs. placebo whereas teachers reported significant reductions in the severity of side-effects with treatment. The low dose led to significant improvements in children's behavioral self-concept compared to placebo, although most children showed no overall change in self-concept. These results highlight the importance of children's perceptions of MPH treatment for research and clinical purposes.

Article:

Methylphenidate (MPH) is the most widely used treatment for children and adolescents with Attention Deficit Hyperactivity Disorder or ADHD (Barkley, 1990; Conners & Wells, 1986). The positive effects of MPH on attention and social behavior have been demonstrated through teacher ratings (e.g., Pelham & Hoza, 1987), parent report (e.g., Barkley, Fischer, Newby, & Breen, 1988), direct observation of classroom behavior (e.g., Rapport, DuPaul, Stoner, & Jones, 1986), and clinic-based tests of attention and impulse control (e.g., Douglas, Barr, O'Neill, & Britton, 1986). Very few investigations of MPH effects have included ratings completed by the children themselves presumably due to: (a) concerns about the reliability and validity of self-report data of ADHD symptoms obtained from this population (e.g., Landau, Milich, & Widiger, 1991); (b) low agreement between self-report and behavior ratings of ADHD symptoms completed by parents and teachers (e.g., Loeber, Green, Lahey, & Stouthamer-Loeber, 1991) and (c) the salience of overt behavior concerns associated with the disorder (Hoza, Pelham, Milich, Pillow, & McBride, 1993). Alternatively, a number of empirical studies (e.g., Edelbroc/, Costello, Dulcan, Conover, & Kalas, 1986; Herjanic & ReiCh, 1982) have suggested that children may be better reporters of internalizing symptoms than are parents and teachers. Given that some of the possible side-effects of MPH include private events (e.g., anxiety, physical symptoms), it may be important to incorporate self-report data in a comprehensive evaluation of medication effects.

Three previous studies have included self-report ratings of performance in determining MPH effects. Milich, Licht, Murphy, and Pelham (1989) had 26 boys with ADHD between the ages of 7 to 11 years old evaluate their performance on a continuous performance test (CPT) when receiving either placebo or .3 mg/kg MPH in a double-blind cross-over design. They found that there was a high correlation between self-evaluation and the quality of CPT performance when the boys were medicated but not when they were receiving placebo.

Whalen, Henker, Hinshaw, Heller, and Huber- Dressler (1991) found that self-evaluations of performance varied not only as a function of medication status but also with respect to whether children were told that they had received a placebo or active medication. In fact, boys who took placebo actually rated their computer task performance higher when they were told that they had received medication then when they were told that they had received a placebo.

Pelham and colleagues (1992) conducted two experiments that included self-reports of behavior and effort. In the first experiment, 28 boys with ADHD between the ages of 7 to 11 years old received a low (either .15 or .3 mg/kg) and high (.3 or .6 mg/kg) dose of MPH in a double-blind, placebo-controlled design. At the end of each day, children were asked to complete a brief rating scale regarding their behavior, effort, attributions for performance, mood, and the degree to which they liked themselves. When receiving MPH, boys gave themselves higher behavior and effort ratings than during the placebo days. No significant differences between doses were reported. An additional 38 boys with ADHD between the ages of 7 to 13 years old participated in the second experiment. A double-blind crossover design was used wherein subjects received either no pill, placebo, or .3 mg/kg MPH each day. As in the first experiment, boys were more likely to report that they tried hard, had a good day, followed rules better, had fewer time-outs, and were more compliant when receiving MPH than during placebo days.

The results of these investigations indicate that children with ADHD may reliably report behavior changes due to MPH treatment, although these reports may vary as a function of how they have been informed about their treatment status. Unfortunately, conclusions based on these results are limited by several factors including that: (a) subjects judged behavior change on a specific clinic task or at a global level only (e.g., good day vs. bad day); (b) children received both MPH and behavioral treatment contemporaneously; and (c) no between-dose analyses were reported. Importantly, no previous study has examined MPH effects on self-report of specific ADHD symptoms.

Self-report data also may be important in determining the side-effects of MPH treatment. Surprisingly, only one study has systematically examined the possible side- effects of MPH in the context of a double-blind, placebo- controlled evaluation. Barkley, McMurray, Edelbrock, and Robbins (1990) obtained parent and teacher ratings of side-effects for 83 children with ADHD between the ages of 5 to 13 years old. Children received placebo, .3 mg/kg, and .5 mg/kg MPH in a crossover design. Parents reported a significant increase in four of 17 side- effects (i.e., insomnia, decreased appetite, stomachaches, and headaches) as a function of one or both doses of MPH. Teachers rated side-effects to be highest during the placebo condition. No self-report ratings were obtained. Thus, there may be important differences between parents and teachers in the observations of side-effects and it is unknown whether self-report data would highlight additional side-effects beyond those reported by parents and teachers.

Self-report of medication effects may be important due to concerns that diminished self-esteem could be an emanative effect of MPH (Henker & Whalen, 1980; Whalen et al., 1991) and because lower than average self- esteem is a frequently encountered outcome for adolescents and adults with a childhood history of ADHD (e.g., Hechtman, Weiss, & Perlman, 1980; Slomkowski, Klein, & Mannuzza, 1995). Equivocal results have been obtained by two recent studies that have specifically examined the effects of MPH on self-esteem ratings. Pelham et al. (1992) found that boys treated with MPH reported liking themselves to a significantly greater degree when on medication than when receiving placebo. A trend toward the same findings was obtained with a separate sample of boys with ADHD treated with a low dose of MPH. Unfortunately, only a single item of self-esteem was included in these two experiments. Ialongo, Lopez, Horn, Pascoe, and Greenberg (1994) used a more comprehensive measure of self-esteem (i.e., the Self- Perception Profile for Children [SPPC]; Harter, 1985) in their study of MPH effects. A between-group design was used wherein 48 subjects with ADHD were randomly assigned to placebo, .4 $_{mg/kg}$,, or .8 mg/kg of stimulant medication. No significant pre-post changes over a 14- week period were obtained on any of the SPPC scales or for the Global Self-Worth score. These results were limited by the use of a between-group design thereby obscuring differences in self-esteem between placebo and active medication within individuals. Also, it is unclear how these results can be generalized to children treated with MPH as a variety of stimulants were used in this investigation.

The effects of MPH on self-report data obtained from children with ADHD are virtually unknown. First, no previous study has examined MPH effects on self-report of specific ADHD symptoms. Thus, it is unclear whether treated children represent a viable source of information about drug response. Second, the between-dose effects of MPH on self-report of side-effects have not been examined. There may be important differences among parents, teachers, and children regarding the presence or absence of medication side-effects. Finally, concerns have been raised about possible detrimental effects of MPH on self-esteem. Yet this phenomenon has not been examined using psychometrically sound measures of self- concept in the context of a crossover design.

The purpose of the present study was to examine the effects of three doses of MPH on the self-report ratings of a sample of children with ADHD. Three specific questions were posed: (a) Are children sensitive to changes in ADHD symptoms as a function of MPH? (b) Do ratings of side-effects vary across dose and across sources of information (i.e., children, parents, teachers)? and (c) What are the acute effects of different doses of MPH on self-esteem ratings? These questions were investigated in the context of a double-blind, placebo-controlled crossover design using multiple measures of drug response. Based on prior research, it was hypothesized that: (a) children would report significantly fewer symptoms of ADHD with MPH treatment, (b) side-effects would be reported to occur more frequently and to be more severe at the higher MPH doses, (c) parents would report more side-effects than teachers, and (d) MPH would have positive effects on children's self-esteem.

METHOD

Participants

Participants were 24 children (19 boys, 5 girls) between the ages of 9 and 15 years old (M == 11.09, SD = 1.7) who met the following criteria:

a) Parent and/or teacher referral to an outpatient ADHD clinic due to reported problems with inattention, impulsivity, and/or overactivity;
b) Parent interview (from Barkley, 1990) indicating that the child met DSM-III-R (American Psychiatric Association, 1987) criteria for ADHD;
c) Independent diagnosis of ADHD by psychologist and pediatrician using DSM-III-R criteria for ADHD;
d) Parent or teacher ratings on the Attention Problem scale of the Child Behavior Checklist (Achenbach, 1991 resulting in a T-score of 65 or greater (i.e., 1.5 SDs above the mean);
e) At least nine years old and able to read self-report questionnaires independently;
f) No evidence of mental retardation, gross sensory o motor disabilities, seizure disorder, autism, psychosis, tic disorders or Tourette's syndrome, or significant cardiac problems;
g) Not currently receiving psychotropic medication.

Children were primarily from lower middle class and middle class families. All were CauCasian. Five children received a diagnosis of Oppositional Defiant Disorder while an additional two subjects were diagnosed with Conduct Disorder. All parents of subjects signed a written informed consent statement agreeing to allow participation in this medication protocol.

Procedures

Children were consecutive referrals during the 1991-92 school year to a stimulant medication evaluation service jointly administered by the Psychiatry and Pediatrics departments of a university-affiliated hospital located in an urban setting in the northeastern U.S. Initially, each child was independently diagnosed as having ADHD by both a clinical or school psychologist and a pediatrician. A stimulant medication evaluation was recommended by both practitioners based on initial evaluation measures including parent interview, teacher and parent ratings, diagnostic interview with the child, and clinic analog observations of attention and behavior control. Approximately 40 percent of the patients seen for an initial evaluation were referred for a stimulant medication evaluation indicating that these children were exhibiting relatively severe symptoms of ADHD.

All children then participated in a double-blind, placebo-controlled crossover design in which each subject was assessed when receiving placebo, low dose (M = .16 mg/kg; SD = .08), moderate dose (M = .29 mg/kg; SD = .11), and high dose (M = .42 mg/kg; SD = .14) of MPH given twice daily at morning and noon. Medication was prescribed in 5-mg increments with the dose range determined by the age of the child. Children under the age of 12 years old received 5 mg, 10 mg, and 15 mg, while older participants were prescribed 10 mg, 15 mg, and 20 mg. MPH was dispensed in fixed doses as opposed to weight-adjusted doses given that body weight has not been found to be a significant correlate of stimulant effects (e.g., Rapport, DuPaul, & Kelly, 1989). Each medication condition lasted seven days with children being randomly assigned to one of six possible orders of MPH dosage wherein the high dose was never designated as the initial active medication condition. The medication was prepared by the hospital pharmacy in increments of 5 mg and packaged within opaque gelatin capsules. Unused capsules were returned to the clinic each week as a check on adherence to the medication schedule. No

participant was removed from the investigation due to noncompliance (i.e., more than one day of failure to administer medication as scheduled). The participants as well as their parents, teachers, and the research assistant in charge of collecting data were blind to the order of medication.

At the end of each dosage condition, participants met with the research assistant to complete a packet of self- report ratings. These questionnaires were completed independently by each participant; however, they were able to ask questions to clarify questionnaire directions or understanding of items. Parents and teachers also completed a packet of ratings at the end of each dosage week. Parent ratings were completed during each weekly clinic visit, while teacher ratings were mailed to the clinic on a weekly basis. The research assistant collected any unused medication and provided the following week's medication with instructions for administration at each weekly clinic visit.

Dependent Measures

Self-report ratings. Three questionnaires were completed by each participant during all phases of the study. First, subjects completed a rating scale consisting of the 14 DSM-III-R symptoms of ADHD.[1] Each symptom was listed as a separate item with the frequency of each symptom rated on a 0 (not at all) to 3 (very much) Likert scale. Items on this measure were the same as items on the ADHD Rating Scale (DuPaul, 1991) completed by parents and teachers, exCept that they were written in the first person (e.g., Difficulty paying attention to my work). Subjects were told to rate the frequency of each symptom over the previous week (i.e., since the beginning of the current medication condition). A total score was calculated as well as determination of the number of symptoms endorsed as occurring pretty much or very much of the time.

The second self-report questionnaire was the Piers- Harris Self-Concept Scale (Piers, 1984) which contains 80 items rated on a yes-no basis. The Piers-Harris yields a total score as well as scores for five subscales (Behavior, Intellectual Status, Physical Appearance, Anxiety, Popularity, and Happiness). T-scores were used in the present analyses. The Piers-Harris has been found to possess adequate levels of reliability and validity (Piers, 1984).

Subjects completed a questionnaire listing the 17 most common side-effects of MPH (Barkley, 1981; Barkley et al., 1990). The occurrence of each side-effect was rated on a Likert scale ranging from 0 (not a problem) to 9 (severe). The rating scale was labeled as a &dquo;Behavior Questionnaire&dquo; to disguise its intended use as a monitoring instrument for potential side-effects. This measure, when completed by parents and teachers, has been found to be sensitive to MPH effects (Barkley et al., 1990). Two scores were used in the present investigation : number of side-effects rated as present and the mean severity rating.

Parent ratings. Parents completed two questionnaires on a weekly basis. These included the ADHD Rating Scale (DuPaul, 1991) and a rating of potential medication side-effects (Barkley, 1981). The ADHD Rating Scale contains 14 items directly reflecting the DSMIII-R symptoms of ADHD. The frequency of each item was rated on a 0 (not at all) to 3 (very much) Likert scale. Two scores were derived from the ADHD Rating Scale: total score and the number of items rated as occurring pretty much or very much of the time. This rating scale has been found to have adequate levels of reliability and validity (DuPaul, 1991) and to be sensitive to MPH effects

(Barkley, DuPaul, & McMurray, 1991). The side-effects measure was identical to that completed by the children and reflected parent perceptions of the severity of 17 potential side-effects.

Teacher ratings. Teachers completed two questionnaires including the ADHD Rating Scale and a rating of potential medication side-effects. The ADHD Rating Scale was identical to the questionnaire completed by parents, as described above. The rating of potential side- effects was identical to those questionnaires completed by the children and parents.

RESULTS

MPH and respondent (Child, parent, teacher) effects on two sets of dependent measures (i.e., ratings of ADHD symptoms and possible side-effects) were examined. In

Table 1
Means and standard deviations of dependent measures by respondent

Measure	Dose MPH			
Self-Report	*Placebo*	*Low*	*Mod.*	*High*
ADHD RS Total	13.12[a] (9.59)	8.25[b] (8.06)	10.58[b] (7.25)	8.96[b] (7.76)
ADHD RS Symptoms	3.79[a] (3.70)	1.83[b] (2.85)	2.38[b] (2.70)	1.92[b] (2.70)
Piers-Harris Total	54.21 (11.47)	58.00 (11.22)	57.17 (12.30)	58.04 (12.57)
Piers-Harris Behavior	47.79[a] (11.21)	54.00[b] (11.09)	51.61 (11.17)	52.42 (12.89)
Piers-Harris Intell. Status	50.67 (10.23)	53.25 (10.58)	54.30 (10.43)	55.46 (10.40)
Piers-Harris Phys. App.	53.33 (11.02)	54.75 (10.27)	53.30 (12.02)	55.54 (10.18)
Piers-Harris Anxiety	53.29[a] (12.96)	59.25[c] (9.08)	56.78[c] (12.86)	57.04[c] (12.12)
Piers-Harris Popularity	48.33 (11.44)	51.00 (10.18)	48.04 (13.96)	49.79 (10.85)
Piers-Harris Happiness	54.25 (12.12)	55.96 (12.33)	53.65 (11.63)	55.25 (9.85)
Side-Effects: Number	6.08 (4.50)	5.42 (3.99)	7.00 (4.34)	6.12 (4.17)
Side-Effects: Mean Severity	2.70[a] (1.67)	3.75[c] (2.43)	3.45[c] (1.77)	3.44[c] (1.89)
Parent Report	*Placebo*	*Low*	*Mod.*	*High*
ADHD RS Total	21.00[a] (9.28)	19.42[d] (9.58)	16.58[d] (10.55)	15.75[d] (9.76)
ADHD RS Symptoms	7.12[a] (4.22)	6.17[ad] (3.98)	5.08[d] (4.64)	4.[bd] (4.23)
Side-Effects: Number	4.75 (3.00)	4.79 (3.49)	5.21 (2.86)	5.54 (2.77)
Side-Effects: Mean Severity	3.02 (2.00)	2.58 (1.87)	2.67 (1.84)	2.86 (1.68)
Teacher Report	*Placebo*	*Low*	*Mod.*	*High*
ADHD RS Total	23.00[a] (9.35)	19.46[d] (9.28)	19.04[d] (11.64)	15.17[d] (9.19)
ADHD RS Symptoms	7.71[a] (3.84)	6.25[ad] (4.49)	5.75[d] (4.61)	3.92[bd] (3.90)
Side-Effects: Number	4.08 (3.51)	4.46 (2.92)	4.38 (2.92)	4.17 (3.27)
Side-Effects: Mean Severity	3.58[a] (2.29)	2.96[d] (2.07)	2.97[d] (1.64)	2.17[d] (1.66)

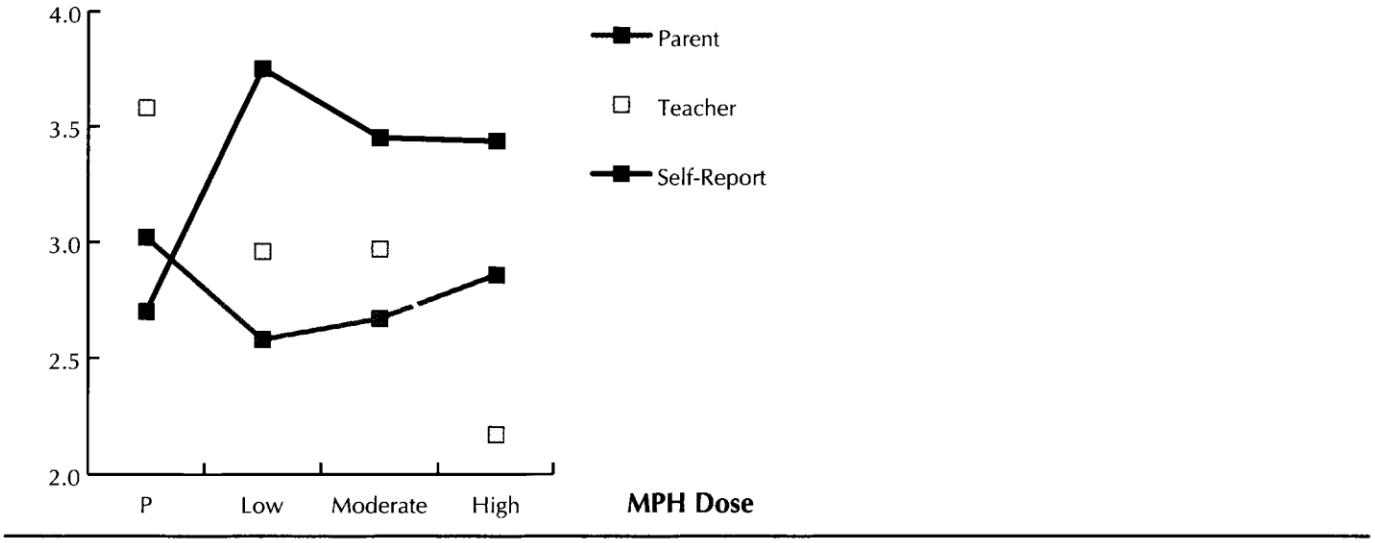
Note: MPH = methylphenidate. Mod. = Moderate. Standard deviations in parentheses.
ADHD RS Total = ADHD Rating Scale Total Score. ADHD RS Symptoms = ADHD Rating Scale Number of Significant Symptoms.
Piers-Harris Intell. Status = Piers-Harris Intellectual Status Scale. Piers-Harris Phys. App. = Piers Harris Physical Appearance Scale.
Values having different superscript letters differed significantly on post hoc comparison.
[b]$p<.05$; [c]$p<.10$; [d]$p<.01$.

addition, MPH-induced changes in self-esteem ratings were investigated. Means and standard deviations for all dependent measures by respondent group and MPH dose are presented in Table 1.

MPH and Respondent Effects on ADHD Ratings

Two separate 3 (Respondent) X 4 (MPH Dose) analyses of variance (ANOVA) with repeated measures across the latter factor were conducted. There was no significant interaction between Respondent and Dose. Significant main effects for Respondent ($F(2, 69) = 10.24$, $p < .001$) and MPH Dose ($F(3, 207) = 9.84$, $p < .001$) were obtained for Total Score on the ADHD Rating Scale. Post hoc Tukey comparison tests were conducted to examine specific between-respondent and between-dose differences. Self-report scores on the ADHD Rating Scale were significantly lower than either parent or teacher ratings ($p < .01$). All three active doses of MPH resulted in significantly lower scores (indicating improvement) on this

Figure 1
Mean severity of side-effects across three doses of methylphenidate (MPH) as rated by parents, teachers, and children (self-report)



measure relative to placebo ($p < .01$). Trend analyses indicated that the dose-response relationship was linear ($F(1, 207) = 26.84$, $p < .001$) with nonsignificant quadratic and cubic components.

A second 3 X 4 ANOVA was conducted for the number of significant symptoms (i.e., items scored as occurring &dquo;pretty much&dquo; or &dquo;very much&dquo; of the time) on the ADHD Rating Scale. As was the case for Total Score, significant main effects for Respondent ($F(2, 69) = 9.63$, $p < .001$) and MPH Dose ($F(3, 207) = 12.40$, $p < .001$) were obtained. Children reported significantly fewer ADHD symptoms than did parents or teachers ($p < .01$). All three aCtive doses of MPH significantly reduced the number of symptoms relative to placebo ($p < .01$). Further, the high dose was associated with fewer symptoms than the low dose ($p < .05$). The dose-response relationship was significantly linear ($F(1, 207) = 35.33$, $p < .001$) with nonsignificant quadratic and cubic components.

Although a significant Respondent X MPH Dose interaction was not obtained for either dependent measure, specific dose effects for children's self-report were examined given the interest in determining whether self-report of ADHD symptoms was sensitive to MPH treatment. An ANOVA with repeated measures across Dose was conducted for each ADHD Rating Scale score with significant effects on the number of symptoms ($F(3, 69) = 3.26$, $p < .05$) and marginally significant effects for Total Score ($F(3, 69) = 2.60$, $p < .10$) obtained. The three active MPH doses led to reductions in the Total Score relative to placebo ($p < .05$). The linear component of the dose- response relationship was significant ($F(1, 69) = 5.12$, $p < .01$) with both the quadratic and cubic components being nonsignificant.

MPH and Respondent Effects on Side-Effects

Two separate 3 (Respondent) X 4 (MPH Dose) ANOVA's with repeated measures across Dose were conducted for side-effects ratings. First, no significant main or interaction effects were obtained for the number of side-effects reported. A second 3 X 4 ANOVA revealed a significant interaction between Respondent and Dose for the mean severity of side-effects ratings ($F(6, 207) = 6.30$, $p < .01$). Thus, three separate ANOVA's with repeated measures across Dose were conducted for each of the Respondent groups. A significant Dose effect was obtained for the mean severity of teacher side-effects ratings ($F(3, 207)$ _= 4.17, $p < .01$). All three MPH doses led to significant reductions in mean severity ratings relative to placebo ($p < .01$) with the highest dose associated with the lowest severity compared to the low and moderate doses ($p < .01$). The linear component of the dose-response relationship was significant ($F(1, 207) = 10.50$, $p < .01$) with quadratic and cubic components being nonsignificant. Marginally significant differences were obtained for self-report of side-effect mean severity ($F(3, 207) = 2.47$, $p < .10$). Interestingly, mean severity ratings were higher for active MPH conditions relative to placebo (see Fig. 1), although mean differences were only marginally

Table 2
Mean severity ratings of 24 subjects for each of 17 side-effects as a function of methylphenidate dose and respondent

	Dose MPH			
Side-Effect	*Placebo*	*Low*	*Moderate*	*High*
Insomnia				
Self-Report	1.71 (2.53)	1.46 (2.00)	2.12 (2.52)	2.04 (2.60)
Parent	1.33 (2.26)	1.46 (2.59)	2.04 (2.27)	1.62 (2.58)
Teacher	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Stares/Daydreams				
Self-Report	2.00 (2.75)	1.96 (2.74)	2.26 (2.63)	0.92 (1.72)
Parent	0.96 (1.88)	1.21 (2.13)	0.54 (0.88)	1.21 (1.96)
Teacher	2.71 (3.22)	2.46 (2.67)	2.42 (2.50)	1.79 (2.19)
Decreased Appetite				
Self-Report	1.58 (2.78)	1.67 (2.74)	2.25 (2.97)	1.71 (2.88)
Parent	0.46 (1.53)	0.25 (0.74)	1.29 (2.20)	1.33 (2.55)
Teacher	0.00 (0.0)	0.26 (0.92)	0.00 (0.0)	0.27 (1.08)
Nightmares				
Self-Report	0.88a (1.96)	0.17b (0.38)	0.21b (0.51)	0.38b (1.24)
Parent	0.04 (0.20)	0.33 (0.76)	0.33 (1.01)	0.21 (0.72)
Teacher	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Talks Less				
Self-Report	1.00 (1.67)	0.83 (1.88)	1.42 (2.34)	1.12 (1.70)
Parent	0.12 (0.45)	0.87 (2.22)	0.21 (0.51)	0.79 (1.84)
Teacher	0.71 (1.68)	0.71 (1.78)	1.08 (1.77)	0.79 (1.62)
Disinterested				
Self-Report	0.83 (1.47)	0.96 (1.90)	1.46 (2.41)	0.67 (1.24)
Parent	0.21 (0.59)	0.38 (0.92)	0.08 (0.28)	0.62 (1.69)
Teacher	0.58 (1.28)	0.71 (1.68)	0.75 (1.51)	0.75 (1.36)
Irritable				
Self-Report	1.04 (1.71)	1.29 (2.29)	2.00 (2.52)	1.75 (2.56)
Parent	2.96 (2.80)	2.04 (2.27)	2.04 (2.48)	3.12 (2.79)
Teacher	1.75 (2.77)	1.62 (2.53)	1.75 (2.47)	0.92 (1.84)
Stomachaches				
Self-Report	1.12 (2.38)	1.09 (2.35)	1.42 (1.89)	0.87 (2.14)
Parent	0.46 (1.14)	0.42 (1.10)	1.04 (1.80)	0.79 (1.77)

(continued...)

significant. No significant Dose effect was obtained for parent ratings of mean severity ($F(3, 207) = 0.49$, N.S.).

In order to examine possible Respondent and/or MPH Dose effects on individual side-effects, a series of 3 X 4 VNOOV's with repeated measures across Dose were conducted for scores on each of the 17 items of the side- effects rating scale. Means and standard deviations for each item as a function of MPH Dose and Respondent are displayed in Table 2. Main effects for Dose were

obtained only for Bites Nails ($F (3, 204) = 2.88$, $p < .05$) and Tics/Nervous Movements ($F (3, 204) = 3.80$, $p < .05$). Ratings for Bites Nails were significantly lower for the Moderate relative to the Low Dose ($p < .05$). Tics/Nervous Movements were rated as less severe during the Moderate and High Dose conditions relative to placebo ($p < .05$). Interestingly, no significant increases in severity ratings as a function of MPH were found for any of the side-effects items.

Table 2 (cont'd)
Mean severity ratings of 24 subjects for each of 17 side-effects as a function of methylphenidate dose and respondent

	Dose MPH			
Side-Effect	*Placebo*	*Low*	*Moderate*	*High*
Headaches				
Self-Report	1.50 (2.36)	0.88 (2.25)	1.48 (2.57)	0.91 (2.33)
Parent	0.58 (1.14)	0.71 (1.65)	1.00 (1.62)	0.50 (1.38)
Teacher	0.62 (1.60)	0.48 (1.31)	0.83 (1.53)	0.48 (1.44)
Drowsiness				
Self-Report	1.79 (2.50)	1.91 (2.81)	2.29 (2.80)	1.96 (2.39)
Parent	0.58 (1.64)	0.29 (0.91)	0.17 (0.64)	0.25 (0.74)
Teacher	0.44 (1.24)	0.92 (1.72)	0.91 (1.95)	0.62 (1.38)
Sad/Unhappy				
Self-Report	0.74 (1.48)	0.71 (2.07)	0.70 (1.43)	0.88 (1.60)
Parent	1.58 (2.08)	1.29 (1.78)	1.00 (1.38)	1.42 (1.74)
Teacher	1.17 (0.83)	1.50 (2.21)	1.04 (1.55)	0.75 (1.98)
Prone to Crying				
Self-Report	0.35 (0.94)	0.46 (1.86)	0.67 (1.88)	0.58 (1.21)
Parent	1.58 (2.43)	0.54 (1.10)	1.29 (2.10)	1.42 (2.24)
Teacher	1.08 (2.67)	0.92 (2.43)	1.00 (2.30)	0.38 (0.82)
Anxious				
Self-Report	1.00 (1.95)	0.74 (1.63)	1.17 (2.01)	0.88 (1.65)
Parent	2.00 (2.43)	1.83 (2.32)	1.42 (1.95)	2.00 (2.32)
Teacher	1.79 (2.73)	1.96 (2.73)	1.50 (2.40)	1.04 (2.10)
Bites Nails				
Self-Report	1.62 (2.99)	1.67 (3.25)	1.12 (2.68)	1.04 (2.61)
Parent	1.04 (2.46)	1.00 (2.36)	0.62 (1.88)	0.83 (2.14)
Teacher	0.87 (2.03)	1.08 (2.39)	0.61 (1.78)	0.75 (2.00)
Euphoric/Unusually Happy				
Self-Report	3.04 (3.48)	3.50 (3.53)	3.79 (3.08)	4.08 (3.44)
Parent	0.67 (1.61)	0.62 (1.74)	1.00 (1.98)	0.54 (1.38)
Teacher	0.39 (1.50)	0.26 (0.75)	0.22 (0.60)	0.25 (0.68)
Dizziness				
Self-Report	0.88 (1.85)	0.54 (1.44)	0.88 (2.17)	0.71 (2.03)
Parent	0.12 (0.61)	0.08 (0.41)	0.17 (0.64)	0.04 (0.20)
Teacher	0.17 (0.83)	0.17 (0.49)	0.00 (0.00)	0.17 (0.58)
Tics/Nervous Movements				
Self-Report	1.04 (2.24)	0.88 (2.15)	0.62 (1.81)	0.50 (1.28)
Parent	0.75 (2.40)	0.58 (1.91)	0.12 (0.45)	0.00 (0.00)
Teacher	1.33 (2.91)	0.83 (1.83)	0.78 (1.95)	0.52 (1.47)

Note: MPH = methylphenidate. Standard deviations are in parentheses. Values with different superscript letters were significantly different based on post hoc comparisons.
[b] $p<.01$.

Significant main effects for Respondent were obtained for six items including: Insomnia ($F(2, 67) == 9.15$, $p < .001$), Stares/Daydreams ($F(2, 67) == 3.22$, $p < .05$), Appetite ($F(2, 67) = 7.42$, $p < .01$), Drowsiness ($F(2, 66) = 7.83$, $p < .01$), Euphoric/Unusually Happy ($F(2, 67) == 35.90$, $p < .001$), and Dizziness ($F(2, 68) == 3.53$, $p < .05$). More specifically, self-report ratings were significantly greater than teacher ratings for Insomnia ($p < .01$), Appetite ($p < .01$), Drowsiness ($p < .05$), and Euphoric/Unusually Happy ($p < .01$). Self-report ratings were also higher than parent ratings for Drowsiness ($p < .01$), Euphoric/Unusually Happy ($p < .01$), and Dizziness ($p < .05$). Parent ratings were significantly greater than teacher ratings for Insomnia ($p < .01$) while teacher ratings were higher than parent ratings for Stares/ Daydreams ($p < .05$).

The only significant Respondent X MPH Dose interaction was obtained for Nightmares ($F(6, 204) = 2.41$, $p < .05$) with subsequent analyses revealing a significant Dose effect for self-report only ($F(3, 204) = 4.53$, $p < .01$). Specifically, lower self-report ratings of Nightmares were obtained for the three MPH doses relative to placebo ($p < .01$). No significant effects of Dose were found for either parent or teacher ratings of this item.

Although significant increases in side-effects as a function of MPH were not obtained at the group level of analysis, it is important to consider the number of individual children who were reported to experience side- effects at each dose. The proportion of the sample who received a rating of “1” or greater on each side-effect item was calculated as a function of Dose and Respondent. Chi-square analyses of changes in proportions as a function of Dose within each Respondent group were all nonsignificant ($p > .05$).

MPH Effects on Self-Esteem Ratings

A series of one-way ANOVA's with repeated measures across MPH Dose were conducted for the Total Score and each of the six subscales of the Piers-Harris. A significant MPH effect was obtained for the Behavior subscale ($F(3, 66) = 4.05$, $p < .05$). The Low dose of MPH led to significant increases in the Behavior T-score (i.e., indicating improvement) relative to placebo ($p < .05$). No further between-dose differences were obtained. The linear ($F(1, 66) = 4.02$, $p < .05$) and quadratic ($F(1, 66) = 4.71$, $p < .05$) components of the dose-response relationship were both found to be significant, while the cubic component was not. A marginally significant MPH Dose effect was obtained for the Anxiety subscale ($F(3, 66) = 2.45$, $p < .10$) with higher scores (indicating less anxiety) evident for the three MPH conditions. No other significant effects for Dose were obtained.

A final set of analyses was conducted to examine whether some individual subjects evidenced lower (or higher) self-esteem in association with MPH treatment. First, reliable change indices (RCI; Jacobsen & Truax, 1991) were calculated across Dose for the Piers-Harris Total Score and each subscale. Specifically, each individual's placebo score was subtracted from his or her score at each MPH dose with the result divided by the standard error of the difference. Next, each score was Categorized as representing significant improvement ($RC1 > 1.96$), significant deterioration ($RCI < -1.96$), and no change ($-1.96 < RCI < 1.96$). In general, most children reported no change in self-esteem for all Piers-Harris scores across all three doses. A few children showed improvement in self-esteem as a function of MPH with only one or two participants evidencing deterioration in self-esteem ratings with treatment. To illustrate the general pattern of results, the percentage of subjects who were categorized as evidencing significant

improvement, significant deterioration, or no change on the Piers-Harris total score as a function of dose is displayed in Figure 2.

DISCUSSION

The present investigation provided several findings illuminating the effects of MPH on self-report ratings of children with ADHD. First, although children reported significantly fewer symptoms of ADHD than did their parents or teachers, self-report ratings were sensitive to medication effects. In fact, MPH led to a decrease in the number of ADHD symptoms in a similar fashion regardless of respondent. Second, there were significant differences among respondents regarding the mean severity of side- effects as a function of medication. Teachers reported that side-effects were less severe during active medication conditions than during placebo.

Conversely, there was a trend for children to report side-effects that were more severe when receiving MPH than placebo. No significant findings were obtained with respect to parent ratings of side-effects. Further, regardless of MPH dose, children reported five of the 17 side-effects to be more severe than did parents or teachers. Finally, the low dose of MPH led to significant improvements in children's behavioral self- concept relative to placebo, with a similar trend for self- report of anxiety. Interestingly, the low dose was reported by children to be optimal in terms of their behavioral self-concept and reduction of ADHD symptoms (see

Figure 2
Number of participants whose Piers-Harris Total Scores worsened, improved, or did not change as a function of three doses of methylphenidate (MPH)

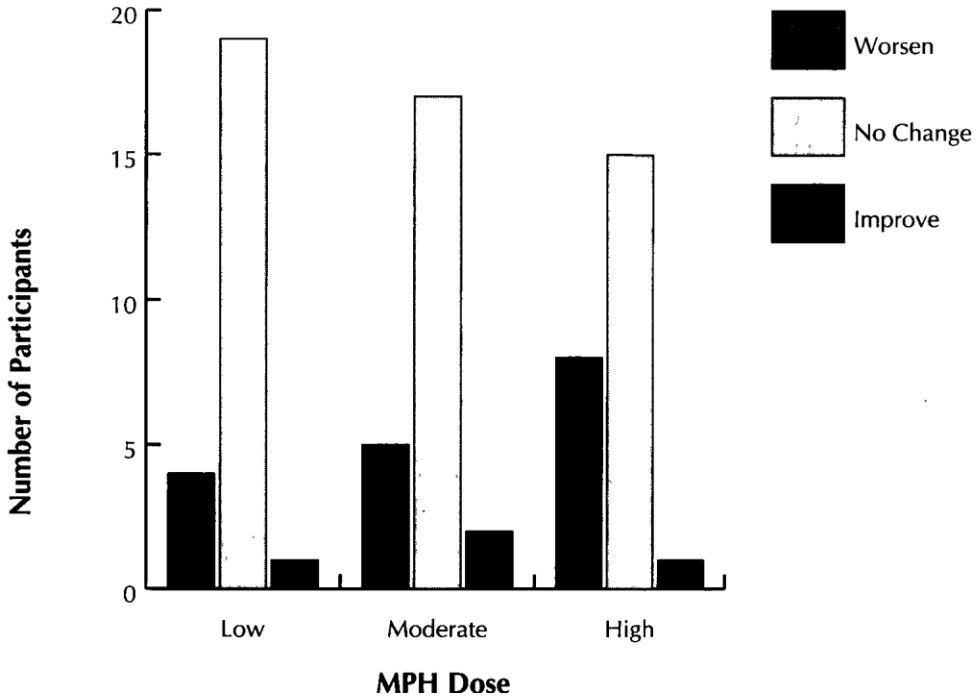


Table 1). Overall, however, most children reported no significant acute change in self-esteem at any dose with some reporting improvement and only one or two children indicating deterioration in self-concept.

Several previous studies have found that children with ADHD can reliably report changes in their performance as a function of medication treatment. For example, in two separate experiments Conducted by Pelham et al. (1992), children's ratings of behavior and effort were improved by MPH relative to placebo. No between-dose differences were evident. The results of the present study are consistent with these findings as children reported significantly fewer symptoms of ADHD during MPH vs. placebo conditions. Although the linear component of the dose-response relationship was significant, no significant between-dose differences in self-report ratings were obtained. Further, the findings of the present investigation go beyond those obtained in prior studies by showing that: (a) children with ADHD can reliably report MPH-induced changes in symptoms of the disorder not just in global ratings of behavior and effort, and (b) the relationship between dose and report of symptoms is similar to that found for parent and teacher ratings. Thus, even though children report fewer overall symptoms of ADHD than do parents and teachers, self-report data show the same relative change with treatment as do parent and teacher ratings.

This is the first study to systematically examine differences in the report of medication side-effects across parents, teachers, and children. Similar to the results of Barkley et al. (1990), teachers reported the most severe side-effects to occur during placebo conditions. Given that most teachers are unable to observe children when the most prominent side-effects are likely to occur (i.e., during mealtimes and at night), this may not be a surprising result. Further, it may be that reductions in ADHD symptoms (which typically are most prominent during the school day) associated with MPH may result in a positive halo that influences teacher side-effects ratings.

The consistency of this finding across studies implies that one should not rely exclusively on teacher report when evaluating possible side-effects. Contrary to Barkley et al.'s (1990) results, parents in the present study did not report any change in the number or severity of side-effects as a function of MPH. Because the dose ranges employed in the two studies were relatively similar, the differences in findings are most likely due to the smaller sample size employed in this investigation relative to the Barkley et al. study, thus limiting power to detect between-dose differences. Nevertheless, the lack of significant findings for parent report is indicative of the heterogeneity of response to MPH across children (i.e., the experience of side-effects is not a universal phenomenon).

In contrast to teacher ratings of side-effects, there was a trend for children to report more severe side-effects with MPH than during placebo conditions. Further, regardless of experimental condition, children reported more severe side-effects for five items relative to parent and teacher report. These side-effects included insomnia, appetite reduction, drowsiness, euphoria, and dizziness.

In the case of at least three of these items (i.e., drowsiness, euphoria, and dizziness), these may represent feeling states that are not directly observable by parents and teachers. In addition, as noted above, teachers are not typically in position to evaluate insomnia or appetite reduction in students. It is important to point out that these differences between respondents in the report of individual side-effects were obtained as a main effect across both placebo and MPH conditions. As such, these findings could reflect general feelings of discomfort and irritability that may be

associated with ADHD rather than medication-induced side-effects. Taken together, the differences in side-effect reports across respondents indicates the importance of obtaining side-effect data not only from parents and teachers but children as well. In particular, children may be more reliable reporters of MPH-induced changes in subjective feeling states than are parents and teachers; although this conclusion must be corroborated with further study employing a larger sample and a wider dose range.

Only two previous investigations have examined stimulant medication effects on the self-esteem of children with ADHD. Pelham et al. (1992) found an increase in self-liking scores associated with MPH vs. placebo, while Ialongo et al. (1994) found no differences in self- concept ratings after 14 weeks of medication. The present results are consistent with Pelham et al.'s findings in that children's behavioral conduct scores on the Piers- Harris were improved relative to placebo during the low dose condition. Alternatively, the present findings are also consistent with Ialongo et al.'s results as the high dose in our study (.4 mg/kg) corresponded to the low dose in their study. In both cases, this dose of stimulant medication did not lead to reliable changes in self-esteem ratings. It is difficult, however, to comparecompare findings with the Ialongo et al. study given that the latter utilized a between-group design, a variety of stimulant medications, and evaluated changes in self-esteem over a much longer time period. Perhaps the acute improvements in self-esteem found by our study and Pelham et al. (1992) are short-lived phenomena that dissipate with time. At the very least, it is reasonable to conclude based on these three studies that MPH exerts very little effect on self- esteem with reliable improvement or deterioration occurring in only a few cases.

Conclusions based on the present findings are limited by several factors. First, the sample size may have diminished the power to detect MPH effects on key variables, especially analyses of side-effects ratings. Second, the mean of the high dose condition (i.e., .42 mg/kg) is more representative of a mild to moderate dose of MPH, thereby tempering the generality of these results to the higher range of doses prescribed in typical practice (i.e., up to .7 mg/kg). In particular, the use of a lower dose range may have attenuated findings with respect to the presence and severity of side-effects. Third, although minimal acute effects of MPH on self-esteem were obtained, it is possible that more significant changes (either deterioration or improvement) in self-concept could occur with longer-term pharmacotherapy. A single week at each dose may not be sufficient to elicit significant alterations in self-esteem. In a related manner, the sensitivity of self-concept ratings to MPH treatment may have been reduced by the response (Yes-No) format and the psychometric limitations of the Piers-Harris. It is possible that more significant findings would have occurred if a three-point or five-point Likert scale was employed. Fourth, it is unclear whether differences between children and adults in the report of ADHD symptoms is representative of a positive illusory style by the children or due to a differentially strong placebo effeCt operating on children's ratings. Unfortunately, baseline (off medication) ratings of ADHD symptoms were not available; thus, precluding investigation of this question. Finally, the obtained results are generalizable only to children with ADHD between nine and 15 years of age. The reliability and validity of self-report data from children younger than nine are unknown.

Despite these limitations, the results of this investigation indicate that children's self-report is useful to obtain in the context of evaluating the effects of stimulant medication. In fact, this is the

first study to clearly demonstrate that children with ADHD report significant reductions in ADHD symptoms as a function of MPH in a fashion similar to parents and teachers. In addition, conclusions about the severity of side-effects can be affected by who is asked to report them. At least within the moderate dose range employed in this study, children were more likely to report side-effects than were parents and teachers. Thus, it is imperative that clinicians ask all three respondents about side-effects rather than relying on a single source of information (i.e., parents) which is the more typical practice. At the group level, MPH had minimal effect on self-esteem ratings; however, there were a few individuals who reported significant deterioration in self-concept with treatment. Thus, it would be prudent to monitor children's feelings about themselves during the dosage titration process and to investigate instances of significant decreases in these feelings attendant to changes in dosage. More definitive conclusions about the value of children's self-report for evaluating medication effects would be possible by conducting investigations employing larger samples, longer-term assessment, and a wider dose range than was used in the present study. Given the popularity and effectiveness of MPH in the treatment of children with ADHD, it is imperative that children's perceptions of medication effects be studied more extensively.

NOTES

1. A copy of the self-report questionnaire is available from the first author upon request.

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