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Methylphenidate and Baseball Playing in ADHD Children: Who's On First?

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The effects of 0.3 and 0.6 mg/kg methylphenidate were analyzed in a double-blind, placebo-controlled, cross-over study in which 17 boys (ages 7.8–9.9 years) with attention deficit hyperactivity disorder (ADHD) played in baseball games. Drug effects were evaluated on children's attention during the game, as indicated by their on-task behavior on the field and their ability to answer questions about the status of the game at all times. Judgment during batting, batting skill during the game, and performance on skill drills prior to the game were also assessed as a function of medication. Results revealed that methylphenidate had a beneficial effect on attending during the game.

One of the major areas of deficit for children with attention deficit hyperactivity disorder (ADHD) is peer relationships. ADHD children are impulsive, inattentive, intrusive, bossy, aggressive, and disruptive around peers, and these behaviors elicit extreme ratings of dislike from peers (Pelham & Bender, 1982). Unfortunately, evidence for the efficacy of psychosocial treatments for peer problems in this population is weak (Krehbiel & Milich, 1986). In recent studies researchers have focused on whether psychostimulant drugs, the most common form of intervention for ADHD children, have beneficial effects on these children's peer relations, and these researchers have reported mixed results. One possible explanation for these discrepant findings is that researchers who have examined dyadic interactions have generally reported few drug effects (e.g., Cunningham, Siegel, & Offord, 1985), whereas researchers studying ADHD children in group settings have often reported beneficial effects of medication (e.g., Hinshaw, Henker, Whalen, Erhardt, & Dunnington, 1989; Pelham & Hoza, 1987).

In existing studies of social relationships in ADHD children, researchers have examined directly observed or reported antisocial and prosocial behaviors thought to be important components of peer relationships. An additional potentially important but, to date, unstudied component of peer relationships is a child's performance in group recreational activities, such as baseball, that are likely to occur after school or during recess. Children spend a great deal of time in these activities, and the activities are likely an important setting for social development in childhood. Although no researchers have compared the behavior and performance of ADHD and normal children in such activities, parents and therapists of these children provide numerous anecdotes of their children's dismal failure in organized sports activities. Perhaps nothing can ruin an ADHD boy's reputation among his playmates more quickly than when he is playing first base in a closely contested game and is not paying attention and therefore misses the ball thrown or hit to him. It has been our observation that peers respond extremely negatively to such mistakes. These difficulties in organized recreational activities go beyond what has typically been studied in ADHD children's peer relationships, and they may be important contributors both to the negative peer relationships that characterize ADHD children and to the children's self-esteem.

To our knowledge there are no studies in which researchers have evaluated the effects of psychostimulant medication on ADHD children's functioning in such activities. Nevertheless, clinicians, researchers, and private practitioners have recommended afternoon and weekend medication for ADHD children with the specific purpose of improving functioning in these kinds of activities. Many parents similarly appear to be following this dosing regimen even in the absence of professional recommendations. In our study we determined whether this increasingly common practice has empirical justification.

Method

Seventeen ADHD boys, 15 White and 2 Black, ranging in age from 7.8 to 9.9 years (M = 8.3), were the subjects in the study. All had received diagnoses of ADHD on the basis of structured interviews, standardized rating scales, and observations of the children during the 8 weeks of the 1987 Summer Treatment Program (STP) at Western Psychiatric Institute and Clinic. The structured interview was that employed in the *Diagnostic and Statistical Manual of Mental Disorders*

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(*DSM–III–R;* American Psychiatric Association, 1987) field trials for disruptive behavior disorders. No reliability data were gathered on the diagnoses. In addition, 10 of the children also reached *DSM–III–R* diagnostic criteria for conduct disorder, and an additional 6 reached criteria for oppositional-defiant disorder. The boys' mean Wechsler Intelligence Scale for Children–Revised (WISC-R) Full Scale IQ was 99.7 (SD = 13.1). The mean scores on the IOWA Conners Teacher Rating Scale (Pelham, Milich, Murphy, & Murphy, 1989) inattention/overactivity and aggression factors were 9.7 (SD = 4.0) and 7.8 (SD = 5.0), respectively.

Overview

The boys in our study were participating in double-blind, placebo-controlled, within-subject, clinical assessments of the effects of methylphenidate, which have been described elsewhere (see Pelham & Hoza, 1987). The study, which was also double-blind, was conducted over 4 consecutive days during the final week of the STP. Two groups of children played a series of four softball games, and measures of response to medication were taken during these games. The 1st day was a practice day. On the following 3 days, children received in random order (with the restriction that as near as possible an equal number of children received each dose on each day) placebo b.i.d., 0.3 mg/kg methylphenidate b.i.d. and 0.6 mg/kg methylphenidate b.i.d. (One obese subject received 0.15 and 0.3 mg/kg methylphenidate.) Skill drills began approximately 45 min following the morning pill ingestion, and the games followed approximately 30 to 45 min later and lasted 40, 40, and 50 min for the 3 study days.

Skill Drills

Prior to the baseball game on each of the 3 study days, the boys went through a rotation of three skill stations—batting, grounders and throwing, and fly balls—similar to the procedures routinely employed during tryouts for Little League baseball. At the batting station, each child batted until he had received five good pitches, the dependent measure being the proportion of pitches that were hit in fair territory. At the grounder station, the proportion of five ground balls fielded successfully was the dependent variable. Each boy was also required to throw five balls to a first baseman, a successful throw being one that the first baseman could catch in the air without removing his foot from the bag. At the fly ball station, each boy was thrown five pop flies, the dependent variable being the proportion of balls successfully caught. Because the skill drill measures involved objective assessments (e.g., the child either did or did not hit the ball in fair territory), no interrater reliability data were collected. However, correlations between the results for the placebo and low-dose days revealed significant retest reliabilities (dfs = 15) for the fielding (r = .52, $p < .05$), throwing (r = .65, $p < .01$), and fly ball (r = .84, $p < .01$) measures, and a trend for batting ($r = .33$, $p < .10$).

After completion of the rotation through the three skill stations, the two groups of boys began the softball game. The children were divided into two teams according to their membership in one of two age-based treatment groups (mean ages of the two groups were 8.6 and 9.3 years), so that team membership remained constant across the 3 days. Within each team, a randomized batting order and field position roster were employed, changing across days. One staff member served as umpire and another as pitcher for both teams. During the game, several sets of dependent measures were collected.

Batting During the Game

Two dependent variables were collected during each child's time at bat: batting skill and batting judgment. *Batting skill* was the percentage of times at bat the boy hit a ball in fair territory, divided by his total number of times at bat. *Batting judgment* referred to the degree to which the boy swung at appropriate pitches and was defined as the number of pitches in the strike zone swung at (regardless of whether the pitch was hit) plus the number of pitches out of the strike zone not swung at, divided by the total number of pitches received. Two raters independently viewed a videotape of the batters on the 2nd day of the study to provide an estimate of reliability for the batting judgment dependent measure; the resulting percentage agreement was 78%, and the kappa was .52.

Fielder in "Ready" Position

In their softball games prior to the study, the children had been taught to assume a readiness posture in the field when the pitch was delivered. The ready position was one commonly used in children's organized baseball activities. For purposes of the study, the following ready criteria were used: (a) knees and hips partially bent, (b) one or both hands resting on the ipsilateral knee(s), (c) subject's visual/facial orientation toward the batter, and (d) position maintained from pitch delivery until the ball reached the plate. Three staff members observed the subjects in the field and recorded at a prearranged signal (i.e., the windup) on each pitch whether they assumed the ready position, each observer being assigned one third of the subjects. A fourth staff member constantly rotated among the primary observers to check reliability. The ready position was assessed for every child on every pitch, reliability being assessed for one third of the subjects on every check. Reliability was checked for 161, 237, and 291 ready position assessments on the 3 days, producing kappas of .68, .80, and .84, respectively. Finally, before every third pitch the pitcher yelled, "Everybody ready?" and scanned the fielding team, thus providing prompted and nonprompted conditions for attending to the pitch.

Game Awareness

Two staff members, each assigned to one team, approached the boys in rotating sequence to ask questions regarding the status of the game (game awareness measures). After each pitch except that of the final out of an inning, each questioner asked one child one of the following questions, which were prearranged in rotating sequence: (a) How many outs are there? (b) How many balls are there? (c) How many strikes are there? (d) How many runs does our team have? (e) How many runs does the other team have? or (f) Who do you bat after? Ample opportunity to know this information was provided by the umpire, who called out the count after the third pitch to a batter, the number of outs after each out, and the score after every score change and between inning halves. The dependent measure was the proportion of questions asked that each child answered correctly. Given the objective nature of this measure, no reliability data were collected.

In summary, the eight dependent variables consisted of (a) performance in daily skill drills conducted immediately prior to the game (batting, catching flies, fielding, throwing); (b) response to comprehension questions designed to tap awareness of the game; (c) on-task behavior during fielding (i.e., in ready position); and (d) performance at bat (skill and judgment).

Results and Discussion

One-way, repeated measures, multivariate analyses of variance (MANOVAs) revealed no significant effects of methylphenidate on children's performance in the skill drill assessments, $F(8, 58) < 1$. Methylphenidate apparently did not exert an effect on ADHD children's baseball skills when the children's attention was prompted in a skill drill. A one-way, repeated measures MANOVA for the two variables of batting skill during the game

and batting judgment was nonsignificant, $F(4, 62) < 1$. The mean percentages of hits per times at bat were 78%, 78%, and 81%, on placebo, low, and high doses, respectively. Similarly, there was no effect of methylphenidate on batting judgment during the game ($F < 1$), with mean percentages of good judgment being 60% on placebo, 66% on the low dose, and 60% on the high dose of the drug.

A one-way, repeated measures MANOVA for the two measures of attention, ready position and game awareness, showed significant effects of methylphenidate, $F(4, 62) = 5.78$, $p < .001$. The univariate analysis of variance (ANOVA) for ready position was also significant, $F(2, 15) = 9.21$, $p < .0025$. Because the effect of prompt was nonsignificant ($F < 1$), with virtually identical means in prompted and unprompted conditions, the data were collapsed over prompt condition when the effect of drug was analyzed. The proportion of pitches on which children in the field were in the ready position (that is, on task) increased from .26 ($SD = .28$) on the placebo day to .53 ($SD = .31$) and .61 ($SD = .29$) on 0.3- and 0.6-mg/kg days, respectively. Post hoc comparisons showed that both 0.3- and 0.6-mg/kg doses were superior to placebo ($p < .01$ and $p < .001$, respectively). Corresponding means for the game awareness questions were .57 ($SD = .23$), .70 ($SD = .17$), and .68 ($SD = .25$), although the univariate ANOVA for the game awareness questions was not significant, $F(2, 15) = 1.78$, $p < .20$. On an anecdotal level, the play-by-play announcer recorded whenever he noticed a fielder throwing or kicking his glove when he should have been attending to the batter. Of the 48 times this was noted across the study, 69% of the occurrences were on placebo days, even though these accounted for only 33% of the study days.

These boys showed medication-related improvement on a measure of attention to task in a baseball game. They were on task (i.e., in the ready position) more than twice as often when medicated as opposed to the placebo day. ADHD boys' inattention in group recreational activities costs them in terms of their relationships with other children: They make errors due to inattention that result in poor performance and social ostracism. To the extent that medication improves their attention and therefore performance in organized sports, our results imply that it may be as helpful for an ADHD child to be medicated during organized sports activities after school and on weekends as it is for him to be medicated during school.

Although methylphenidate improved the ADHD children's attention during the games, it did not affect their actual performance or skills. However, even this limited improvement may be valuable in reducing the social ostracism experienced by these children. Peers may be willing to forgive a child who tries but fails as a result of poor ability, because ability is a stable attribute over which he or she does not exert much control. However, the peers may be likely to be much less forgiving of the child who is facing the wrong way and *apparently* not trying, because effort is seen as an attribute over which the child can exert control.

Although the results of this study suggest that medication may be helpful during organized sports activities, the risks of after-school and weekend medication must be assessed against the benefits it may provide. Because it is clear that the total cumulative dose of methylphenidate determines the degree of growth retardation in medicated ADHD children (Mattes & Gittelman, 1983), care should be exercised to limit nonschool medication to times when organized sports activities occur. Alternatively, one of the long-acting stimulants might provide adequate coverage after school (e.g., Pelham et al., in press). Given the individual differences common in response to stimulants, the applicability of these results to individual children must be assessed (Pelham & Hoza, 1987).

The majority of the medication effect was accounted for by the 0.3-mg/kg dose, a finding somewhat inconsistent with recent studies showing linear effects through 0.6 mg/kg (e.g., Hinshaw et al., 1989). However, no other researchers have assessed drug effects on the kinds of dependent measures that we employed in a recreational setting. Perhaps factors in the more structured environments of typical drug studies interact with medication to produce effects through a wider dose range than is the case in relatively unstructured environments such as that of a fielder in a baseball game.

Several limitations to these findings need to be noted. First, the sample size was relatively small and consisted entirely of ADHD boys referred to a day treatment program. The results need to be replicated with samples drawn from other sources and need to include naturally occurring groups of children. Second, given the structured and relatively slow-paced nature of baseball, it cannot be assumed that the positive results will generalize to other types of recreational activities. Finally, it is not known whether the results would generalize to ADHD children who did not receive extensive training in assuming the ready position.

Because medication did not improve children's baseball *skills,* nonpharmacological means of improving ADHD children's performance during sports activities clearly need to be used in conjunction with medication. As a result of our observations during this study, we have modified the treatment in our summer program to include a relatively greater emphasis on teaching sports skills and sports knowledge to our ADHD children. Good, systematic, and intensive coaching and a great deal of practice may yield improvement in ADHD children's sports performance comparable with or complementary to improvement induced by medication.

Finally, several directions for future research are suggested by these results. Direct assessment of the relation between ADHD children's peer relationships and their performance in group sports activities may help provide ideas for development of efficacious social skills training programs. The interaction between medication and instructional and coaching techniques needs to be explored, because these interactions appear to be important in explaining medication effects on other areas of ADHD children's functioning and might well be influential in this domain. In addition, studies are needed in other areas in which the drugs have typically not been evaluated. Stimulants might affect sports other than baseball differently, and other activities in which ADHD children typically engage—bike riding, for example—need to be investigated. ADHD children's lives extend beyond the classroom and laboratory, and further investigation of medication effects in heretofore unexplored recreational activities is recommended.

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