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A BEHAVIORAL-EDUCATIONAL ALTERNATIVE TO DRUG CONTROL OF HYPERACTIVE CHILDREN

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A behavioral procedure for controlling hyperactivity without inhibiting academic performance is described. Using a time-sample observational method, the hyperactivity displayed by three school children was recorded during math and reading classes. Concurrently, math and reading performances were measured. The study consisted of two baselines, one while the children were on medication and the second while they were off medication. A multiple-baseline design across the two academic subject matters was used to assess the behavioral intervention, which consisted of token reinforcement for correct academic responses in math and subsequently math and reading. Discontinuation of medication resulted in a gross increase in hyperactivity from 20% to about 80%, and a slight increase in math and reading performance. Introduction of a behavioral program for academic performance, during no medication, controlled the children's hyperactivity at a level comparable to that when they were on drugs (about 20%). At the same time, math and reading performance for the group jumped from about 12% during baseline to a level of over 85% correct. Each child performed behaviorally and academically in an optimal manner without medication. Contingency management techniques provided a feasible alternative to medication for controlling hyperactivity in the classroom while enabling the children to grow academically.

DESCRIPTORS: drug therapy, hyperactivity, classroom behavior, academic behavior, emotionally disturbed, multiple baseline, token economy

Hyperactivity or hyperkinesis in the classroom is a clinical condition characterized by excessive movement, unpredictable behaviors, unawareness of consequences, inability to focus on and concentrate on a particular task, and poor academic performance (Stewart, Pitts, Craig, and Dieruf, 1966). It is estimated that about 200,000 children in the United States are currently receiving amphetamines to control their hyperactivity (Krippner, Silverman, Cavallo, and Healy, 1973).

Drugs such as methylphenidate (Ritalin) and chlorpromazine have been shown to control hyperactivity in the laboratory and applied settings. The evidence from the laboratory is based on recording devices actuated by the child's movements (Hollis and St. Omer, 1972; Sprague, Barnes, and Werry, 1970; Sykes, Douglas, Weiss, and Minde, 1971). In the classroom, children have been rated by their teachers along various dimensions to determine the effectiveness of stimulants on their behavior. Comly (1971) found that of 40 hyperactive children, whose behavior was rated twice weekly by teachers, those children receiving stimulants were rated as having better listening ability, less excitability, less forgetfulness, and better peer relationships. In a similar study, Denhoff, Davis, and Hawkins (1971) showed that teachers rated hyperactive children on dextro-amphetamine (Dexedrine) as improved on measures of hyperactivity, short attention span, and impulsivity. In addition, global ratings by parents, teachers, and clinicians have shown that drugs such as methylphenidate (Ritalin) and dextro-ampheta-

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mine decreased children's hyperactivity in school and at home (Conners, 1971).

While there is still some conflicting evidence on drug effectiveness (Krippner *et al.*, 1973), as well as a growing ethical concern for the morality and wisdom implied in administering medication to children, (Fish, 1971; Hentoff, 1970; Koegh, 1971; Ladd, 1970) drugs are commonly used to control hyperactivity in the classroom.

Because the often-implied objective behind the use of drugs for the hyperactive child is that of enabling him to profit academically, it is surprising that few data directly support this belief. Most studies have measured the effect of medication on component skills of learning, *e.g.,* attention, concentration, and discrimination. For example, Conners and Rothschild (1968), Epstein, Lasagna, Conners, Rodriquez (1968), Knights and Hinton (1968) tested drug effects on general intelligence test performance. Sprague *et al.* (1970) studied children's responses of "same" or "different" to pairs of visual stimuli presented on a screen. Conners, Eisenberg, and Sharpe (1964) studied the effects of methylphenidate (Ritalin) on paired-associate learning and Porteus Maze performance in children with hyperactive symptoms. Others (Conners, Eisenberg, and Barcai, 1967; Sprague and Toppe, 1966), concentrated their efforts on the effects of drugs on the attention of hyperactive children to various tasks. These laboratory studies investigated the effects of drugs on component skills related to learning, but they did not measure academic performance *per se* (*e.g.,* math and reading) in the classroom.

Sulzbacher (1972) experimentally analyzed the effects of drugs on academic behaviors of hyperactive children in the classroom. Measures of correct solutions and error rates were taken in arithmetic, writing, and reading in three hyperactive children. In addition, measures were taken of the children's rates of talk-outs in class and their rates of out-of-seat behavior during class. The children were successively given a placebo, then 5 mg of dextro-amphetamine (Dexedrine), and finally 10 mg of dextro-amphetamine. The results showed that medication of 5 mg improved the children's academic responses; however, there was wide variance in academic performance when the children were administered 10 mg. The results for social behavior also varied. Of two children, one showed less hyperactive classroom behavior (talk-outs and out-of-seat behavior) at a dosage level different than the second child. However, the placebo had more effect on controlling the third child's behavior than did medication. The author's conclusion was that stimulant drugs "can effectively modify disruptive behaviors without adversely affecting academic performance in the classroom". Drug effects on academic performance, however, were highly variable.

Since Sulzbacher's major interest was in determining the role of drugs on hyperactivity and academic performance, he did not pursue behavioral alternatives to the control of hyperactivity. Yet, there is at present, a body of established findings indicating that such alternatives may be available. For example, O'Leary and Becker (1967) found that when children were rewarded for sitting, making eye contact with the teacher, and engaging in academically related activities, their misbehavior was virtually eliminated. Ayllon, Layman, and Burke (1972) showed that misbehavior may be also reduced, not by rewarding the child for good conduct, but by imposing academic structure in the classroom. This structure involved giving academic assignments with a short time limit for their completion. Ayllon and Roberts (1974) found that another behavioral technique to eliminate classroom misbehavior is to reward children for academic performance only. These findings suggest that disruptive behavior can be weakened by reinforcing incompatible academic performance. Using this method, the child performs well both academically and socially without treating the disruptive behavior directly.

The children in the above studies were disruptive, not hyperactive. Although the topography of the response is similar, hyperactivity differs from disruption in its magnitude, duration, and frequency. Illustrations of this difference are well documented, indicating that hyperactive children are in constant motion, fidget excessively, frequently enter and leave the classroom, move from one class activity to another and rarely complete their projects or stay with one particular game or activity. Their academic performance is typically poor (Campbell, Douglas, Morgenstern, 1971; Freibergs and Douglas, 1969; Stewart, Pitts, Craig, and Dieruf, 1966; Sykes, Douglas, Weiss, and Minde, 1971).

Two questions arise:

Can behavioral techniques used to decrease disruptive behavior be at least as effective as drugs in controlling an extreme form of classroom misbehavior such as hyperactivity? At the same time, can such techniques help the hyperactive child to grow educationally? The present study attempted to answer these questions.

METHOD

Subjects and Setting

Three school children, (Crystal, Paul, and Dudley) clinically diagnosed as chronically hyperactive, were all receiving drugs to control their hyperactivity.

Crystal was an 8-yr-old girl. She was 47 in. (118 cm) tall and weighed 76 lb (34.2 kg). She had an I.Q. of 118 as measured on the WISC. She was enrolled in a learning-disabilities class because of the hyperactive behavior she displayed before taking medication and because of her poor academic work. She had been on drugs since she was 5 yr old, when her doctor felt that her behavior was so unpredictable that he prescribed 5 mg of Methylphenidate q.i.d. to calm her down.

Paul was a 9-yr-old boy. He was 53 in. (133 cm) tall and weighed 65 lb (29.2 kg). He had an I.Q. of 94 as measured on the WISC. He had been enrolled in the learning-disabilities class for 2 yr before the study and had been taking 5 mg of methylphenidate b.i.d. for 1 yr to control his hyperactive behavior.

Dudley was a 10-yr-old boy. He was 55 in. (138 cm) tall and weighed 76 lb (34.2 kg). He had an I.Q. of 103 as measured on the WISC. He was enrolled in a learning-disabilities class for 2 yr before the study and on the advice of his doctor had been taking 5 mg of methylphenidate t.i.d. for 4 yr.

In addition to their drug treatment, Crystal and Dudley were under the care of a child psychiatrist and a pediatrician during the study.

The three children attended a private elementary school. They were enrolled in a self-contained learning disability class of 10 children and one teacher. The children and the teacher remained together throughout the school day in the same room. Other personnel during the study consisted of two observer-recorders: one of the authors and an undergraduate student.

Response Definition

Hyperactivity and academic performance across two academic periods, math and reading, were measured.

Math. Math was defined as addition of whole numbers under 10. The teacher wrote 10 problems on the board at the beginning of each class. The children were given 10 min to complete the problems. Problems were taken from Laidlaw Series Workbooks, Levels P and 1.

Reading. Reading was defined as comprehension and was measured by workbook responses to previously read stories in a basal reader. Each child had 20 min to complete a 10-question workbook page per day. The books were Merril-Linguistic Readers - 3. In both math and reading, the written response served as a permanent product from which the percentage of correct answers could be determined.

The academic assignments in both math and reading increased slightly in difficulty as the child progressed through the work.

Hyperactivity. Since hyperactive behavior has overlapping topographical properties with other deviant behaviors, hyperactive behavior was defined using the same response definition as presented by Becker, Madsen, Arnold, and Thomas for deviant behavior in the classroom (1967). To define and record deviant behavior, Becker and his colleagues used seven general categories of behavior incompatible with learning. These included gross motor behaviors, disruptive noise with objects, disturbing others, orienting responses, blurting out, talking, and other miscellaneous behaviors incompatible with learning. In the present experiment, the behaviors of the hyperactive children most often fell into the following four categories: gross motor behaviors, disruptive noise, disturbing others, and blurting out. The most frequently recorded category for these hyperactive children was gross motor behaviors, which included running around the room, rocking in chairs, and jumping on one or both feet. Disruptive noise with objects included the constant turning of book pages and the excessive flipping of notebook paper. Disturbing others and blurting out included the constant movement of arms, resulting in the destruction of objects and hitting others, screaming, and high-pitched and rapid speech. Categories that were not recorded with any consistency included orienting responses and talking, as in a conversation with another person. Thus, although the response definition for deviant behavior was used, the actual recording was heavily weighted on those behaviors described by Stewart *et al.* (1966) as being typical of hyperactive children.

Observational and recording procedure for hyperactivity. Initially, six children were identified by the school director as being hyperactive and receiving medication for it. These children were observed across two class periods: math and reading. The duration of each class period was 45 min. Each child was observed in successive order on a time-sample of 25 sec. At the end of each 25-sec interval, the behavior of the child under observation was coded as showing hyperactivity or its absence. At that time, the observer marked a single slash in the appropriate interval, on a recording sheet, if one or more hyperactive behaviors occurred. If no hyperactive behaviors were observed at that time, the appropriate interval was marked with an "O". The number of intervals of hyperactivity over the total number of intervals for each child gave the observer the per cent of intervals in which each child was hyperactive. Each of the six children was observed a total of 17 times per 45-min class period. Using this recording procedure, it was possible to determine, during baseline, that the most chronically hyperactive children were Crystal, Paul, and Dudley. By dropping observations on the less-severely hyperactive children it was possible to increase the number of observations for the chronically hyperactive ones. Recording hyperactivity from one child to the next was now sampled about every 18 sec in the manner described above. Each child was now observed approximatetly 50 times each class period throughout the remaining phases of the experiment.

Observer agreement on academic performance and hyperactivity. The percentage of correct math and reading problems was checked by the teacher and one of the authors each day and the obtained agreement score was 100% on each occasion for each child.

Reliability checks for hyperactivity were taken by one of the authors and one of three undergraduate students in Special Education. The student was given the list of deviant behaviors described by Becker *et al.* (1967) one day before the reliability check to become familiar with the responses. The students were not told of the purpose of the study or of the changes in experimental conditions. Each observer during the reliability check used a watch with a sweep second hand. In addition, a prepared sheet showed the observers the sequence in which the children were to be sampled and the intervals at the end of which each observer was to look at the subject and record whether or not the behavior was occurring at that instant. Each observer sat on opposite sides of the room to ensure unbiased observations.

The percentage of agreement for hyperactive as well as nonhyperactive behavior was calculated by comparing each interval and dividing agreements in each by the total number of observations and multiplying by 100. Reliability checks were taken to include the baseline period under medication (Blocks 2, 3, 5, and 6; in Figures 1, 2, and 3), the period when medication was discontinued and no reinforcement was available (Blocks 7 and 9), and the final period when reinforcement was introduced in both math and reading (Block 11). Reliability scores for hyperactivity for each child were always more than 85%, with the scores ranging from a low of 87% to a high of 100%. The average reliability score was 97%.

Check-point system and back-up reinforcers. A token reinforcement system similar to that used by O'Leary and Becker (1967) in a classroom setting was used. Children were awarded checks by the teacher on an index card. One check was recorded for each correct academic response. The checks could be exchanged for a large array of back-up reinforcers later in the day. The back-up reinforcers ranged in price from one check to 75 checks, and included such items and activities as candy, school supplies, free time, lunch in the teacher's room, and picnics in the park.

Procedure

Each subject's daily level of hyperactivity and academic achievement, on and off medication, were directly observed and recorded before the behavioral program. In addition, using a multiple-baseline design, the relative effectiveness of the motivational system on (a) hyperactivity and (b) academic performance, in math and reading was evaluated. This type of design allowed each child to serve as his own control, thereby minimizing the idiosyncratic drug-behavior interactions that have the potential for confounding the interpretations and even the results when comparing one subject with another. This design is particularly useful in the study of the effects of discontinuing drugs on behavior, since as Sprague *et al.* (1970) and Sulzbacher (1972) have pointed out, the inherent problem in assessing effects of medication lies in the fact that each child reacts to the presence or absence of medication on an individual basis.

The design of the study included the following four phases:

Phase 1: *on medication.* Crystal, Paul, and Dudley were observed for 17 days to evaluate hyperactive behavior when they were taking drugs. Academic performance in math and reading was also measured.

With the full cooperation of the children's doctors and their parents, medication was discontinued on the eighteenth day, a Saturday. An additional two days, Sunday and Monday (a school holiday) allowed a three-day "wash-out" period for the effect of medication to disappear. It is known that these stimulant drugs are almost completely metabolized within one day. No measures of hyperactivity or academic performance were obtained during this weekend period.

Phase 2: *off medication.* Following the three-day "wash-out" period, a three-day baseline when the children were off medication was obtained. Time-sampling observations of hyperactivity were continued, as well as measures of academic performance. This phase served as the basis against which the effects of reinforcement on hyperactivity and academic performance could later be compared.

Phase 3: *no medication; reinforcement of math.* During this six-day period, the children remained off drugs while the teacher introduced a reinforcement system for math performance only. Observations of hyperactivity continued and academic performance was measured.

Phase 4: *no medication; reinforcement of math plus reading.* During this six-day phase, the children remained off drugs while reinforcement was added for reading and reinforcement of math was maintained. Observations of hyperactivity and measures of academic performance were continued.

RESULTS

When Ritalin was discontinued, the level of hyperactivity doubled or tripled its initial level.

However, when reinforcement was systematically administered for academic performance, hyperactivity for all three children decreased to a level comparable to the initial period when Ritalin chemically controlled it.

Figure 1 shows that hyperactivity for Crystal during the drug phase in math averaged about 20%, while academic performance in math was zero. When Ritalin was discontinued, hyperactivity rose to an average of 87% and math performance remained low at an average of 8%. When math was reinforced, and Crystal continued to stay off drugs, hyperactivity dropped significantly from 87% to about 9%. Math performance increased to 65%. Hyperactivity in math was effectively controlled through reinforcement of math performance. However, the multiple-baseline design shows that concurrently Crystal's hyperactivity during reading class remained at 90% before reinforcement was introduced for correct reading responses.

At the same time measures were taken in the area of math, hyperactivity and academic performance were also measured in the area of reading. Crystal's hyperactivity during reading class averaged approximately 10% under medication. Academic performance in reading was zero under medication. When Crystal was taken

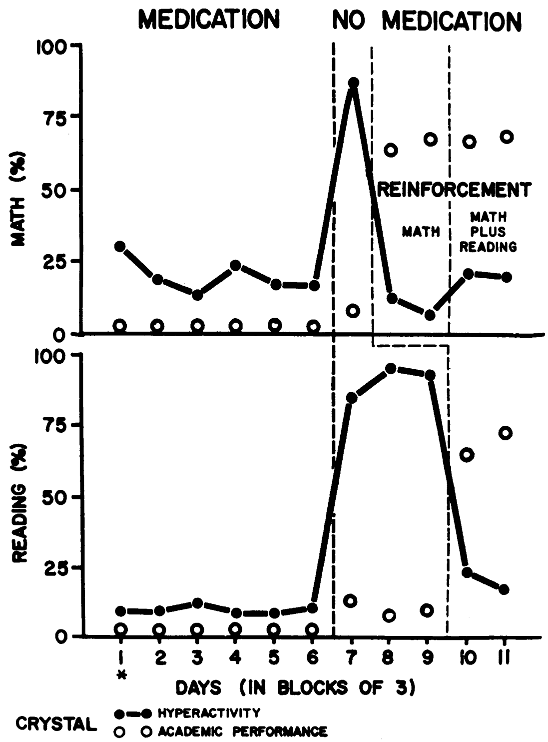

Fig. 1. Crystal. The percentage of intervals in which hyperactivity took place and the per cent of correct math and reading performance. The first and second segments respectively show the effects of medication, and its subsequent withdrawal, on hyperactivity and academic performance. A multiple-baseline analysis of the effects of reinforcement across math and reading and concurrent hyperactivity is shown starting on the third top segment. The last segment shows the effects of reinforcement on math plus reading and its concurrent effect on hyperactivity. (The asterisk indicates one data point averaged over two rather than three days).

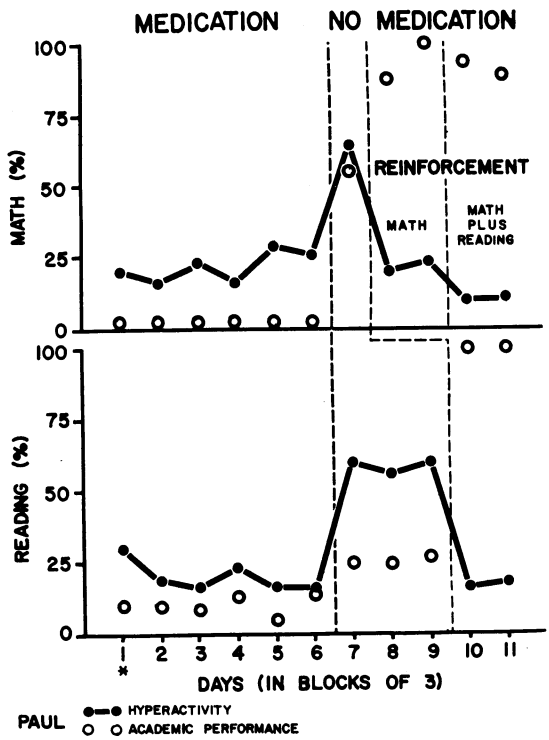

Fig. 2. Paul. The percentage of intervals in which hyperactivity took place and the per cent of correct math and reading performance. The first and second segments respectively show the effects of medication, and its subsequent withdrawal, on hyperactivity and academic performance. A multiple-baseline analysis of the effects of reinforcement across math and reading and concurrent hyperactivity is shown starting on the third top segment. The last segment shows the effects of reinforcement on math plus reading and its concurrent effect on hyperactivity. (The asterisk indicates one data point averaged over two rather than three days).

off drugs, hyperactivity rose dramatically from 10% to an average of 91%. Academic performance remained low at approximately 10%. Only when reinforcement was administered for reading was hyperactivity in this area reduced from 91% to 20%. Reading performance increased from 10% to an average of 69%.

Similar results were found for Paul and Dudley, as can be seen in Figures 2 and 3.

Figure 4 shows the pre and post measures of hyperactivity and academic performance for Dudley, Crystal, and Paul as a group. It can be seen that when the children were taking drugs, hyperactivity was well controlled and

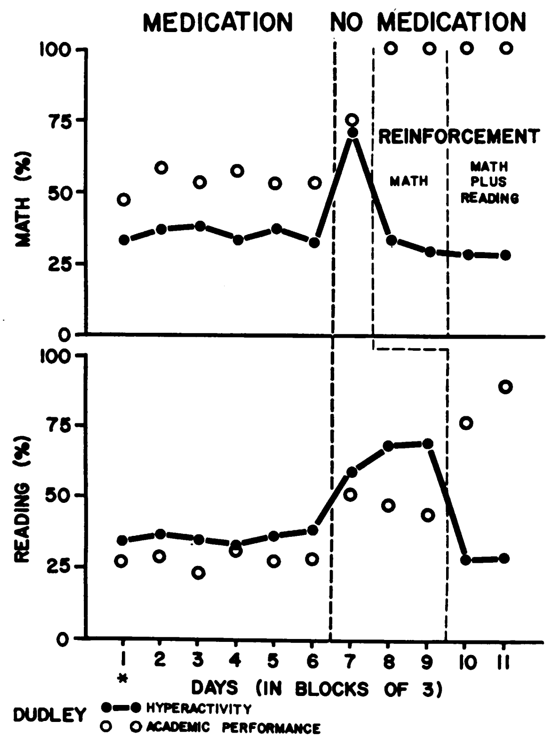

Fig. 3. Dudley. The percentage of intervals in which hyperactivity took place and the per cent of correct math and reading performance. The first and second segments respectively show the effects of medication, and its subsequent withdrawal, on hyperactivity and academic performance. A multiple-baseline analysis of the effects of reinforcement across math and reading and concurrent hyperactivity is shown starting on the third top segment. The last segment shows the effects of reinforcement on math plus reading and its concurrent effect on hyperactivity. (The asterisk indicates one data point averaged over two rather than three days).

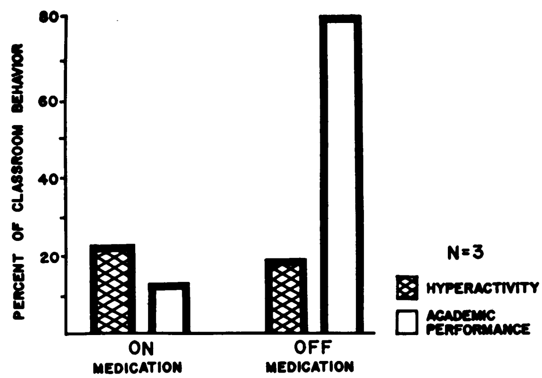

Fig. 4. Average per cent of hyperactivity and academic performance in math and reading for three children. The first two bars summarize findings from the 17-day baseline under drug therapy. The last two bars show results for the final six-day period without drug therapy but with a reinforcement program for both math and reading performance.

averaged about 24% during math and reading. When medication was discontinued and a reinforcement program was established to strengthen academic performance, the combined level of hyperactivity was about 20% during math and reading for the three children. This level (20%) of hyperactivity matched that obtained under medication (24%).

During the period when the children were taking drugs, their per cent correct in math and reading combined, averaged 12%. When medication was discontinued and a reinforcement program was established, their average per cent correct in both academic subjects increased from 12% to 85%.

DISCUSSION

These findings show that reinforcement of academic performance suppresses hyperactivity, and they thus support and extend the findings of Ayllon and Roberts (1974). Further, the academic gains produced by the behavioral program contrast dramatically with the lack of academic progress shown by these children under medication.[2]

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[2]For a systematic replication of this study see Layman, *unpublished*.

The multiple-baseline design demonstrates that token reinforcement for academic achievement was responsible for the concurrent suppression of hyperactivity. Indeed, while this control was demonstrated during math periods, the children's concurrent hyperactivity during reading remained at a high level, so long as the reinforcement procedure for reading was withheld. Only when reinforcement was introduced for both math and reading performance did the hyperactivity for all three children drop to levels comparable to those controlled by the drug.

The control over hyperactivity by the enhancement of academic performance was quick, stable, and independent of the duration and dosage of the medication received by each child before the program. One child had been under medication for as long as 4 yr, another child for 1 yr. Despite this extreme difference in history of medication, the behavioral effects were not differential to that history.

When medication was discontinued, hyperactivity increased immediately and to a high level in all three children. The effectiveness of medication in controlling hyperactivity, evaluated through direct observations of behavior, supports the data of earlier studies using recordings based on instrumentation (Hollis *et al.*, 1972; Sprague *et al.*, 1970; Sykes *et al.*, 1971).

During the few days of no medication, hyperactivity became so severe that the teacher and parents freely commented on the gross difference in the children's behavior in school and at home. Their reports centered around such descriptions as "He's just like a whirlwind", "She is climbing the walls, it's awful", "Just can't do a thing with her . . ." "He's not attending, doesn't listen to anything I tell him", and others. It was only with a great deal of support and counselling that the teacher and parents were able to tolerate this stressful period. It was this high level of hyperactivity shown by all three children that allowed the opportunity to test the effectiveness of a reinforcement program for academic performance in controlling hyperactivity.

Since both hyperactivity and academic performance increased concurrently, as soon as medication was discontinued, it might be construed that these two dimensions are compatible. This may be an unwarranted conclusion, however, because the slight increments in academic performance concurrent with increments in hyperactivity may only reflect the type of recording method used in this study. For example, measures of the behavior of the children show that once they had finished their academic assignments, they became hyperactive. Thus, academic performance and hyperactivity could take place sequentially. When the time limit for academic performance had expired (*e.g.*, after 10 or 20 min, depending on the subject matter) the child could engage in hyperactivity for the rest of the class period.

It usually took only one session for each child to learn that academic performance was associated with reinforcement while hyperactivity was not, suggesting that in the absence of medication these children react to reinforcement as normal children do. The classroom with reinforcement procedures now set the occasion for academic performance, rather than hyperactivity.

The present results suggest that the continued use of Ritalin and possibly other drugs to control hyperactivity may result in compliant but academically incompetent students. Surely, the goal of school is not to make children into docile robots either by behavioral techniques or by medication. Rather, the goal should be one of providing children with the social and academic tools required to become successful in their social interactions and competent in their academic performance. Judging from the reactions and comments of both parents and teacher, this goal was achieved during the reinforcement period of the study. The parents were particularly relieved that their children, who had been dependent on Ritalin for years, could now function normally in school without the drug. Similarly, the teacher was excited over the fact that she could now build the social and academic skills of the children because they were more attentive and responsive to her than when they were under medication.

On the basis of these findings, it would seem appropriate to recommend that hyperactive children under medication periodically be given the opportunity to be drug-free, to minimize drug dependence and to facilitate change through alternative behavioral techniques. While this study focused on behavioral alternatives to Ritalin for the control of hyperactivity, it is possible that another drug or a combination of medication and a behavioral program may also be helpful.

This study offers a behavioral and educationally justifiable alternative to the use of medication for hyperactive children. The control of hyperactivity by medication, while effective, may be too costly to the child, in that it may retard his academic and social growth, a human cost that schools and society can ill afford.

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