*COMPARING TREATMENT TACTICS WITH A HYPERACTIVE
PRESCHOOL CHILD: STIMULANT MEDICATION
AND PROGRAMMED TEACHER INTERVENTION¹*

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Two treatment tactics, food and praise contingent on appropriate play and varying doses of methylphenidate (Ritalin), were evaluated for their effects on a preschool child's activity changes. In addition, other social, verbal, and academic behaviors were monitored to examine possible side effects of the two treatment tactics. Fewer free-play activity changes occurred during contingent reinforcement phases while medication had variable effects: increasing attention to tasks but, at higher doses, decreasing intelligibility of speech and responsiveness to mands. The study outlines a replicable model for comparing medication with alternative behavioral strategies to control hyperactivity and enhance skill development.

DESCRIPTORS: hyperactivity, preschool, social and academic behavior, drug evaluation, treatment interactions, preschool children

Although psychotropic medications have achieved some notable success at calming hyperactive children, considerable concern remains about their widespread use (Committee on Drugs, 1971). One basis for such concern is that when medication is prescribed to alter behavior, there is a subtle implication that the child's behavior is at fault, rather than the environmental situation that surrounds the child. Predictive differential diagnostic procedures do not now exist that would enable teachers and physicians to choose treatment tactics on the basis of information obtained from neurological examinations (Sulzbacher, 1975). Sprague and Werry (1954) and Sulzbacher (1973) have pointed out the scarcity of carefully controlled studies of the effects of psychotropic medication on objectively measured behaviors. It is, however, possible to apply various treatment strategies and to observe their effects on precisely defined target behaviors

(Werry and Quay, 1969; Hutt and Hutt, 1970; Strong, Sulzbacher, and Kirkpatrick, 1974; Strain and Timm, 1974). The present study assessed the relative effects of stimulant medication and contingent reinforcement procedures on the behavior of one "overly active and disruptive" preschool child.

METHOD

Subject

Byron was one of seven children enrolled in a preschool classroom for children with severe learning disabilities and behavior problems at the Experimental Education Unit (EEU) at the University of Washington. (See Allen, Turner, and Everett, 1970, for a more detailed description of this classroom.) He was referred to the classroom with a primary diagnosis of mental retardation and subsequent delayed language development. At the beginning of his enrollment, Byron appeared preoccupied with touching objects, seldom lingering long enough to play constructively with any one item. He was noncompliant to adult direction and his speech was predominantly echoic. He had been diagnosed elsewhere as emotionally disturbed. He and his

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(3) A cooperative activity (*i.e.*, pulling another child in a wagon). (4) A unified activity involving imitative movements, gestures, or common verbalizations. (5) A shared-play activity identified as such by verbal approach and response between the subject and another child. (6) A sustained physical encounter.

(.) *Isolate play* occurred in any period where the subject was not engaged in proximity play (P) or cooperative play (C).

Bottom row of blocks: *appropriate play* was defined as any purposeful, manipulative encounter with a piece of play equipment and was symbolized by the beginning letter of the material, *e.g.*, blocks (B), train (T), drums (D). Inappropriate play included such specific actions as grating a play object against the upper teeth, simply carrying an object while wandering, or holding an object but not manipulating it. Inactivity and inappropriate play were indicated by blank spaces.

(X) *Wandering* referred to Byron's characteristic periods of purposeless movement about the classroom without any evidence of appropriate manipulation of materials.

Activity change was defined as changing from (1) appropriate play with one play object to appropriate play with another play object, or (2) to wandering behavior, or (3) to inappropriate play or inactivity, or any sequence variation of these.

During the depicted 3-min sample the subject was scored as follows. (1) Teacher attention (/)—six occurrences. (2) Nondirectional verbalizations (N)—five occurrences. (3) Indistinct verbalizations (Z)—four occurrences. (4) Isolate play (.)—13 occurrences. (5) Cooperative play (C)—zero occurrences. (6) Wandering (X)—seven occurrences. (7) Proximity Play (P)—five occurrences. (8) Activity Changes—eight.

Reliability

On nine of the total 66 days of the study two observers simultaneously scored Byron's behavior. Interrater reliability was computed as the number of agreements divided by the total num-

ber of 10-sec intervals. The mean percentage of agreement was 91.7%. The reliability scores ranged from 85% to 97% with a median of 91%.

Description of Phases During Free Play

A. *Baseline 1*. This phase lasted 20 days and involved recording the subject's behavior and scoring the number of activity changes. Teachers interacted with the subject as they did with the other children in the classroom.

B. *Medication*. During this four-day phase, the child received 10 mg of methylphenidate each day, typically 5 mg before coming to school and 5 mg at noon. All classroom procedures remained unchanged from baseline.

C. *Intervention and medication*. The 10-mg daily medication schedule was maintained and the teachers also instituted intervention during this 11-day phase. Byron received special attention from the teacher contingent on his appropriate play. In this controlled intervention, the teacher approached the child at the beginning of the 20-min recording period. As soon as he began to play appropriately, she started a stopwatch and began to interact with him by talking to him about play materials and contributing new materials or ideas to his play. Although no attempt was made to restrain him physically to a specific area, he was "encouraged" to remain as long as possible: for example, when he was standing and playing with a puzzle on the table, the teacher suggested during her conversation that he sit down. Following 15 sec of continued appropriate play the child was presented with a piece of sweetened cereal to eat and praise such as, "Byron, here's a piece of cereal. I like the way you stay and put the puzzle pieces in". If the subject remained and continued playing appropriately, the stopwatch was reset, the teacher attention continued, and cereal and praise were awarded after 15 sec. If, however, the child moved to another area of the room, the teacher observed him until he began to play appropriately and then re-instituted the above pattern of intervention.

D. *Baseline 2.* For 19 days baseline data were again recorded as in Phase A. The subject received no medication and experienced normal classroom routine. This phase was somewhat extended due to Byron's periodic absences and the added difficulty of obtaining stabilized data.

E. (5-mg) and F. (15-mg) *medication.* To ascertain differential effects of the drug, the days of 5-mg and 15-mg doses (0.33 and 1.00 mg/kg of the child's weight) were randomly assigned to different treatment conditions. The effects of the two dosage levels could be assessed independently, as methylphenidate has a rapid onset (20 to 30 min after the medication is taken) and is excreted within 24 hr. Identical 15-mg, 5-mg, and placebo tablets were randomly placed in dated envelopes and given to the subject's mother. These were administered before the child left for school. All observational data were collected within 4 hr after the drug was administered. A double-blind situation was established in that neither the subject's mother nor any of the teachers knew the assigned dosage for that day. Because Byron's mother began to express increased concern over the fact that Byron was apparently remaining awake later and later in the evening (11:30, 12:45, 3:30 a.m.) this phase was prematurely terminated.

G. *Intervention (no medication).* Teacher intervention was re-instituted after the unforeseen termination of the medication. Four days of data were obtained during which teachers interacted with the subject in the manner described under Phase C (intervention and medication). No medication was administered during these four days.

H. *Baseline 3.* All medication and programmed teacher intervention were withdrawn for the remaining three days of the quarter. The subject was returned to the conditions present during Phase A (Baseline 1) and Phase D (Baseline 2).

ACADEMIC PERFORMANCE

During the later phases of the study (Phases D through H), teachers recorded Byron's per-

formance throughout the pre-academic skill-instruction period to determine the effects of medication on this important behavioral dimension. At this time, Byron sat at a table with two other children and performed three pre-academic conceptual and fine motor tasks (*i.e.*, 15-piece puzzles, sorting, and classification tasks). He received the undivided attention of one teacher, while another teacher worked with the other two children at the table. Teacher attention was *not*, therefore, a variable during this period of the day.

Academic Behavior Definitions

1. *Task time:* the time from the end of the teacher's instructions to the child's completion of the task. The sum of the times for three tasks given each day constituted the total task time.

2. *Attending behavior:* any time during which the child was actively engaged in completing a task or was visually or motorically oriented toward it.

3. *Mands:* any teacher statement that required a response from the subject.

4. *Compliance:* any behavior that constituted an appropriate response to a teacher mand.

Observation techniques for academic behaviors. The subject's behavior was recorded by an observer who remained in the classroom for the duration of the academic session. By using two stopwatches, the observer was able to record both the total task time and the cumulative time spent attending to tasks. The number of mands given by the teacher and the number of subsequent compliances by the child were recorded on tally sheets.

Reliability checks were made on four days, using a second observer who sat across the room from observer one. The difference between the computed percentage of time attending and percentage of compliance to mands as recorded by the two observers yielded a per cent agreement with observer one. The mean percentage agreement was 80% on attending behavior and 90.75% on number of mands complied with.

Fig. 1. Influence of various dosages of methylphenidate and teacher intervention on daily frequencies of activity changes during free-play period.

RESULTS

The measure of Byran's hyperactivity was the number of activity changes that occurred during the daily 20-min observation period. The data are summarized in Table 1 and displayed in Figure 1. Data on other behaviors are summarized in Tables 2, 3, and 4. Results of Byran's performance at academic task time are depicted in Table 5.

DISCUSSION

The objective of the behavioral strategy employed in the teacher-intervention phases was to

decrease the number of activity changes by reinforcing an incompatible behavior, specifically, extended periods of appropriate play. Methylphenidate in 5- and 15-mg dosages was alternately compared with the teacher-intervention strategy during the latter half of the study. In addition, a broad array of behaviors was measured. The Washington Social Code was individualized to reflect characteristic behaviors of this child. Measures of attending and compliance behavior were recorded during academic instruction. Together, these measures reflected changes in physical, verbal, social, and academic domains as behavioral management and chemical interventions were applied. Sufficient evidence was

Table 1
Summary of Activity Changes

Phase	Days	Mean	Median	Range	Per Cent Rise or Fall from Mean of Baseline
A. Baseline 1	20	34.7	37.0	11-52	—
B. 10 mg Ritalin	4	33.25	33.5	25-41	— 4.18
C. 10 mg Ritalin + intervention	11	18.18	19.0	13-25	—47.61
D. Baseline 2	19	35.0	32.0	21-52	+ 0.86
E. 5 mg Ritalin	3	40.0	43.0	32-45	+15.27
F. 15 mg Ritalin	2	22.5	22.5	15-30	—35.16
G. Intervention	4	16.25	17.5	10-20	—53.17
H. Baseline 3	3	48.33	46.0	45-54	+39.28

Table 2
Number of Occurrences of Nondirectional and Indistinct Verbals

Phase	Days	NonDirectional Verbals				Indistinct Verbals			
		Mean	Median	Range	% Change from Baseline	Mean	Median	Range	% Change from Baseline
D. Baseline 2	19	12	11	1-33	—	6	5	2-10	—
E. 5 mg Ritalin	3	24.67	24	19-31	+105.58	8.33	7	7-11	+ 38.33
F. 15 mg Ritalin	2	14.5	14.5	5-24	+ 20.83	25.0	25.0	11-39	+316.67
G. Intervention	4	5.33	5	1-8	— 55.58	7.33	6	4-12	+ 22.17
H. Baseline 3	3	32.66	36	23-29	+172.17	7.33	7	3-12	+ 22.17

Table 3
Number of Time Samples Subject Engaged in Isolate Play

Phase	Days	Mean	Median	Range	Per Cent Rise or Fall from Mean of Baseline
D. Baseline 2	19	69	89	33-119	—
E. 5 mg Ritalin	3	98	81	81-114	+42.03
F. 15 mg Ritalin	2	70.5	70.5	52-89	+ 2.17
G. Intervention	4	51.66	33	21-101	—25.13
H. Baseline 3	3	69.33	71	69-71	+ 0.48

Table 4
Number of Time Samples Subject Spent Wandering

Phase	Days	Mean	Median	Range	Per Cent Rise or Fall from Mean of Baseline
D. Baseline 2	19	20	20	3-38	—
E. 5 mg Ritalin	3	19.67	21	16-22	— 1.65
F. 15 mg Ritalin	2	12.5	12.5	7-18	—37.5
G. Intervention	4	8	8	8-9	—60.0
H. Baseline 3	3	25.66	24	23-30	+28.30

Table 5
Percentages of total academic time spent attending and of mands complied with during this time.

Phase	Days	Time Attending				Mand Compliance			
		Mean	Median	Range	% Change from Baseline	Mean	Median	Range	% Change from Baseline
D. Baseline 2 (last six days)	6	88.33	87	78-99	—	64.67	66.0	51-83	—
E. 5 mg Ritalin	3	91.33	96	79-99	+3.40	71.0	75.0	59-79	+ 9.79
F. 15 mg Ritalin	2	96.0	96	0-92	+8.68	58.0	58.0	51-65	—10.31
G. & H. Baseline 3	7	86.3	83	81-98	—2.3	61.57	60.0	54-72	— 4.97

then available from which to make a clinical decision about which form of intervention was in Byron's best interests.

Activity Changes

The mean of 34.7 activity changes in 20 min during Baseline 1 reflects a change in physical orientation every 35 sec. To teachers this was indeed "hyperactive" behavior, and accurately reflected the unproductive nature of Byron's play. As shown in Table 1 and Figure 1, the most noticeable decrease in the number of activity changes occurred during teacher intervention (Phases C and G). The possibility that the decrease in Phase C (10 mg Ritalin and Intervention) was due to an interaction of the drug and the teacher intervention together was explored in Phases E, F, and G. Days of 15-mg dosages produced fewer activity changes than 5-mg days. This suggests that the higher dosage had some effect. However, the level of hyperactivity at the highest dosage was no better than that achieved with behavioral intervention alone.

Verbal Behavior

Very little of Byron's verbal behavior was directed toward people. He either mumbled indistinctly to himself or made echoic announcements to no one in particular (defined here as nondirectional verbal behavior). Both of these classes of verbal behavior were somewhat decelerated by teacher intervention, but a pattern of reduced day-to-day variability and a relative increase of nondirectional verbalizations is apparent during drug-dosage conditions. The 15-mg dosage appeared to increase the occurrence of indistinct verbalizations markedly.

Isolate Play

As Byron showed no evidence of interacting with other children, the variability in his isolate play (Table 3) reflects chance proximal contact with other children. His lack of any social behaviors with peers precluded meaningful effects of these interventions on this dimension of Byron's behavior. It was felt that as long as Byron

continued to change activities and wander about the room, his relationships with other children would fail to develop.

Academic

Medication slightly increased Byron's orientation to tasks; the high dosage also appeared to leave him slightly less responsive to teacher mandates (see Table 5). The medication did not, however, produce an overall decrement in behavior (sedation).

Side Effects

The parents were unaware of the 15-mg dosage when they called the child's insomnia to the teacher's attention and asked that the study be curtailed. A random schedule of medication and placebos had been set up, and it was due to this curtailment that no placebo condition occurred in this study.

Despite the premature termination, sufficient evidence was available to support the decision to discontinue medication and to continue the program of contingent teacher attention for Byron. Although the medication did not affect Byron's activity changes to the degree that contingent reinforcement did, it cannot be presumed that similar results would occur with other children. It should be noted that there is no evidence in the classroom data that the child suffered any side effects during the drug-treatment trials.

Follow-Up After Treatment

The following year, Byron attended a public-school primary special-education class. Although he appeared to have made some academic progress, his social and classroom behavior was reported to be deteriorating, and he was referred back to the Experimental Education Unit a year later. Contingent teacher attention was again employed to manage Byron's classroom behavior. His teachers reported that they saw no need for medication. More recently, they faded out contingent teacher attention in favor of contingent peer contact as a consequence for appropriate behavior and task completion.

Summary

This study presents a strategy employed to evaluate the relative effects of psychotropic medication and behavioral management for one child. The strategy circumvents arguments about the "inherent evils" of either drugs or behavior modification by establishing a replicable procedure for evaluating the impact of treatment on behaviors of concern and assessing whether the intervention had unexpected effects on other behaviors. Although in this case the employed methodology has its shortcomings due to unforeseen exigencies, the combination of a relatively low "teacher-cost" observational system and a planned intervention sequence provides a considerable amount of objective information enabling teachers, physicians, and parents to act in the best interests of the child.

REFERENCES

- Allen, K. E., Hart, B. M., Buell, J. J., Harris, F. R., and Wolf, M. M. Effects of social reinforcement on isolate behavior of a nursery school child. *Child Development*, 1974, **35**, 511-578.
- Allen, K. E., Turner, K. D., and Everett, P. M. A behavior modification classroom for Head Start children with problem behaviors. *Exceptional Children*, 1970, **37**, 119-129.
- Bijou, S. W., Peterson, R. F., Harris, F. R., Allen, K. E., and Johnston, M. S. Methodology for experimental studies of young children in natural settings. *Psychological Record*, 1969, **19**, 177-210.
- Hutt, S. J. and Hutt, C. *Direct observation and measurement of behavior*. Springfield, Ill.: Charles C Thomas, 1970.
- Pinkston, E. M., Reese, N. M., LeBlanc, J. M., and Baer, D. M. Independent control of a preschool child's aggression and peer interaction by contingent teacher attention. *Journal of Applied Behavior Analysis*, 1973, **6**, 115-124.
- Sprague, R. L. and Werry, J. S. Psychotropic drugs and handicapped children. In L. Mann and D. A. Sabatino (Eds.), *Second review of special education*. Philadelphia: JSE Press, 1974. Pp. 1-50.
- Strain, P. S. and Timm, M. A. An experimental analysis of social interaction between a behaviorally disordered preschool child and her classroom peers. *Journal of Applied Behavior Analysis*, 1974, **7**, 583-590.
- Strong, C., Sulzbacher, S. I., and Kirkpatrick, M. A. Use of medication *versus* reinforcement to modify a classroom behavior disorder. *Journal of Learning Disabilities*, 1974, **7**, 214-218.
- Sulzbacher, S. I. Behavior analysis of drug effects in the classroom. In G. Semb (Ed.), *Behavior Analysis and Education—1972*. Lawrence: University of Kansas, 1973. Pp. 37-52.
- Sulzbacher, S. I. Psychotropic medication with children: An evaluation of procedural biases in re-results of reported studies. *Pediatrics*, 1973, **51**, 513-517.
- Sulzbacher, S. I. The learning disabled or hyperactive child: diagnosis and treatment. *Journal of the American Medical Association*, 1975, **234**, 938-941.
- Werry, J. S. and Quay, H. C. Observing the classroom behavior of elementary school children. *Exceptional Children*, 1969, **35**, 461-470.

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