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THE RELATIVE EFFICACY OF METHYLPHENIDATE (RITALIN) AND BEHAVIOR-MODIFICATION TECHNIQUES IN THE TREATMENT OF A HYPERACTIVE CHILD

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Drug *versus* placebo effects were contrasted with those of contingency management in the treatment of a hyperactive child. Several criterion behaviors were monitored in two different settings to gauge the breadth and generalizability of drug and behavior-management effects. Medication and contingency management effects were both found to be situation specific. No interaction effects were found. Accuracy of task performance, amount of eye contact with the experimenters, frequency of repetitive hand movements, and distractible behavior were apparently unaffected by medication (Ritalin *versus* placebo) within the clinic. A multiple-baseline design incorporating contingency reversals revealed the reinforcement contingencies to be the crucial variable controlling behavior within the clinic. Medication effects were shown to be significant within the home setting where reinforcement contingencies were not changed. While aggressive behavior decreased as a function of Ritalin, repetitive hand movements increased.

DESCRIPTORS: academic behavior, drug therapy, behavior therapy, ritualistic behavior, reinforcement, feedback, drug *versus* reinforcement, multiple baseline, timeout, hyperactive children

Two treatments for the hyperactive and disruptive child have become much used in recent years. Behavior-management techniques have been successfully taught to parents and teachers (*e.g.,* O'Leary, Becker, Evans, and Saudargas, 1969; Wahler, Winkel, Peterson, and Morrision, 1965) and reinforcement regimes have been adapted to both home and school settings to control such behaviors as visual orientation (Quay, Werry, McQueen, and Sprague, 1966), out-of-seat and talking-out behavior (O'Leary and Becker, 1967), school attendance (O'Leary *et al.,* 1969), aggression (Bernal, Duryel, Pruetl and Burns, 1968; Patterson, Jones, Whittier, and Wright, 1965; O'Leary and Drabman, 1971), self-control and self-reinforcement (Meichenbaum and Goodman, 1971; Palkes, Stewart and Kahana, 1968; Ridberg, Parke, and Hetherington, 1971), and actual school achievement (Hewett, Taylor, and Artuso, 1969). Simultaneously, the prescription of methylphenidate (Ritalin) and the amphetamines has also been on the rise (Grinspoon and Singer, 1973). Although the combined use of both behavior-modification techniques and stimulant drugs may be frequent in clinical practice, there is little or no research to support the assumption that use of stimulants facilitates or enhances learning beyond what might be expected from contingency management techniques alone (Conrad, Dwarkin, Shai, and Tabiessen, 1971; Christensen and Sprague, 1973).

The effect of methylphenidate and the amphetamines on the behavior of the hyperactive child is now recognized as far from monolithic (Grinspoon and Singer, 1973; Sroufe, 1975). Global behavior ratings made by parents and teachers may show improvement with drug management, as compared to placebo (Sroufe, 1975). However, drug effects are dependent on several variables. The degree of structure in a given situation appears to be one such crucial

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variable. The medicated child, compared to the child on placebo, may be less active and more goal directed within the structure of the classroom (Cohen, Douglas, and Morgenstern, 1971; Sprague *et al.,* 1970), but may be more active and less directed in the free-field situation of the playground (Millichap and Boldrey, 1967; Witter, 1971). Analogously, there is some evidence that parents are less able than teachers to discern drug effects from placebo effects within the relatively unrestrained home behavior of their child (Ellis, Witt, Reynolds, and Sprague, 1974). Hence, setting effects would seem to be significant.

Task effects are also apparent. Research reviews (Grinspoon and Singer, 1973; Sroufe, 1975) suggest that vigilance tasks, those requiring rote learning and/or fine motor control, are facilitated by medication. Problem-solving potential and abstract reasoning ability do not appear to be enhanced (Sroufe, 1975). Thus, evidence to date would indicate that the type of learning task involved needs to be specified in determining drug effect for these children. While the teacher's global rating of the child's classroom behavior may improve under medication as compared to placebo, the child's actual school achievement may be unaffected (Sroufe, 1975).

Another factor to be considered is that of the observation system employed in assessing the usefulness of the drug. Although literature reviews fairly consistently report positive findings for drug management when global ratings are used, there is less consistency when more specific behaviors are charted (Grinspoon and Singer, 1973; Sroufe, 1975). For instance, activity level as monitored by a stabilimeter, has actually increased with medication even when the child is rated as globally improved. (Millichap and Boldrey, 1967).

Yet another issue is that of whether enhanced attention-to-task in certain situations is a stimulant drug effect unique or "paradoxical" to hyperactive children. Since little or no research utilizing normal children as controls is available, it is not known whether methylphenidate and the amphetamines would have a similar effect on normal children (Sroufe, 1975).

The present study attempted to investigate several of the above variables. The relative efficacy of methylphenidate (Ritalin), placebo, and reinforcement contingencies was assessed with regard to several criterion tasks and specified behaviors. Further, drug *versus* placebo effects were monitored in two settings—a clinic setting, simulating a one-to-one school structure, and the relatively unstructured home setting. Hence, setting, task, and observation schema variables were taken into account in specifying drug *versus* reinforcement effects for a particular "hyperactive" child.

PROCEDURE

Subject

Arnold was 8-yr 11-months old, and had completed the third grade. He had been referred to a Community Mental Health Center for evaluation with regard to hyperactive behavior and poor school achievement. He was characterized by his parents and by school personnel as exhibiting aggression with peers and sibling, noncompliance with requests and school routine, poor fine and gross motor coordination, little eye contact, mumbled, rapid speech; short attention span, and lack of age-appropriate play skills. The most salient feature of Arnold's problem, however, was his frequent engagement in repetitive, ritualistic behaviors, such as repeatedly smelling his hands or rolling imaginary, minute objects between his fingers. Often, these hand rituals were accompanied by high-pitched, piercing noises or by "raspberries" blown on the back of his hands. Arnold had been diagnosed as "hyperactive" in the first grade and had been placed on Ritalin. Both parents and teachers concurred that Arnold was more "manageable" when medicated. However, the parents expressed concern that Arnold's repetitive behaviors might be exacerbated by Ritalin. Also, it was noted that Arnold was of significantly low height and

weight for his chronological age, and Ritalin sometimes adversely affects growth patterns (Safer, Allen, and Barr, 1972).

Despite medication and at least average intelligence (WISC IQ 109; Stanford-Binet IQ 115) Arnold produced almost no work within the classroom. Extensive psychological testing revealed extremely erratic performance, with great fluctuations on the same task administered on different days. One consistent finding was his difficulty in utilizing information presented visually, especially in tasks requiring visual sequential memory. Hence, in addition to the more classical signs of hyperactivity (poor peer relations, inability to follow instructions, poor school achievement, short attention span, high activity level), Arnold also evidenced motor deficits, an abnormal EEG, and idiosyncratic, bizarre behaviors.

General Procedure

Arnold was seen in the clinic for 90 min twice a week for eight weeks. During four of the eight weeks, he received medication; during the other four weeks, he received placebo in a double-blind design.

Arnold was seated at a small table in a 3- by 6-m room with a one-way mirror across one wall. The experimenters were a male and a female therapist who presented the tasks to Arnold during alternate sessions. The experimenter sat on the opposite side of the table and presented the tasks and poker chips as token reinforcers according to the prescribed schedule for a given session. Arnold was shown an array of possible prizes and told their cost in poker chips at the outset of each session. Prizes included such things as plastic models to assemble, a rubber bat, magnets, toy trucks, or planes.

Tasks

During each session, Arnold performed six sequential memory tasks. Recent recall tasks were chosen for two reasons. First, this represented an area of deficit for Arnold as designated by formalized testing. Second, according to previous research, methylphenidate should show its maximum effect on this sort of vigilance task, rather than on a task requiring abstract reasoning ability (Sroufe, 1975).

Three of the sequential memory tasks involved visual input and three involved auditory input. Auditory tasks had already been shown to be easier for Arnold than were visual tasks. Hence, drug and reinforcement effects could be assessed in relation to an area of comparative strength, as opposed to one of deficit.

Visual Tasks

1. *Card sequence.* Arnold was shown a display of six playing cards of a single suit for 5 sec. The cards were then shuffled and handed to Arnold to arrange in the same sequence. Arnold was given five trials of different sequences at each session. A trial was scored as correct only if all six cards were in the designated order.

2. *Memory for designs.* Arnold was shown a design drawn on a 7.5- by 12.5-cm card for 5 sec. The design was withdrawn, and Arnold was asked to produce the design with paper and pencil. Arnold was presented with five different designs at each session. Each reproduction was given a rating of 1, 2, or 3, depending on accuracy. The total number of points earned divided by a perfect score of 15 yielded the per cent correct score for each session.

3. *Imitation sequence.* The experimenter modelled a four-step, motor sequence and then asked Arnold to imitate the four actions. There were five such sequences at each session. The correct execution of each step was noted, and Arnold received a per cent correct score for each session.

Auditory Tasks

1. *Unrelated words.* Arnold was asked to repeat a sequence of six unrelated words just uttered by the experimenter. Five different sequences of six unrelated words were presented at each session. Each correctly repeated word was noted, and Arnold received a per cent correct score for each session.

2. *Comprehension questions.* Arnold was read a short segment from a book or article appropriate to his grade level. He was then asked to answer seven questions related to the material just read to him. Each correct answer was noted, and Arnold received a per cent correct score for each session.

3. *Auditory command sequence.* Arnold was given a verbal command involving four distinct steps. The correct execution of each step was noted. Five such four-step commands were given at each session, and Arnold received a per cent correct score for each session.

Observation System

The accuracy of task performance was charted as the per cent correct on each of the six tasks at each of the 16 clinic sessions. In addition, several other dimensions of Arnold's behavior were tracked within each clinic session. Ritualistic behavior, eye contact with the experimenter, and distractible behavior were charted. During each 1-min interval of a given session, each of the above behaviors was noted as either present or absent. Each session was composed of 60 to 90, 1-min intervals. The following definitions were used: (1) *ritualistic behavior:* any repetitive noise or repetitive gesture of the upper extremities. (2) *eye contact:* more than 5 sec of mutual eye contact with the experimenter during a given minute. (3) *Distractible behavior:* any surplus movement or a repetitive movement involving the lower extremities. During each session, Arnold received a per cent score of 1-min intervals in which (1) ritualistic behavior, (2) eye contact with the experimenter, and (3) distractible behavior were observed to occur.

Observers and Reliability

Three observers coded the above behaviors while observing through the one-way mirror. Two observers also functioned as the experimenters during alternating sessions. Observers were not informed of the medication regime.

During six of the 16 clinic visits, two observers independently coded Arnold's behavior. The scoring of each 1-min interval was compared separately for each of the behavior categories. The per cent agreement of the observers was obtained by dividing the number of intervals scored the same by both observers by the total number of 1-min intervals for that session. The mean per cent agreement across the six reliability checks was: (1) eye contact 0.86, (2) ritualistic behavior 0.88, (3) distractible behavior 0.71. The mean per cent agreement across all behavior categories over the six reliability checks was 0.82.

Home Procedure

The mother administered a token economy for Arnold's appropriate behavior within the home throughout the eight weeks of the study. The mother and Arnold negotiated together what the prize would be and its cost in points. Typical prizes included a family outing to a drive-in movie, a box of colored pencils, a kite. Points were awarded by the mother for cooperative behavior with friends and sibling and for compliance with her requests. Arnold continued to accumulate points until a given prize had been won. Arnold was given 2 min of "timeout" in the bathroom following each observed aggressive act. Aggressive behavior was defined as a noxious motor action (*i.e.,* hitting, poking, pushing, grabbing) directed toward another person.

The mother collected data on Arnold's behavior for three 5-min time segments each day. Five minutes of data were collected in the morning, 5 min in the afternoon, and 5 min in the evening. During each minute of the 5-min interval, the mother noted the occurrence of ritualistic, distractible, or aggressive behavior. If none of these occurred, the minute was scored as appropriate. No interobserver reliability information is available regarding the home-observation system. However, the mother did not know when Arnold received Ritalin and when placebo. An informal log or diary kept by the mother indicated that she was unable to guess correctly which weeks Arnold received placebo and which Ritalin.

Drug Management

Before the study, Arnold had received 10 mg of Ritalin QID (four times per day). This had been established as his optimal dosage following several dosage trials under the direction of a private pediatrician. During the initial six weeks of the study, a staff psychiatrist prescribed either 10 mg of Ritalin QID or placebo QID for Arnold. The mother was given an envelope containing the medication for each week. Medication was dispensed in a double-blind design. Neither the experimenters, the mother, nor Arnold were aware of when Arnold received Ritalin or when he received placebo. During each of the four two-week phases, however, it was understood that Arnold would be on Ritalin for one of the weeks and on placebo the other week. Thus, during each of the four phases of the study (Baseline, Treatment I, Treatment II, Reversals), Arnold was on Ritalin half the time and on placebo half the time. Medication changes occurred on Saturdays. Arnold was seen in the clinic on Tuesdays and Thursdays.

Reinforcement Contingencies

The first two weeks, or four clinic visits, were a baseline condition. No poker chips were given to Arnold, and no prizes were available. Arnold performed the six sequential memory tasks at each session, and data were collected as to his task accuracy and his behavior.

Treatment Phase I occupied the next two-week period or second-four clinic visits. Poker chips, exchangeable for prizes at the end of the session, were introduced. These tokens were given for "hands down" and quiet behavior. All hand behavior was categorized into either ritualistic or "hands down, quiet behavior". "Hands down, quiet behavior" was incompatible with ritualistic behavior. Hands were required to be in a resting position or engaged in the handling of task materials without repetitive or bizarre gestures. Any verbalizations were required to be compatible with task requirements. A shaping process was employed. At first, Arnold received a chip for each 15 sec of "hands down" behavior not accompanied by bizarre noises. The experimenter placed a running stopwatch on the table. Each time Arnold raised his hands towards his face, engaged in ritualistic behavior, or made strange noises, the experimenter stopped the watch and turned away from Arnold for the duration of the ritualistic behavior. As soon as Arnold returned to the "hands down" position and was quiet, the experimenter again oriented toward Arnold, started the stopwatch, and resumed administration of the task. After 15 sec of "hands down" behavior, Arnold was handed a chip and told, "Good, you have your hands down and you are quiet". When Arnold had succeeded in earning chips for three consecutive 15-sec intervals, the time interval was lengthened to 30 sec. According to the same criteria, the interval was lengthened to 45 sec, 1 min, and eventually to 3-, 4-, and 5-min intervals on a random basis. During Treatment Phase I, no chips were dispensed for task accuracy. Chips were contingent only on lack of ritualistic behavior.

Treatment Phase II occupied the third two-week period. During these four clinic visits, Arnold continued to receive poker chips contingent on the absence of ritualistic behavior, and also earned chips contingent on the accuracy of his task performance. Arnold earned a chip for each correct response as outlined in the section describing the tasks.

During weeks seven and eight, there were two reversals of the reinforcement contingencies. During Session 13, the tokens were given for task accuracy, but chips were not dispensed for "hands down" behavior. In Session 14, tokens were once again given for both task accuracy and "hands down", quiet behavior. In Session 15, the reversal was re-instituted, and poker chips were given contingent on task accuracy, but no chips were dispensed for "hands down" behavior. During the final session, chips were again given for both accuracy and "hands down" behavior. Two reversals were required in order to counterbalance for possible medication effects. During one of the reversals, Arnold received Ritalin.

During the other reversal, Arnold received no medication.

The price of prizes was manipulated in such a way that Arnold was capable of "purchasing" a single prize at each session. Only once did he earn sufficient chips to buy two prizes at a single session. Hence, if chips were dispensed for both task accuracy and "hands down" behavior, the cost of a prize was increased for that session. Arnold was informed of the price at the beginning of each session.

The home program remained the same throughout the study. Points were earned for cooperation with peers and sibling and for compliance with requests. Timeout was administered for aggressive behavior. No points were given for lack of ritualistic or distractible behavior, although the mother collected data on these behaviors.

RESULTS

An analysis of variance, repeated measures design was employed to analyze the clinic data for drug and reinforcement effects with respect to: (a) task accuracy, (b) ritualistic behavior, (c) distractible behavior, (d) eye contact. Home data were analyzed separately to discern possible effects on ritualistic behavior, and aggressive behavior.

Clinic Data

Drug Effects

The data on Ritalin *versus* placebo effects within the clinic are presented in Figure 1. There was no significant difference in Arnold's ability to perform either auditory or visual tasks whether on or off medication ($F = 0.1$, $df = 1/2$). He was better able to retain auditory than visual material whether on Ritalin or placebo.

Similarly, there was no main drug effect with respect to per cent time spent in: (a) ritualistic behavior ($F = 12.86$, $df = 1/2$, (b), distractible behavior ($F = 1.00$, $df = 1/2$), or (c) eye contact with the experimenters ($F = 0.3$, $df = 1/2$). During Sessions 5 and 6, the first two sessions in which reinforcement was introduced, a shaping procedure was instituted, reinforcing 15, 30, and 45 sec of "hands down" behavior. Even though Arnold's behavior came under the control of this reinforcement system, the observation system did not immediately reflect the change. During baseline, Arnold had engaged in ritualistic behavior for 30 to 50 sec of every minute. During Sessions 5 and 6, Arnold might raise his hands towards his face only once or twice during the minute. However, according to the coding system, if any instance of ritualistic behavior occurred, the minute was scored as ritualistic. The data system was hence slow to reflect the actual changes in Arnold's behavior. Coincidentally, it happened that Sessions 5 and 6 were placebo sessions. The trend of the data in Table 1 to show less ritualistic behavior under Ritalin than placebo is probably due to this anomaly of the coding system, rather than to a trend of drug effect. In any case, there was no main drug effect nor any interaction effect between reinforcement and drug condition with respect to ritualistic behavior.

Reinforcement Effects

The data on reinforcement effects are also evident in Figure 1 and Table 1. Arnold was significantly more accurate in performing the sequential memory tasks during sessions when he received poker chips for correct responses than during sessions when he did not receive chips for accuracy whether or not he was on medication ($F = 14.62$, $df = 1/3$, $p < 0.05$). There is no significant interaction between reinforcement and drug effects ($F = 0.2$, $df = 2/2$). There does appear to be a differential effect of reinforcement contingencies on auditory *versus* visual memory tasks (see Table 1). There is some gain in accuracy for both sorts of tasks when correctness is reinforced, but the majority of gain is seen in visual tasks. Hence, reinforcement effects are greatest in the area of initial deficit.

Significant reinforcement effects are also seen with respect to ritualistic behavior ($F = 76.00$,

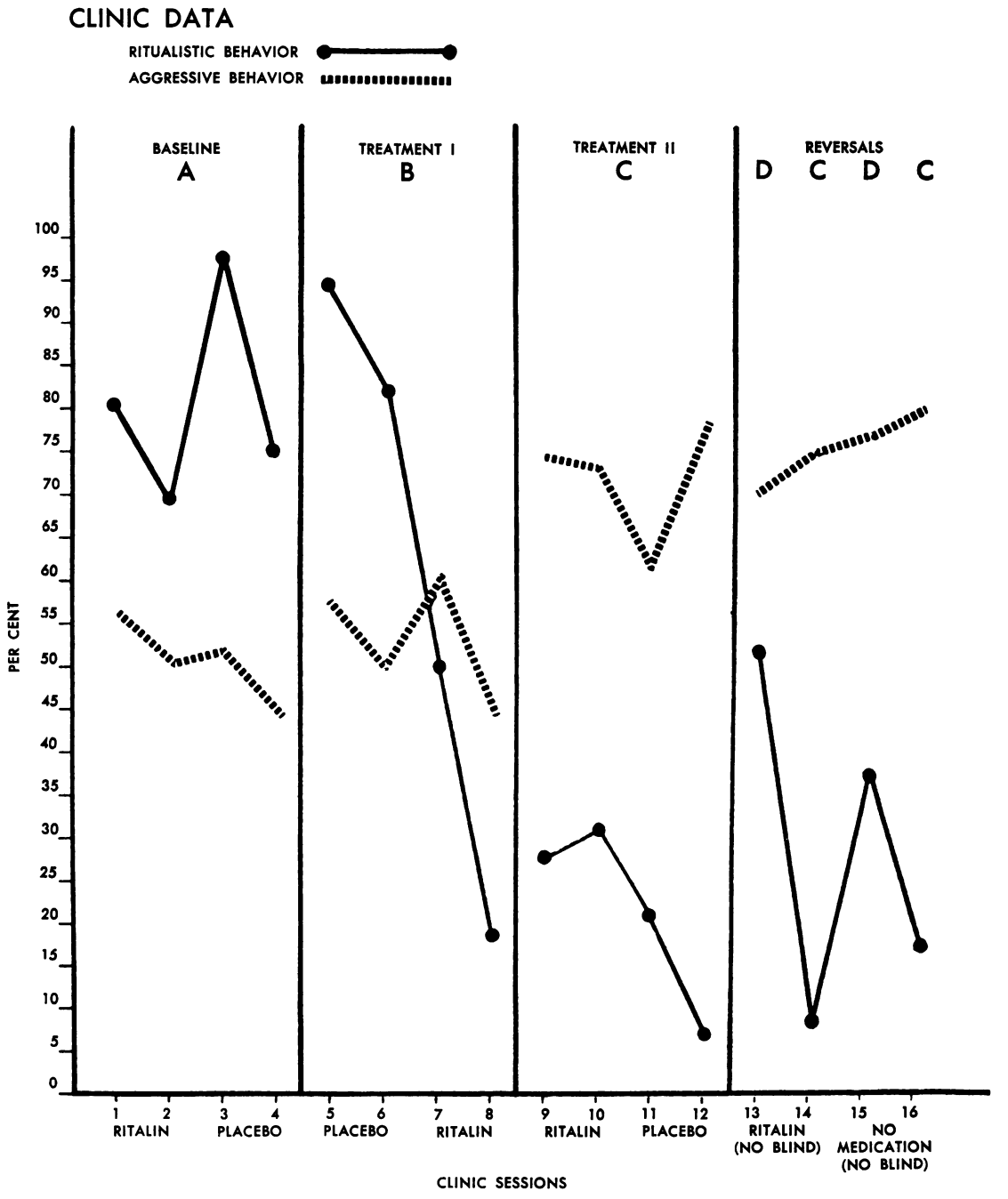

Fig. 1. Clinic: Mean per cent correct on tasks and mean per cent 1-min intervals in which ritualistic behavior was observed to occur—(A) Baseline: no tokens for "hands down"; no tokens for accuracy. (B) Treatment I: tokens for "hands down"; no tokens for accuracy. (C) Treatment II: tokens for "hands down"; Token for accuracy. (D) Reversal: no tokens for "hands down"; tokens for accuracy.

$df = 2/2$, $p < 0.025$). Regardless of whether Arnold was on Ritalin or placebo, he showed less ritualistic behavior during sessions in which he received poker chips for "hands down", quiet behavior than during baseline and reversal (no reinforcement) days. Again, there was no signifi-

Table 1

Reinforcement and Drug Effects in Clinic

I. *Task Accuracy*—mean per cent correct		
	Ritalin	*Placebo*
A. Reinforcement for accuracy	0.73	0.77
No reinforcement for accuracy	0.51	0.50
	Auditory Tasks	*Visual Tasks*
B. Reinforcement for accuracy	0.77	0.70
No reinforcement for accuracy	0.65	0.49
II. *Ritualistic Behavior*—mean per cent 1-min intervals		
	Ritalin	*Placebo*
Reinforcement for "Hands Down, quiet behavior".	0.29	0.44
No reinforcement for "Hands Down, quiet behavior".	0.67	0.70
III. *Distractible Behavior*—mean per cent 1-min intervals		
	Ritalin	*Placebo*
Reinforcement for "Hands Down, quiet behavior".	0.21	0.32
No reinforcement for "Hands Down, quiet behavior".	0.36	0.40
IV. *Eye Contact*—mean per cent 1-min intervals		
	Ritalin	*Placebo*
Reinforcement for "Hands Down, quiet behavior".	0.44	0.37
No reinforcement for "Hands Down, quiet behavior".	0.09	0.16

cant interaction between reinforcement and drug effects with respect to ritualistic behavior ($F = 2.6$, $df = 2/2$).

There were also no significant reinforcement or interaction effects with respect to either distractible behavior or amount of eye contact with the experimenters. Reinforcement in the form of poker chips was never dispensed contingent on either of these behaviors. Distractible behavior and eye contact were monitored to gauge possible drug effects and to assess whether reinforcement effects might generalize to behaviors other than those directly reinforced. This did not occur.

Figure 1 presents the clinic data for task accuracy and ritualistic behavior. Ritalin and placebo days are denoted, as well as changes in the reinforcement regime. This provides a graphic depiction of the maleability of Arnold's ritualistic behavior and accuracy of recall to reinforcing events. It also shows the relative imperviance of these behaviors to drug effects.

Home Data

Home data collected by the mother are presented in Figure 2. There was a significant drug effect with respect to ritualistic behavior. ($F = 36.15$, $df = 1/6$, $p < 0.001$). Arnold engaged in significantly more ritualistic behavior during the weeks he received Ritalin than during the weeks he received placebo. There was no generalization to the home of the reinforcement contingencies applied at the clinic ($F = 2.55$, $df = 2/12$). The amount of ritualistic behavior recorded at home was unrelated to any contingencies applied within the clinic. At home, no contingencies were applied to ritualistic behaviors.

There was also a significant drug effect with respect to aggressive behavior ($F = 50.63$, $df = 1/6$, $p < 0.001$). Arnold was much less aggressive during weeks he received Ritalin than during weeks he received placebo. Aggressive behavior at home appeared unaffected by the reinforcement contingencies within the clinic

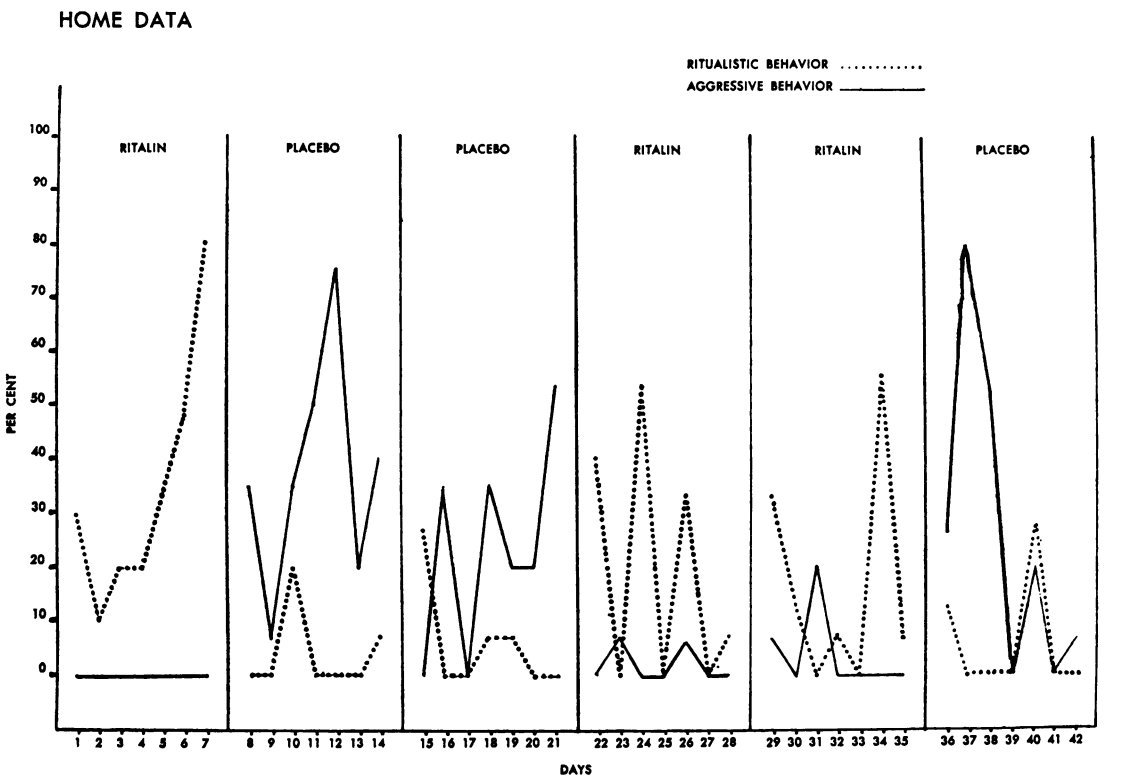

Fig. 2. Home: mean per cent of 1-min intervals in which ritualistic and aggressive behavior was observed to occur under Ritalin and placebo conditions.

($F = 0.4$, $df = 2/12$). Aggressive behavior was not in evidence in the clinic; Arnold was seen individually and aggressive responses were typically directed at Arnold's sibling or peers. However, the effects of medication in possibly curtailing aggression was a major concern of the parents. Aggressive behavior in the home was also monitored to assess possible generalization of clinic reinforcement procedures to behaviors never specifically reinforced.

Hence, while there were no significant drug effects within the clinic, a very different result was found within the home. Arnold showed an increase in ritualistic behavior but a decrease in aggressive behavior when on Ritalin as compared to placebo. None of the reinforcement programs in the clinic showed any generalization to the home.

DISCUSSION

Recent reviews on both drug management (Grinspoon and Singer, 1973; Sroufe, 1975) and behavior management (Berkowitz and Graziano, 1972) of children have stressed the notion that in future research, multiple problem behaviors need to be monitored in several settings to assess the breadth and generalizability of beneficial effects. In both fields, it now appears that behavioral changes may be more circumscribed than early studies seemed to indicate. Drug effects, for instance, for any particular child appear to be related to the degree of structure in a given situation and to the nature of the task posed to the child. The child on medication does not uniformly perform at a higher level in all settings and on all tasks than he does on placebo. Similarly, changes in behavior rendered by reinforcement contingencies do not appear to generalize to other settings or to other behaviors simply as a matter of course (Wahler, 1969; Wulbert, Barach, Perry, Straughan, Sulzbacher, Turner, and Wilts, 1974). Indeed, generalization must, itself, be programmed and reinforced. The present study attempted to delineate setting, task,

and measurement variables in assessing the relative efficacy and possible interaction of drug effects and of contingency management in the treatment of a particular child.

For this child, no significant drug effects on any of the problem behaviors were discerned within the structure of the clinic setting, but definite drug effects were noted within the home. Arnold engaged in significantly less aggression but significantly more ritualistic behavior at home when receiving Ritalin rather than placebo. One might conjecture that initially, Ritalin did exacerbate Arnold's tic-like behavior, but that over time this ritualistic behavior became particularly strongly conditioned to stress or demand situations such as existed at school and in the clinic. Hence, ritualistic behavior eventually became relatively autonomous of drug effects in these stress situations, but remained a function of Ritalin within the relaxed structure of the home.

Reinforcement contingencies imposed within the clinic successfully diminished these repetitive behaviors within the clinic. However, since there were no contingencies for such tic-like behaviors imposed within the home, the ritualistic behavior remained a function of drug management in that setting. There was no automatic generalization from the clinic to the home of "hands-down" quiet behavior.

It is important to note that there were no interaction effects. Although clinical lore maintains that use of Ritalin and the amphetamines render hyperactive children more accessible to learning and reinforcement effects, there is little research to substantiate this notion. Arnold showed no tendency to respond more readily to a reinforcement regime when medicated than when on placebo. Hence, the present study does not support the common assumption that medication enhances learning effects.

Drug effects were purposely evaluated in the clinic setting with those aspects of Arnold's behavior where the *greatest* medication effect would be predicted control of excess activity level and accuracy of performance on vigilance-type tasks. Arnold had been maintained on Ritalin for 3 yr before the study because parents, teachers, and pediatrician were all convinced of its global beneficial effects. However, when specific behaviors were monitored, it was discovered that medication was actually associated with an increase in one of the problem behaviors (excess repetitive movement) in some settings. Since the actual beneficial effect of Ritalin was restricted to a decrease in aggression at home, and since it was feared that Ritalin was adversely effecting Arnold's growth pattern, he was removed from medication as a result of this study.

The reinforcement regime was shown to be the potent variable in controlling Arnold's behavior within the clinic setting. It should be stressed, however, that reinforcement effects did not readily generalize to either other behaviors or to other settings. Increased eye contact with the experimenters and decreased excessive movement of the lower extremities were behaviors never specifically reinforced during the study. These behaviors did not change as a function of the reinforcement of increased task accuracy and decreased excessive movement of the upper extremities. In analogous manner, there was no evidence of the generalization of changes acquired in one setting to that of another setting. Although Arnold successfully decreased his ritualistic behavior in the clinic, a similar decrease did not simultaneously appear in the home where contingencies were unchanged. Thus, when Arnold was removed from medication, specific behavior-management programs had to be fashioned to the home and school. Arnold was placed in a special classroom that operates on a token economy. At home, a shaping procedure was instituted to control aggressive behavior.

It is hoped that the present study may serve in a pragmatic manner as a model for evaluating specific medication effects for the individual child. The idiosyncratic nature of drug effects for any particular child require monitoring several simultaneous dimensions. Global ratings of improved *versus* unimproved would appear inadequate in weighing the advantages and disadvan-

tage for a particular child of maintenance on a drug whose long-term effects are unknown.

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