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An Analysis of the Hyperactive Syndrome: A Comparison of Hyperactive, Behavior Problem, Asthmatic, and Normal Children[1]

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In an attempt to determine whether the commonly described deficits associated with hyperactivity – inappropriate activity, short attention span, low frustration tolerance, and impulsivity – are unique to this population, hyperactive, behavior problem, asthmatic, and normal control children were studied. The tests most often used in research with hyperactives were administered. Hyperactives, when compared to normals, did show deficits in the aforementioned areas. However, when compared to the behavior problem and asthmatic children only the attentional deficits clearly differentiated hyperactives from the other children.

Hyperactivity is one of the most common childhood problems encountered by both clinicians and educators today. Recent estimates apply this label to between 7% and 10% of the school-age population, although previous estimates have ranged from 3% to 20% (Stewart, Pitts, Craig, & Dieruf, 1966). Although it was originally thought to be due largely to organic factors or birth complications, controlled investigations have not found any significant differences in these areas between groups of hyperactives and normal controls (Dubey, 1976; Douglas, Werry, & Weiss, 1965; Sroufe, 1975). However, there has been evidence that congenital factors may influence the development of hyperac-

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tivity with the discovery of a higher incidence of minor physical anomalies in these children when compared to normal children (Firestone, Lewy, & Douglas, 1976; Rapoport & Quinn, 1975; Waldrop & Halverson, 1971). More extensive investigations comparing hyperactives ot other pathological groups have not reported similar differences. When autistic and retarded children of idiopathic origin and hyperactives were studied, it was discovered that there were more minor physical anomalies in all these groups than with normal controls (Firestone, Peters, Rivier, & Knights, 1978; Steg & Rapoport, 1975). In fact, Firestone, Peters, Rivier, and Knights (1978) have found that hyperactives, retardates, their siblings, and their parents had equal number of minor physical anomalies that were significantly higher than those in normal control children and their families. There was no evidence of behavior disorders in the siblings of the probands. These results suggest that minor physical anomalies may be found more frequently in many behaviorally disordered children and are not unique to hyperactives.

Several deficits in the cognitive and behavioral spheres of hyperactive children have been identified. Although early investigations suggested that hyperactives were much more active than normal controls, more systematic research has revealed that it is not the overall activity level that distinguishes these children but its social inappropriateness (Barkley & Ullman, 1975; Keogh, 1971; Werry & Sprague, 1970). In addition, it is generally reported that the major cognitive deficits of hyperactives lie in the areas of an inability to sustain attention (Douglas, 1972a, 1974; Cohen & Douglas, 1972; Sykes, Douglas, & Morgenstern, 1972; Firestone & Douglas, 1975), poor impulse control (Campbell, Douglas, & Morgenstern, 1971; Douglas, 1972a, 1974; Firestone & Douglas, 1975; Meichenbaum & Goodman, 1969; Palkes, Stewart, & Kahana, 1968), and low frustration tolerance (Campbell & Douglas, 1972; Marwit & Stenner, 1971; Parry & Douglas, 1974; Schrager, Lindy, Harrison, McDermott, & Wilson, 1966; Douglas, 1974). However, a major problem with research in this area is that virtually all studies to date have compared hyperactives to normal controls. The history of research with hyperactive children as well as other pathological groups (Quay & Werry, 1972; Steg & Rapoport, 1975; Firestone, Peters, Rivier, & Knights, 1978) has suggested that comparison of pathological groups with normal controls is insufficient to adequately describe the uniqueness of a disorder. Specifically, it is possible that the reported deficits of hyperactive children may bot be sufficient to delineate the disorder but rather may be common to a number of, if not all, pathological groups of children.

The present study was an attempt to describe those deficits that might be unique to hyperactive children. In order to achieve this goal, hyperactive, asthmatic, behavior problem, and normal control children were studied. Asthmatic children were chosen as one reference group because they are a large group of easily identifiable children who do not demonstrate significant emotional pathology or abnormal parenting (Quay & Werry, 1972). However, these

youngsters do experience a considerable amount of attention from health care professionals. The four groups of children were given some of the most commonly reported tests in the research literature on hyperactivity.

METHOD

Subjects

Fifty children between the ages of 5 and 12 from the Children's Hospital of Eastern Ontario took part in the investigation. The children were required to have a Peabody Picture Vocabulary IQ of 80 or higher and to be living at home with at least one parent. Excluded from the samples were children showing definite signs of brain damage, epilepsy, or psychosis, and those on any form of psychotropic medication. Table I describes the population under investigation.

Hyperactive Children (HA). These subjects were diagnosed as hyperactive by a pediatrician and a psychologist and had four primary problems: overactivity, short attention span, impulsivity, and an inability to tolerate frustration. In addition, problems with aggressiveness, tantrums, or oppositional behavior had to be present. These characteristics had to be present since early childhood (1½-2 years of age) and be evident at home and in school. In addition, each child had an average score of 1.5 or higher on the hyperactivity factor of the Conners (1969) rating scale for teachers (TRS).

Behavior Problem Children (BP). Any of the children thought to be hyperactive by some observers but not unanimously rated as hyperactive by the four observers (parents, teachers, pediatrician, psychologist) were placed in this group. Thus these children were showing problematic behaviors of the "conduct-disorder" type, but either home or school behavior was not seen as a severe problem or their developmental histories were not consistent with hyperactivity.

Asthmatic Children (AC). These subjects were selected from the total population of asthmatic children hospitalized during 1975 or 1976. Each child had been hospitalized for at least 3 nights for breathing difficulties during this

Table I. Description of the Four Groups Studied

	Hyperactive (N = 12)	Behavior Problem (N = 8)	Asthmatic (N = 15)	Control (N = 15)
Age	8.10 ± 1.50	8.14 ± 1.94	8.32 ± 1.87	9.63 ± 1.45
IQ	116.27 ± 14.30	110.42 ± 20.67	110.46 ± 15.50	108.13 ± 13.15

period. This was an attempt to ensure that only the more serious cases be accepted. None of these children were described as or had ever been referred to a professional for behavior or learning problems.

Normal Control Children (NC). Included in this category were children attending the outpatient medical clinics during 1975-1976. These children were seen at the hospital for annual medical examinations or minor medical problems (abrasions, influenza, etc.). Children with chronic illnesses and those who had spent more than 2 nights in a hospital during the designated period were excluded from the study. These children had never been referred for professional help related to behavior or learning problems, nor were they currently described as problematic.

Rating Scales, Tests, and Apparatus

Conners Rating Scales. Conners (1969) has developed a widely used rating scale for teachers; this scale of 39 items has been factor-analyzed to give five factors: (1) Conduct-Problem, (2) Inattentive-Passive, (3) Tension-Anxiety, (4) Hyperactivity, and (5) Sociability. The score for each factor is based upon the mean of the items within the factor (a 4-point scale, 0-3, is used). A score of 1.5 or higher on the hyperactivity factor is a frequently used criterion for inclusion into a hyperactive group.

Matching Familiar Figures Test. The children's form of the MFF, a test of impulsivity, consists of 12 standard pictures familiar to children and 6 variants of each standard. The *S* must point to that variant that is identical to the standard that remains in view. Two scores are obtained for each *S*: (1) the mean latency to the first response on each of the 12 items and (2) the total number of errors on each item.

Story Completion Test. Douglas and her colleagues have developed a semistructured, projective technique for use with children (Douglas, 1965; Campbell & Douglas, 1972; Parry & Douglas, 1974). In this test (Parry & Douglas, 1974) eight unfinished stories are presented to each child. Each story depicts a hero who is about to embark on an interesting experience and some external event occurs that threatens to interfere. The story, which is read aloud by the experimenter, is stopped at this point. The examiner then reads three alternative endings and the *S* is asked to choose which ending best completes the story. These endings are coded as either (1) denial, (2) pessimism, or (3) compromise. Douglas and her colleagues have found that hyperactives tend either to deny the existence of frustrating events or to respond with extreme pessimism. Nonhyperactive children between 6 and 12 years of age usually react realistically and compromise.

Maze Test. This maze test is based on the Porteus Mazes Test (Porteus, 1968). The examination of qualitative scores (Q-scores) instead of mental ages

or test quotients on the Porteus Mazes gives an indication of impulse control rather than IQ or planning ability (Erikson & Roberts, 1967). In the present study an automated version of the maze was used that simplifies collection of Q-scores by automatically recording the number as well as the duration of contacts with the sides of the maze. The task requires a child to run a stylus through a maze, which is upright. The maze is completed twice with the dominant hand. The average score for the trials is computed. Total time to complete the task is also monitored. Norms for this task have been collected by Knights and Moule (1968).

Reaction Time Apparatus. The reaction time apparatus has been used previously (Cohen & Douglas, 1972) and has been shown to be sensitive to the effects of methylphenidate (Cohen, Douglas, & Morgenstern, 1971; Firestone, Davey, Goodman, & Peters, 1978; Firestone & Douglas, 1975).

The reaction time apparatus was triggered by auditory stimuli that had been preprogrammed. Stimuli were recorded on separate channels of a stereophonic tape recorder. The first tone was fed directly from the first channel of the tape recorder to the *S's* earphone and acted as the warning signal (WS). This was a 500-cps tone of 70-dB intensity and 1-second duration. Onset of the WS marked the beginning of a 10-second preparatory interval at the end of which another tone recorded on the second channel of the tape recorder activated the reaction signal (RS). This consisted of a 7.5-watt light bulb enclosed in a small gray metal container, which was situated along with the response button on the right arm of the *S's* chair. Trials were separated by a 5-second interval. The circuit was constructed so that the RS would not appear unless the response button was depressed. Simultaneous with the appearance of the RS a Standard Electrical Clock Timer started and ran until the *S* removed his finger from the response button. The onset and termination of the warning and reaction signals and the *Ss* responses were automatically marked on the polygraph chart record.

Three kinds of "impulsive" responses were studied in relation to the DRT. False starts refer to those button releases that occurred between the onset of the WS and up to 2.5 seconds following its occurrence. Interstimulus responses were those that occurred from 2.5 seconds after the WS up to the onset of the reaction signal. Responses after the button release to the reaction signal that occurred before the warning signal of the next trial were designated redundant responses.

Stabilimetric Cushion. During the reaction time test, children were seated in an armchair fitted with a stabilimetric cushion designed to measure gross motor activity. Sensitive switches, located under the foam at the four corners of the cushion, automatically record any movement on a display panel out of sight of the child. This type of apparatus was previously used by Sprague and Toppe (1966).

Procedure

Each child was tested alone in a small windowless room. All paper-and-pencil tests, which took about 26 minutes, were administered first, in a random order of presentation. The second part of the experimental session consisted of the reaction time test and also took about 25 minutes. The child was seated in an armchair equipped with a stabilimetric cushion. The reaction time apparatus was attached to the right arm of this chair. Each subject was told that the experimenter was interested in how fast he or she was, and how still he or she could sit. During the task the chair was facing a blank wall and the lights were dimmed in order to eliminate as many extraneous variables as possible.

RESULTS

An analysis of variance indicated that the four experimental groups did not differ significantly in age or IQ (Table I). The teacher-rated Conners scores for the AC and NC groups were unavailable because of parental reticence concerning school involvement when their children were experiencing no educational difficulties. Ethical considerations dictated that such requests be honored. The analysis performed on the scores for the remaining two groups (the HA and the BP groups) were nonsignificant, indicating that there were no differences between the two groups on any of the five factors, as rated by the teachers (Table II).

Due to absenteeism, equipment failure, and lack of cooperation, there were incomplete data on some subjects. For statistical examination, the dependent variables were broken down into two multivariate analyses of variance (MANOVA). The first MANOVA was performed on that subset of the original 50 subjects who were missing no data on the 10 main dependent variables. The second MANOVA was performed on all those subjects missing no data on the story completion test.

The MANOVA performed on the 10 main dependent variables resulted in a significant main effect, $F(3,45) = 2.05$, $p < .01$. Table III presents the

Table II. Teachers' Ratings for the Hyperactive and Behavior Problem Children

	Hyperactive	Behavior problem
Conduct problem	.97 ± .60	1.08 ± 1.12
Inattentive-passive	1.33 ± .59	1.18 ± .57
Tension-anxiety	.28 ± .19	.80 ± .67
Hyperactivity	2.30 ± .51	1.43 ± .96
Sociability	.15 ± .32	.00 ± .00

Table III. Means and Standard Deviations for the 10 Dependent Variables in the First MANOVA

Group[a]		Variable									
		MFF latency	MFF errors	Maze duration	Maze contacts	Maze total time	Reaction time	False starts	Interstimulus responses	Redundant responses	Stabilimetric cushion
Hyperactive	$\bar{X}$	15.79	18.00	3.77	17.65	51.79	.93	4.18	5.09	8.90	47.81
	SD	26.24	11.38	3.18	11.89	15.76	.35	2.60	5.20	7.91	49.89
Asthmatic	$\bar{X}$	20.90	7.86	1.91	9.89	65.13	.60	3.66	3.86	4.60	25.13
	SD	13.36	5.34	1.62	7.70	28.65	.16	3.63	5.13	5.90	25.19
Normal control	$\bar{X}$	20.33	5.86	1.29	7.76	71.93	.45	2.53	.66	1.93	13.13
	SD	10.38	5.37	1.76	8.90	16.78	.09	2.66	.81	2.91	15.85
Behavior problem	$\bar{X}$	8.82	14.00	1.72	12.68	66.92	.54	8.25	1.62	4.25	6.87
	SD	4.70	5.45	.68	5.19	20.41	.11	10.60	2.61	4.55	10.00

[a]N = 11, 15, 15, and 8, respectively.

Table IV. Univariate *F*-Test Statistics for the 10 Dependent Variables Used in the First MANOVA[a]

Variable	*MS*	*F*
MFF latency	309.35	1.26
MFF errors	380.91	7.42[b]
MAZE duration	14.04	3.42[c]
MAZE contacts	225.18	2.86[c]
MAZE total time	886.20	1.88
Reaction time	.51	12.47[b]
False starts	59.04	2.33
Interstimulus responses	51.36	3.31[c]
Redundant responses	103.82	3.38[c]
Stabilimetric cushion	3455.99	4.09[c]

[a] $df = (3,45)$.
[b] $p < .01$.
[c] $p < .05$.

means and standard deviations for these variables. Univariate tests indicated that there were significant differences between the groups on 7 of the 10 variables (see Table IV). Dunn's test (cited by Kirk, 1968), an a priori test for nonorthogonal comparisons, was used in a post hoc fashion to examine the relationship between the groups on those dependent variables for which there was a significant univariate effect, with a .05 level of significance being employed. The dependent variables can be discussed under the headings of (1) psychometric tests of impulsivity (the MFF and Maze Test), (2) attention as measured by the reaction time task, and (3) tests of motor inhibition (false starts, interstimulus and redundant responses, and the stabilimetric cushion measure).

Psychometric Test of Impulsivity. On the MFF it was found that the hyperactives made significantly more errors than did the AC and NC groups, but not more than the BP group. The latter three groups did not differ from each other.

The hyperactives made significantly more contacts (touches to the sides of the maze) and contacts of longer duration on the maze test than the NC group, but they did not differ from the AC or BP groups on either measure. The NC, AC, and BP groups did not differ significantly.

Reaction Time Task. The AC, BP, and NC groups all evidenced significantly faster reaction times than did the hyperactive group, while not differing significantly from each other.

Tests of Motor Inhibition. Hyperactives made more gross body movements than the NC and BP groups, but not more than the AC. The three nonhyperactive groups did not differ from each other.

Table V. Means and Standard Deviations for the Three Dependent Variables in the Story Completion Test

Group[a]		Variable		
		Compromise responses	Pessimistic responses	Denial responses
Hyperactive	$\bar{X}$	2.90	1.18	4.90
	SD	2.84	1.77	2.25
Asthmatic	$\bar{X}$	4.15	2.15	2.69
	SD	2.07	2.67	2.05
Normal control	$\bar{X}$	5.86	1.53	1.60
	SD	2.26	1.92	1.45
Behavior problem	$\bar{X}$	5.66	1.66	1.66
	SD	.57	.57	.57

[a] $N = 11, 13, 15$, and 8, respectively.

The hyperactive group made more interstimulus and redundant responses than did the NC group, but not more thant the AC and BP groups. The latter three groups did not differ from each other on either measure.

The MANOVA performed on the story completion test scores also resulted in a significant main effect, $F(3,38) = 2.20$, $p < .01$. Table V presents the means and standard deviations of the story completion scores. Univariate analyses indicated that significant differences existed among the four groups on compromise responses, $F(3,38) = 7.15$, $p < .01$, and denial responses, $F(3,38) = 7.15, p < .01$.

Dunn's tests indicated that the hyperactive group made significantly fewer compromise responses than did the NC group, but the same number as the AC and the BP group. The three nonhyperactive groups did not differ significantly from each other. The hyperactives made significantly more denial responses than all three other groups, which did not differ from each other.

DISCUSSION

Comparison of the Hyperactive and Normal Control Children

In general the results of the present study replicate previous findings suggesting that hyperactive children are more inattentive, more impulsive, and more easily frustrated than normal control children. The hyperactives also appeared more active than the normal control children as measured by the stabilimetric cushion. This suggests that although their apparent activity

level may be amplified by other deficiencies, it may not be appropriate to simply label it an illusion dependent upon their more basic attentional deficit (Cromwell, Baumeister, & Hawkins, 1963).

A small number of other discrepancies arose between present findings and past reports. For example, previous research has isolated a pattern of responding in the hyperactive child delineated by quick responses and high error rate (Campbell et al., 1971). It was found in the present study that the hyperactive group was no more hasty in responding on the MFF than the NC group, although the higher error rate was evident. A similar pattern was found on the maze test. Hasty execution (measured by total time) was not found to be characteristic of the hyperactive children, although maze contacts and duration (which are somewhat equivalent to the MFF error rate) did significantly differentiate between the two groups. Although the hyperactive group took the same length of time as the NCs in making their first response, the excessive number of errors seems to indicate that they did not utilize their time as efficiently for problem solving as did the NC group.

The hyperactive children in the present study did, in general, show poorer inhibitory control than the other children, as evidenced by the higher rate of interstimulus and redundant responses. However, it is not clear why a greater number of false starts was not found as in previous research (Firestone & Douglas, 1975).

The hyperactive subjects in the present study evidenced slower mean reaction times than did the NC groups. This supports previous suggestions that hyperactive children are deficient in attentional processes (Cohen & Douglas, 1972; Firestone & Douglas, 1975). Also supported was the suggestion by Parry and Douglas (1974) that hyperactive children, as compared to NCs, are unable to cope realistically with frustrating events. Instead they tend to deny the existence of such events. The extreme pessimism found by Parry and Douglas with hyperactives was not found in the present study.

Comparison of the Hyperactive with the Behavior Problem and Asthmatic Children

Of central interest to the present investigation was the performance of hyperactive children when compared to other children with problems. The results are thus discussed with this view in mind. It is important to recall that the BP children were differentiated from the hyperactive group on the basis of disagreement among four sources (physician, psychologist, mother, and teacher) concerning their diagnosis. Because of this it must be kept in mind that any differences found between the two groups may be spurious rather than an indication of real differences; that is, the two groups may represent

similar children with only the accuracy of observors differing. They may, however, reflect real differences between the children and justify the inclusion of the BP group as separate from the hyperactive group.

The performance of the BP group was similar to the hyperactives on all but three psychological measures. These children performed faster than the hyperactives on the reaction time task, suggesting superior attentional processes; they moved less on the stabilimetric cushion, indicating greater motor inhibition; and they made fewer denial responses on the story completion test. The BP children did not differ from the NCs on these measures. The fact that the BP children performed as poorly as the hyperactive group on the MFF and the maze tests and the remaining tests of motor inhibition suggests that here at least may be one other pathological group who share some deficits with hyperactive children. The story completion test results indicate that hyperactives are not alone in having difficulty accepting compromise solutions to frustrating events. In general, it seems that the behavior problem children share deficits in impulse control with hyperactive children but do not share their attentional problems.

Results indicate that the asthmatic group performed as poorly as the hyperactive group on several measures. They made as many contacts of long duration on the maze test as did the hyperactives. They also made as many interstimulus and redundant responses and as many gross body movements as measured by the stabilimetric cushion. Story completion scores indicated that the hyperactive and asthmatic groups seemed to find it equally difficult to accept realistic compromise solutions to frustrating events. It appears that the asthmatic children share deficits in impulse control and motor inhibition with hyperactive children but do not share their problems with attentional processes.

It is interesting to note that the asthmatic children appear to share certain psychological deficits with the hyperactive children but are not perceived as behavior problems as are the hyperactives. Gittelman-Klein, Klein, Abikoff, Katz, Gloisten, and Kates (1976) have pointed out that psychological and behavioral measures do not always correspond. Rather than being used interchangeably, these measures might be used as complementary diagnostic tools.

The results of the present study corroborate previous suggestions concerning the specific deficits apparent in hyperactive children when compared to a normal control group. They appear to be more inattentive, more impulsive, and more active than normal children. They also find it more difficult to handle frustration realistically than do normal controls. The present results demonstrate, however, that similar deficits can be found in other pathological groups. In fact, the only deficit that remains, when the other pathological groups are considered, is that of attention. This suggests that the definition of hyperactivity, based on the most commonly used criteria, may not be satisfactory.

Further investigations are required to delineate the necessary and sufficient characteristics for the label of "hyperactive" for a child. Also, at least one pathological reference group ought to be included in any research into psychological disorders in order to provide additional control. Whether the similarities among the three pathological groups presented here are reactive to being labeled "ill" or are inherent in each pathology would also be worthwhile pursuing.

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