A Naturalistic Assessment of the Motor Activity of Hyperactive Boys

I. Comparison With Normal Controls

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• The motor activity of hyperactive and normal boys was studied in 12 age- and classroom-matched pairs. Activity was measured continuously for a one-week period with a portable solid-state monitor. Hyperactives exhibited generally higher levels of motor activity than normal controls regardless of the time of day, including during sleep and on weekends. In a situation-by-situation analysis, hyperactives were most consistently and significantly more active than the controls during structured school activities. Little evidence was found, however, to support the hypothesis that hyperactivity is simply an artifact of the structure and attentional demands of a given setting. Pervasive increases in simple motor behavior are a clear attribute of hyperactive behavior and distinguished hyperactives from controls as well as did a standardized measure of attention.

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Clinically, hyperactive children are described as overactive, impulsive, incapable of sustained attention, and having difficulties in school.[1,2] The diagnosis of hyperactivity, however, is still in dispute despite a great deal of research effort.[3,4] Controversy centers around the measure-

See also p 688.

ment of specific symptoms and the situational specificity of these symptoms, as well as their clinical significance. Further, hyperactives as a group are heterogeneous in the number and degree of symptoms exhibited, and it is generally thought that no one symptom can be considered diagnostic. The question of the relative importance of the various symptoms has recently been underscored by the change in the category hyperkinetic reaction of childhood to attention deficit disorder in the latest *Diagnostic and Statistical Manual* of the American Psychiatric Association (*DSM-III*),[5] based in part on the discrepant data concerning motor activity in these children. Because of the inconsistencies in definition and in the measurement of behaviors considered characteristic of hyperactivity, it is often impossible to compare the findings of different research centers.

Objective, reproducible measurements of characteristic hyperactive behaviors in the laboratory, particularly motor activity, are difficult to obtain and have yielded inconsistent results.[6-8] There are several factors that appear to influence laboratory measurements of motor activity: (1) the type of activity measured, (2) the method of measurement, (3) the length of the observational period, and (4) most importantly, the nature of the setting in which the observations were made. Attempts to objectively quantify activity levels have included such devices as actometers (modified automatically winding wrist watches), pedometers, and stabilimetric chairs. Such studies are often conducted over short time periods in laboratory settings designed specifically to study the effect of setting on activity. Actometer measurements of ankle or wrist movement are higher for hyperactive children than normal control children in structured situations,[9,10] but not during free play.[7,11] These results are similar to observer ratings of gross and small motor movement.[10-14] Other measurement systems such as quadrant changes in a grid-marked room measure only gross locomotor activity and are probably not sensitive to fidgetiness and restlessness, which are among the most common complaints about hyperactive children. Studies using ultrasound and photoelectric cells require expensive equipment and a laboratory setting, and these devices are sometimes unreliable.[15]

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Table 1.—Sample Characteristics of Normal and Hyperactive Boys

Measure	Mean ± SD	
	Normals (N=12)	Hyperactives (N=12)
Age, yr	8.6±1.9	8.6±2.1
PANESS* score	0.36±0.06	0.35±0.05
Teacher Rating Scale†		
Conduct factor	0.37±0.60	1.31±0.68
Hyperactivity factor	0.31±0.30	2.67±0.33
Parent Rating Scale†		
Conduct factor	0.47±0.44	1.10±0.36
Hyperactivity factor	0.54±0.50	2.31±0.45
Continuous Performance Test		
Omission errors	14.3±4.6	17.7±4.9
Commission errors	13.2±4.7	23.3±14.4
Interstimulus interval, ms	700±245	1,273±921
WISC-R* full-scale IQ	. . .	111±15

*PANESS indicates Physical and Neurological Examination for Soft Signs; WISC-R, Wechsler Intelligence Scale for Children–Revised.
†Items scored 0 through 3.

Because of questions regarding the ubiquitousness and essentiality of motor activity in the diagnosis of hyperactivity and the problems of situational specificity, we undertook an investigation of the motor activity of hyperactive and normal children over an extended time frame in their own home and school environments. To the best of our knowledge, to date there has been no naturalistic study of activity levels in these patients; in part, this has been due to the lack of a suitable measurement device with a long-term internal memory capacity. Such a device, recently developed at the National Institutes of Health by Colburn and his colleagues,[16] is capable of recording hourly activity data continuously for up to 240 hours. These activity monitors have been used for short-term observations of hyperactives and normals, reliably demonstrating higher levels of activity in hyperactives and reductions after a single dose of stimulant drug.[17] They have also been used in long-term studies of adult depressive patients,[18] but have never been used for long-term outpatient observations of children. In this investigation, we studied the motor behavior of children on a 24-hour basis for one-week periods in their own environments in a wide range of different settings.

SUBJECTS AND METHODS

Subjects

Hyperactive boys between the ages of 6 and 12 years were recruited from area schools and clinics. Inclusion criteria for hyperactivity were (1) at least 2 SDs above published age-matched, sex-matched norms on factor IV (hyperactivity) of the Conners' Teacher Rating Scale[19] and (2) evidence of restlessness or inattention on observation or from history in at least one other situation (home, psychiatric interview, or psychological testing). Exclusion criteria were (1) "hard" neurological disease, ie, clinical seizure disorder or other medical disorder, (2) major psychiatric disorder such as psychosis or depression, but not conduct disorder or developmental disorder, (3) full-scale IQ less than 80 on the Wechsler Intelligence Scale for Children—Revised (WISC-R), and (4) special class placement (classmates were used as controls to match school schedules). Twelve boys met the criteria and were included in the study. Age- and classroom-matched normal boys were selected, with the aid of community teachers and parents, as controls. In each case, they were a classmate/friend of the hyperactive boy under study. Usually controls were neighbors; in addition to school schedules, therefore, weekend activities such as church and sports were often similar as well.

Psychiatric interviews were carried out on all boys, using a structured psychiatric interview.[20] Community teacher behavior ratings[21] and parent ratings of behavior[22] were also obtained. All boys were examined neurologically with a standardized neurological examination, the Physical and Neurological Examination for Soft Signs (PANESS).[23] Attention was assessed clinically and with an automated vigilance task, described later. In addition, each hyperactive boy was given a battery of psychological tests that included the WISC-R, Peabody Individual Achievement Test, Bender-Gestalt Test of Perceptual Motor Abilities, and projective tests. Each boy included in the study met the *DSM-III* diagnostic criteria for attention deficit disorder with hyperactivity. Two children also met the *DSM-III* criteria for conduct disorder, undersocialized, nonaggressive, while seven of the 12 were diagnosed as also having one or more specific developmental disorders (reading, one; articulation, two; mixed, four; and arithmetic, one). Evidence of inattention and motor restlessness on the basis of history and/or observation was present in school in all 12 subjects; at home in nine of the 12; on interview in nine; and from notes of clinical psychological testing in ten of the subjects. All subjects were judged hyperactive in at least two situations. None of the control boys showed evidence of hyperactivity on the basis of psychiatric interview, parent or teacher ratings, or history; however, two had mild developmental disorders (articulation, one; mixed, one).

Characteristics of the sample are shown in Table 1. All control boys were within 1 SD of mean age norms on factors I and IV (conduct problems and hyperactivity, respectively) of the Conners' Teacher Rating Scale.[21] Ratings on the Conners' Parent Symptom Questionnaire[22] followed a similar pattern. Hyperactives made significantly ($P<.05$) greater numbers of commission and omission errors on the initial presentation of the Continuous Performance Test (CPT).[24] No evidence of differences in neurological status was noted, however, as reflected in PANESS[23] scores. It should be stressed that these hyperactive children were all from middle-class homes and had a relatively mild disorder for which special class and/or special living facilities would not be clinically considered.

Procedure

During the one-week study, the motor activity of each subject and control child was monitored continuously. To correlate activity counts with the type of activity they reflected, children (with parental aid) kept an hourly diary of their school, after-school, evening, and weekend activities. These daily diaries included mealtimes, bedtime, organized sports, indoor and outdoor play periods, television watching, religious activities, shopping, etc. School schedules were also obtained from teachers and included reading, mathematics, lunch, recess, physical education, and special events. At the end of the week, each subject was administered the CPT, and behavior for that week was rated by parents using the Conners' Parent Questionnaire and by teachers using the Abbreviated Conners' Rating Scale.

Motor Activity.—Motor activity was automatically and continuously recorded for seven days, 24 hours per day. It was measured by an acceleration-sensitive device with a solid-state memory that stores data on the number of movements per unit time over a ten-day period.[16] In this case, motor activity counts for consecutive one-hour periods were recorded. The measurement of movement by the monitors is nonlinear, in that the presence of any acceleration above a certain threshold is recorded. Maximum sampling occurs at the rate of 1.14 movements per second. Because of limited memory capacity, each activity count represents the sum total of 16 movements stored in the accumulator. Therefore, for example, ten activity counts in an hour actually represent 160 movements. The accumulator accepts a maximum of 255 activity counts per time period. The total number of counts per hour was printed out at the end of the week with a digital computer. The monitors measured $4 \times 6 \times 1$ cm, weighed 75 g, and were worn continuously, including during sleeping hours, in a pouch suspended on a belt worn around the waist. Thus, truncal activity was the dimension of movement that was sampled. Monitors were removed only during activities that might damage the monitor (eg, bathing and swimming). Because between-subject comparisons were performed, great care was taken in the choice and calibration of the monitors. Attempts

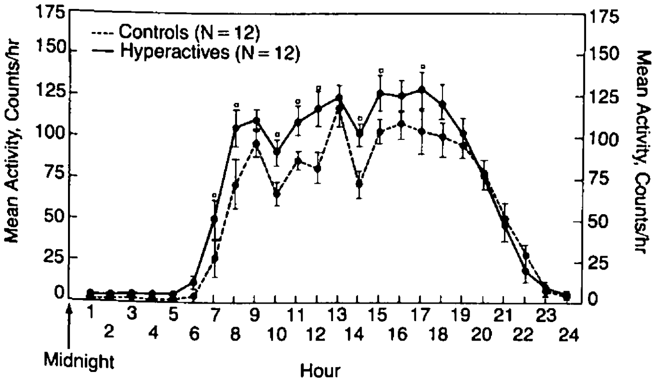

Fig 1.—Mean hourly activity scores over period of three to five days and SEMs for hyperactives and controls calculated for typical weekday. Small squares indicate hours during which hyperactives were significantly more active than controls ($P<.05$, by Scheffé procedure after analysis of variance).

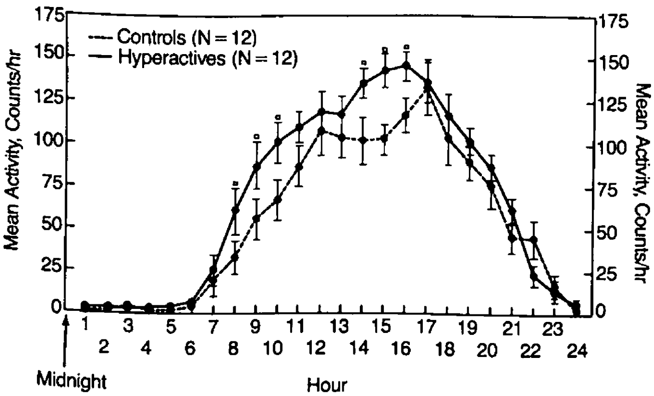

Fig 2.—Mean hourly activity scores (over period of one to two days) and SEMs for hyperactives and controls on weekends. Small squares indicate hours during which hyperactives were significantly more active than controls ($P<.05$, by Scheffé procedure after analysis of variance).

were made to use monitors that had very close calibration factors, minimizing the degree of variability inherent in this method of measurement. In this way, valid comparisons could be made between each hyperactive subject and his age- and classroom-matched control.

Sustained Attention Measure.—Rosvold and colleagues'[24] CPT was modified to allow a greater performance range in normal subjects. A sequence of single letters were presented to the subject on a digital display with a stimulus duration of 150 ms. The subject's task consisted of pushing a button when an "X" appeared if, and only if, it was directly preceded by an "A." Failure to do so was scored as an omission error; pressing the button outside the critical sequence was a commission error. The error rate was increased by reducing the interstimulus interval, originally set at 500 ms, by 5% after each correct identification and increasing the interval by 5% after each error of commission or omission. Subjects were instructed to maximize the presentation rate. The task took approximately seven minutes, during which 30 critical stimuli were presented.

RESULTS

All subjects completed the one-week study without problems. Of the 24 boys who took part, all but one kept the monitor on at all times. This subject did not wear the monitor while sleeping. In general, there were few difficulties in adjusting to the monitors, and most subjects reported "forgetting they had them on."

Total activity counts for each subject were obtained for each hour of the 168-hour study period. Because of technical failure, however, there was occasional partial data loss. The diaries, kept by the subjects, contained sufficient information to allow general type of activity to be categorized for specific hours during each day. The activity data were analyzed in two ways: (1) a comparison of activity levels based solely on the hour of the day was made between the hyperactive and control groups using a profile analysis of variance (ANOVA)[25]; and (2) comparisons of activity scores dependent on the type of activity were made using t tests for independent samples.

Table 2.—Profile Analyses of Variance Comparisons of Average Hourly Activity Scores of Hyperactive and Normal Boys

	Mean Squares	DF	F	P
Weekdays				
Groups				
Hyperactives v controls	18,828.4	1.21	6.88	.02
Time				
Hour of day	51,542.7	1.21	87.36	.0001
Group × time	589.99	1.21	1.65	NS
Weekends				
Groups				
Hyperactives v controls	19,794.1	1.20	5.84	.025
Time				
Hour of day	54,186.0	1.20	64.23	.0001
Group × time	1,288.2	1.20	1.53	NS

Overall Activity Levels

For the purpose of this analysis, the data were first separated into weekday (school days) and weekend 24-hour periods. Hourly activity counts for any day on which data were missing, because a subject failed to wear the monitor or because of technical failure, were discarded. Data for days that were considered atypical (eg, holidays, school trips, etc) were also excluded. Next, the data for each subject were considered in daily 24 one-hour blocks, beginning with activity counts for the midnight to 1 AM block and ending with the counts for the 11 PM to midnight block. Hourly means for each subject were then computed from the data for the qualifying days to derive individual average hourly activity scores over a "typical" 24-hour day for weekdays and weekends. Because one of the control subjects did not wear his monitor while sleeping, his data were excluded from this analysis.

Mean hourly activity scores considered in 24-hour blocks for hyperactive and control subjects (Figs 1 and 2) were compared with profile ANOVA[25] (group × time) separately for weekdays and weekends. The results of these analyses are shown in Table 2. As this table shows, the hyperactive boys displayed greater activity levels than the control boys on weekdays ($F=6.88$, $df=1.21$, $P<.02$) and on weekends ($F=5.84$, $df=1.20$, $P<.025$). There was also significant variation in activity levels across hours. No interaction was seen, however, between groups and hour of the day either on weekdays ($F=1.65$, $df=1.21$, not significant) or weekends ($F=1.53$, $df=1.20$, not significant), indicating that hyperactive boys were more active than controls regardless of the time frame. This included sleeping as well as waking hours.

Differences between groups at individual time points were then compared with the Scheffé multiple comparison procedure.[26] Hyperactive boys were significantly ($P<.05$) more active during the hours shown in Figs 1 and 2. On weekdays, the hours during which hyperactive boys displayed higher activity levels, as measured by activity monitors, included most school hours as well as midafternoon and the hours just after waking. On weekends, the pattern was very similar; early morning and early to midafternoon hours showed the greatest differences between hyperactives and controls.

Activity Levels During Specific Situations

Using the diaries plus the teacher schedules, hourly activity counts were coded on the basis of the specific activity that was engaged in during each hour. The predominant activity within the hour was always considered; in the rare cases of ambiguity or

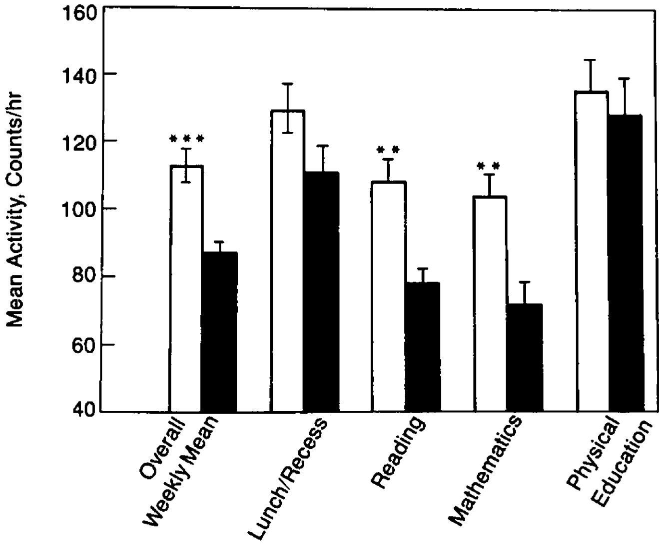

Fig 3.—Mean hourly activity scores over period of four days and SEMs for 12 hyperactives (open bars) and 12 controls (solid bars) during school hours (baseline week). Asterisks indicate significant differences on two-tailed *t* tests: triple asterisk, *P*<.001; double asterisk, *P*<.01.

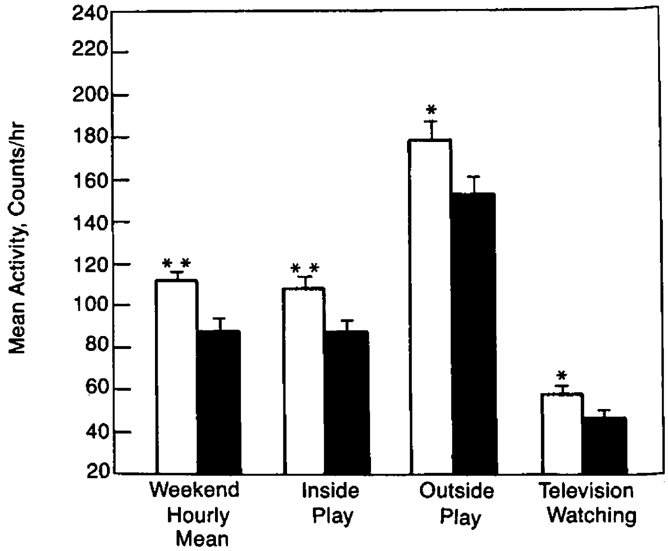

Fig 4.—Mean hourly activity scores (over period of two days) and SEMs for 12 hyperactives (open bars) and 12 controls (solid bars) calculated by activity during weekends (baseline week). Asterisks indicate significant differences on two-tailed *t* tests: single asterisk, *P*<.05; double asterisk, *P*<.01.

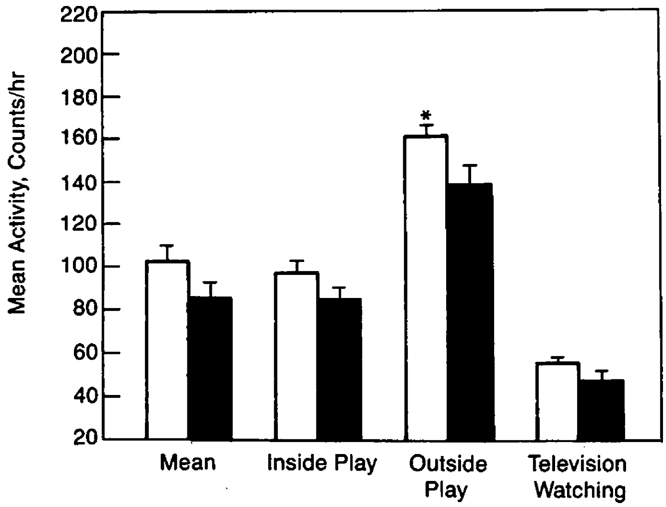

Fig 5.—Mean hourly activity scores (over period of four days) and SEMs for 12 hyperactives (open bars) and 12 controls (solid bars) calculated for specific situations during after-school hours (baseline week). Asterisk indicates significant difference (*P*<.05) on two-tailed *t* tests.

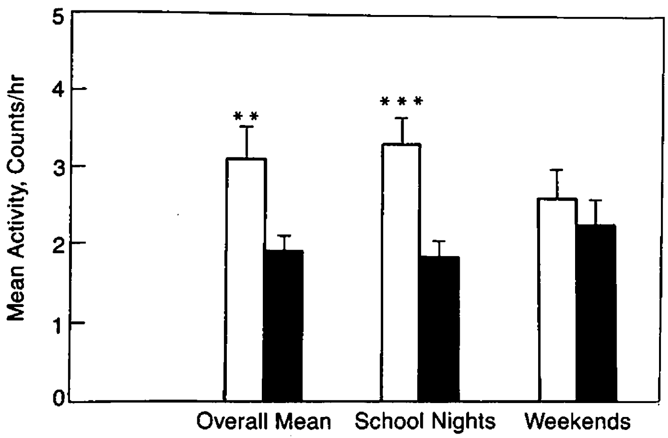

Fig 6.—Mean hourly activity scores and SEMs for 12 hyperactives (open bars) and 12 controls (solid bars) during sleep (baseline week). Asterisks indicate significant differences on two-tailed *t* tests: triple asterisk, *P*<.001; double asterisk, *P*<.01.

inadequate information, those counts were not categorized and therefore were not included in the analysis. The following categories were used for weekdays: school (including all school hours), school reading (including reading, grammar, and other verbal subjects such as social studies), school mathematics, lunch/recess, school physical education, after school (including all after-school hours until bedtime), after-school outside play, after-school inside activities (including meals), after-school television watching, after-school shopping, after-school homework, and after-school organized sports. Weekend categories were inside activity, outside play, television watching, shopping, homework, church, and organized sports. Sleep time was considered the hours between midnight and 5 AM, inclusive. This eliminated (or made very unlikely) problems of inclusion of activity associated with falling asleep or waking. If any indication was present from diaries or the activity records that a child was not asleep during any of the hours, those hours were not included. Sleep was further divided into weeknights (school the next day) and weekends (no school the next day).

After the coding, average hourly activity counts for each category for hyperactive and control subjects were then calculated. These scores were compared with *t* tests for independent samples. No comparison was made if there were insufficient data (N<6).

The results are shown in Figs 3 through 6. There was variation in activity scores depending on the activity. Television watching, for example, produced the lowest levels of activity during waking for both groups, while outdoor play yielded the highest. In each case, the mean hourly activity scores for each category were higher for hyperactive boys than for normal control boys. Significant differences were seen in overall school activity, in activity levels during academic subjects in school, in some weekend activity measures, and also in sleep.

Discriminant Analysis

A stepwise discriminant analysis was used to distinguish, from the baseline-week activity and attention measures, which measure

Table 3.—Wilk's λ and Standardized Discriminant Function Coefficients for Measures Isolated as Best Discriminators Between Hyperactive and Normal Boys

Measure	Wilk's λ	Standardized Discriminant Coefficient
Activity and attention measures		
Overall school activity	.632	.921
CPT* omission errors	.510	.643
Activity measures only		
Overall school activity	.646	1.000
Attention measures only		
CPT* commission errors	.803	1.000

*CPT indicates Continuous Performance Test.

or group of measures best discriminated hyperactive from control boys on the basis of prior clinical assignment to each group. The variables included in this analysis were overall school activity counts, overall after-school activity counts, overall weekend scores, sleep activity scores, CPT-omission errors, CPT-commission errors, and CPT-interstimulus interval. Table 3 summarizes the findings. The Table shows that only two of the seven dependent measures, overall school activity and CPT-omission errors, reached criteria as discriminators. In addition, the overall school activity score was the best single measure for maximizing group differences, and therefore was entered into the discriminant analysis first. The second measure entered was omission errors on the CPT. All other measures did not increase the capacity of the equation to discriminate between the two groups. The combination of these two measures differentiated the two groups with an 87.5% accuracy rate; two hyperactives and one control were not classified correctly. In general, commission errors are better discriminators, and this is also true in our study. Only omission errors, however, added significantly to the motor activity discrimination.

Two subsequent stepwise discriminant analyses were also performed, the first to determine which among the activity measures discriminated between groups best and the second to examine the attention measures in the same way. These results are shown in Table 3. Among the attention variables used in this study, commission errors on the CPT had the highest discriminant ability. On the basis of this variable, 75% of the cases were classified correctly. Of the activity measures, baseline school activity scores were found to have the highest discriminant ability, with correct classification of 75% of the cases. Although both predicted 75% of the sample accurately, different children were misclassified in each case. The motor activity measure tended to misclassify the older hyperactive subjects who generally moved less than younger hyperactives and some controls, while the attention variable tended to misclassify the younger controls who had difficulty with the CPT, which requires rapid identification and discrimination of letters, a difficult task for young children.

COMMENT

This study sought to accurately and objectively record the activity levels of hyperactive children and controls in their natural environments, which included school, home, and sleep, over a one-week time period. Using an activity monitor that sampled truncal movement and recorded these movements on an hourly basis over a far longer time period than in previous studies, we have shown that hyperactive boys had significantly higher activity levels than their normal controls regardless of the hour of the day on both weekdays (school days) ($P<.02$) and weekends (nonschool days) ($P<.025$). This strengthens the argument that hyperactives have quantitatively higher activity levels and are not merely perceived as more active because of the qualitative way in which their activity is expressed. It has been suggested that hyperactives are considered more active than normal children because their movements are inappropriate and lack direction, making their activity seem more salient[27]; it is the inappropriateness rather than the quantity, according to this hypothesis, that is interpreted as overactivity. This is not supported by the present study, in that we have demonstrated increasing levels of motor activity of hyperactive boys when compared with control children, thus confirming previous studies in which multiple measurements (eg, wrist and ankle movements, number of quadrant changes on a grid floor, and total distance traveled by ankle and wrist) of motor activity showed hyperactives to be consistently more active than their normal controls across measures.[8,14] While hyperactives may also exhibit qualitative differences in behavior (an issue not addressed in this study), a substantial ubiquitous increase in simple motor behavior is a clear characteristic of this group.

The methodology of this investigation had three important advantages over those used in other studies of the activity levels of hyperactive children. First, children were not asked or told to engage in any specific tasks or to restrict their participation in any way. For this reason, our measures of their activity are a true reflection of their natural activity. Although significant correlations have been obtained between laboratory measures of hyperactivity and observational measures in the home,[28] the artificiality of the laboratory settings limits attempts to generalize laboratory findings to the "real world." Second, we were able to record behavior over a relatively longer time period than previous studies did. Laboratory and observational studies are restricted by the brevity of the study interval. Although repeated measures have sometimes been employed, this type of procedure is costly and time consuming. Third, our measurements were objective, while other naturalistic studies have involved the use of observers to rate and categorize behavior. Despite high interrater reliability, an element of bias may appear in such measurements that is not present in our study. A strength of observational coding systems is that they can discriminate qualitatively between hyperactives and normals[29,30] in the specific situations for which they were designed. This was one important limitation of the present investigation, in that qualitative differences in activity between hyperactives and controls could not be addressed.

Although hyperactive children displayed higher overall levels of motor activity, in some specific situations, differences between groups were much greater. It is commonly believed that demands for sustained attention in a structured environment such as the classroom exacerbate or even produce the "hyperactivity." Our findings are only partially consistent with this view. Comparisons of average hourly activity scores of hyperactive and normal children showed the greatest differences between groups during school hours and, in particular, during academic subject time (reading and mathematics). In contrast, during lunch and recess periods and during physical education, activity levels increased for both hyperactive and normal children, but did not differ significantly between groups. Times when the environment is less structured and less demanding may allow normal children to also "let go," thus minimizing possible differences. Recent investigations[31] of hyperactive children in the classroom have shown higher rates of hyperactive behavior across situations, similar to our findings, while other studies of observed classroom behaviors have found interactions of classroom structure and hyperactive behavior.[12,18,32] Because of the use of observers, it was possible to record and analyze many types of behavior (eg, vocalizations, peer interactions, off-task behavior) besides simple motor movement, the display of which may be more situation specific as well as more conspicuous than simple motor movement. This problem of quality of movement, not addressed in this investigation, is underscored by studies in which it was found that teachers and psychologists were able to distinguish between hyperactives and normals only in structured situations in which little gross movement was exhibited.[32,33] Clinically, this is an important point. Although hyperactives are more active across situations, as seen herein, it may be that only when their behavior is qualitatively different from that of normals is it sufficiently disturbing to be labeled "hyperactive."

Our results are in partial support of the situational specificity hypothesis during school hours; comparisons of activity levels between groups on weekend (nonschool) hours are not. In a variety of situations with differing degrees of structure and attentional demand, hyperactives showed consistently higher levels of motor movement than did their normal controls. Different settings tended to influence the behavior of both groups similarly in that both groups displayed increases during outdoor play, for example, and much lower levels during television watching. But even during times when they were quietest, hyperactives were still more active—much less able to sit still.

One of the more surprising and impressive results of this study was the higher level of movement of hyperactives during sleep. Sleep patterns of hyperactives, including total sleep time, sleep architecture,[34-37] and autonomic activity during sleep,[37] are very similar to those of normal control children. Some differences have been reported, such as decreased latency to onset of initial rapid-eye-movement periods and increased motor activity in sleep as measured by EEG interruptions.[37,38] Our findings are particularly salient to this point, in view of the way in which the data were collected. Because activity was measured in the home environment, there were no constraints on sleep time except those imposed by parents and no interference from artificial settings or recording equipment. Therefore, in a naturalistic environment, hyperactive children were more restless in their sleep than normal control children. By extrapolation from sleep laboratory data, however, these findings are not likely to be due to differences in actual time asleep, but in fact reflect true differences in activity while asleep. Theoretically, this provides a potent argument against the situationality of hyperactivity and against inattention as a primary determinant of motor activity.

Acceptance of high levels of motor activity as a diagnostic symptom of hyperactivity has never been complete, perhaps because of situational specificity issues. In fact, recent research has emphasized attention deficits as the core and distinguishing symptom.[39,40] A discriminant analysis of the combined set of attention and activity variables used in this study identified an activity measure, overall school activity scores, as providing the greatest predictive ability to discriminate between hyperactives and normal controls. Although another study with different measurement systems has isolated attention variables as better discriminators,[41] the most salient difference between groups in the present study was clearly activity and not attention measures as assessed by the CPT. Moreover, within the hyperactive group, activity did not correlate significantly with attention measures and, therefore, seemed to be an independent variable. In addition, errors on the CPT did not have any significant relation to IQ levels in the hyperactives. All of these findings must be considered with caution because the discriminant analysis was carried out on a small number of subjects with a relatively large number of variables. In terms of diagnosis, then, motor behavior should be included as an important criterion and as a good basis on which to make diagnostic decisions. Despite heterogeneity of other symptoms, high levels of motor activity can be diagnostic, particularly because of the consistency with which it is found.

The most important finding of this investigation is that although there is some contribution of context to the overactivity of hyperactive children, across a variety of situations and physiological states, hyperactives manifested higher levels of motor activity than did their normal controls. Given these findings, a close correlation between ratings of hyperactive behaviors in different situations, as was found by Rapoport and Benoit,[28] would be expected. Frequently, however, no such close correlation between the ratings of hyperactive behavior at home and school is found when parents and teachers are the raters.[6,42-44] Distinctions have been made between situational hyperactivity, which is identified by a single source, either parent or teacher, and pervasive hyperactivity, in which hyperactive-type behavior is seen cross-situationally.[42] Subjects in the present study were determined by their teachers, and in nine of 12 cases also perceived by their parents, as hyperactive. Similarly, nine and ten of the 12 were also considered restless in psychiatric interview or during psychological testing, respectively. It could be argued that the cross-situational nature of the increased activity of these hyperactives, in comparison with controls, may be particular to this type of sample in which the identification of hyperactivity was made by several sources. Pervasive hyperactives in the studies of Schachar and Sandberg and colleagues[4,44] had a greater prevalence of neurological abnormalities, cognitive difficulties, and psychiatric disturbances than the situational hyperactives in their population. In contrast, the boys in the present sample were not severely disturbed, nor did they have low IQs. In most cases, it was their school behavior that was the real concern of the family. Although the characteristics of those regarded as pervasively hyperactive in the previous studies and the hyperactives in the present study were clearly different, high levels of motor activity were seen consistently in this study. It is possible that, at least in terms of motor activity, a greater situational generality of hyperactivity is present than is apparent from studies based solely on parent and teacher ratings. Further study comparing activity levels of pervasive and situational hyperactives, and those with greater and lesser degrees of disturbance in any situation, would help clarify the concept of "the hyperactivity syndrome." Finally, future studies using this technique should compare 24-hour motor activity of hyperactive children with that of other deviant controls. Of particular interest would be a comparison with conduct-disordered populations, as the fundamental difference between these children and hyperactive children has not yet been firmly established.

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