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Observations and Ratings of Tics in School Settings

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This paper describes the findings of a school-based tic assessment procedure (direct observations, teacher rating scales) for hyperactive children with comorbid tic disorder. Rates of motor tic frequency were found to be moderately stable across both days and school settings. Correlations between direct observations of tics and clinician rating scales were generally in the low to moderate range as were correlations between teacher and clinician rating scales. Overall rates of hyperactive/disruptive behaviors were not associated with rates of motor tic occurrence, and the behavioral symptoms of both disorders were also independent for specific intervals of time.

The findings from recent epidemiological studies indicate that tic disorders in the elementary school population are much more common than previously believed (e.g., Burd, Kerbeshian, Wikenheiser, & Fisher, 1986; Comings, Himes, & Comings, 1990). Children with a tic disorder who are referred for psychiatric or neurological evaluation are typically comorbid for a variety of psychopathologies (Chase, Friedhoff, & Cohen, 1992; Cohen, Bruun, & Leckman, 1988; Comings, 1990; Kurlan, 1992; Shapiro, Shapiro, Young, & Feinberg, 1988), most notably attention-deficit hyperactivity disorder (ADHD). Over half of all clinic-evaluated children with Tourette syndrome (TS) show the symptoms of this disorder (Comings &

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Comings, 1984, 1987; Erenberg, Cruse, & Rothner, 1985; Matthews, 1988; Price, Leckman, Pauls, Cohen, & Kidd, 1986; Singer & Rosenberg, 1989; Singer & Walkup, 1991). The relatively high rate of behavioral disturbance in children with TS greatly complicates clinical management by increasing not only the number of target symptoms, but, owing to their differential response to many behavioral and pharmacological interventions, the potential for symptom exacerbation as well (Burd & Kerbeshian, 1987; Gadow & Sverd, 1990).

The behavioral assessment of TS symptomatology shares many common difficulties with the diagnosis and treatment of ADHD, three of which are noted here. First, the topography, frequency, and intensity of tics varies greatly both among and within patients, with the majority of individuals experiencing spontaneous fluctuation in symptom severity over time (Shapiro et al., 1988). Second, many patients are able to briefly suppress tics for varying lengths of time and in certain settings, especially in the physician's office (Cohen et al., 1988; Comings et al., 1990). Third, fluctuation in tic frequency may be task-specific. For example, activities that require concentration are generally believed to be associated with reduced levels of tic activity (Shapiro et al., 1988). For these and other reasons, the traditional office evaluation (observation of the patient and anecdotal reports from caregivers) may not be a satisfactory procedure for evaluating tics.

Unlike the assessment procedures for disruptive behavior disorders, the number of psychometric instruments available for the assessment of tics is limited. Several clinician-completed rating scales are available (Leckman, Towbin, Ort, & Cohen, 1988; Shapiro et al., 1988), but they do not resolve the problem of symptom fluctuation and situational specificity (Walkup, Rosenberg, Brown, & Singer, 1992). To their credit, clinician-completed rating scales generally include historical information obtained from family members, which is clearly important because those family members are much more likely to be exposed to the full range of the child's symptoms. Nevertheless, care providers vary greatly in their knowledge of tics, and many are inexperienced with respect to judging the relative severity of symptoms (Leckman et al., 1988).

Direct observation of child behavior in naturalistic settings has proven to be highly useful in the study of children with ADHD, especially for documenting treatment effects (Abikoff & Gittelman, 1985; Gadow, Nolan, Sverd, Sprafkin, & Paolicelli, 1990; Whalen et al., 1978). Although direct observation procedures for assessing tics have typically been limited to scoring brief segments of clinic-based videotapes (e.g., Goetz et al., 1987; Leckman et al., 1991; Shapiro et al., 1989), some investigators have ventured into the patient's natural environment (Azrin & Peterson, 1990; Gadow, Nolan, & Sverd, 1992).

One procedure that holds promise for the assessment of tics is the school-based medication evaluation (SBME), which uses both direct observations and teacher-completed behavior rating scales to evaluate response to stimulant drug therapy in children with ADHD (Gadow, Nolan, Paolicelli, & Sprafkin, 1991; Gadow et al., 1990). The study reported in this paper used the SBME to examine (a) tic phenomenology (e.g., variability in tic frequency across both time and setting), (b) the reliability and validity of a teacher-completed tic rating scale, and (c) the temporal relation between comorbid symptoms.

METHOD

Subjects

The subjects were 34 children (31 boys and 3 girls) between the age of 6 and 12 years old (M = 8.8; SD = 1.9), who were referred to a Tic Disorders clinic for evaluation by a clinician specializing in the treatment of patients with tic disorders (J.S.) or to a child psychiatry outpatient service. The diagnostic procedure included child and parent clinical interviews and a battery of psychometric instruments for assessing ADHD symptoms and tics. All subjects met DSM-III-R (American Psychiatric Association, 1987) diagnostic criteria for ADHD and either chronic motor tic disorder or Tourette's disorder. A board-certified psychiatrist (J.S.) with 20 years' research and clinical experience treating children with hyperactivity and tic disorders diagnosed each case on the basis of a clinical interview with the parent and a review of the assessment instruments. Each child also met research diagnostic criteria (Kurlan, 1989; Tourette Syndrome Workshop Committee on Classification and Rating Scales, 1988) for Tourette syndrome (definite or by history) or chronic multiple motor or phonic tic disorder (definite or by history). In this study at least one reliable examiner witnessed motor and vocal tics in all of our children.

The tic measures used as part of the diagnostic evaluation were the Yale Global Tic Severity Scale (YGTSS; Leckman et al., 1989) and the Tourette Syndrome Unified Rating Scale (Kurlan, Riddle, & Como, 1988). The extent to which the study sample's tics interfered with normal daily living is best characterized by their Overall Impairment Rating scores from the YGTSS: none (n = 4), minimal (n = 13), mild (n = 7), moderate (n = 7), marked (n = 2), and severe (n = 1). Their Global Severity scores from the same instrument ranged from 13 to 79 (M = 44.6; SD = 13.8). Also obtained from the YGTSS were a Total Motor Tic score (range 9 to 21; M = 14.0; SD = 3.5) and a Total Phonic Tic score (range 0 to 16; M

= 10.6; *SD* = 3.9). For this study, we also calculated a Total Tic score by assuming the Total Motor and Phonic Tic scores for each child; these scores ranged from 10 to 36.

The following ADHD measures were used as part of the diagnostic evaluation: Abbreviated Teacher Rating Scale (ATRS; Conners, 1973), the IOWA Conners Teacher's Rating Scale (Loney & Milich, 1982), the Conners (48-item) Parent Rating Scale (Goyette, Conners, & Ulrich, 1978), the Mothers' Objective Method of Subgrouping (MOMS) checklist (Loney, 1984), and the parent and teacher versions of the Stony Brook Child Psychiatric Checklist (SBC-3R; Gadow & Sprafkin, 1987). All but one child was above cutoff on at least one parent measure: ADHD index (*M* = 9.9; *SD* = 2.4); Conners Hyperactivity index (*M* = 18.1; *SD* = 4.6); and MOMS Hyperactivity subscale (*M* = 4.1; *SD* = 1.2). All children were above cutoff on at least one teacher measure: ADHD index (*M* = 9.8; *SD* = 3.6); ATRS (*M* = 20.0; *SD* = 6.0); IOWA Inattention-Overactivity subscale (*M* = 11.4; *SD* = 3.0). One boy's teacher refused to complete any ratings.

Children who exhibited one or more of the following were excluded from consideration for the study: children who were believed to be too severely ill (dangerous to self or others, tics were the major clinical management concern), psychotic, mentally retarded (IQ < 75), or who had a seizure disorder, major organic brain dysfunction, major medical illness, medical or other contraindication to medication (other than tics), or pervasive developmental disorder.

Medication

Subjects received three (0.1-, 0.3-, and 0.5-mg/kg) doses of methylphenidate and placebo twice daily, 7 days a week for 2 weeks each. Dose schedules were counterbalanced and randomly assigned. Parents and school nurses received medication and identically matching placebos in dated, sealed envelopes at 2-week intervals. Unused envelopes were returned, which allowed us to assess compliance with the medication regimen. Double-blind conditions were maintained throughout the 8-week evaluation.

Procedure

School. The procedure and rationale for conducting a school-based medication has been described in detail elsewhere (Gadow, 1993; Gadow et al., 1990, 1991); thus only a brief description is presented here. Observations of child behavior were conducted by trained observers in three school settings: classroom, lunchroom, and playground. One observer

(E.N.) had several hundred hours of experience using the observation codes in school settings. The other observers were trained with videotapes and in a school setting to a minimum 80% agreement level on each of the code categories and on motor and vocal tics. The protocol provided for 4 days of observation for each treatment condition, but in some cases extraneous factors (e.g., child or teacher absence from school) resulted in fewer days for a condition. The mean number of observation days per setting was as follows: classroom (13.5), lunchroom (13.1), and recess (12.1).

Children were observed for 30 min in the classroom while engaged in academic seatwork. The observers were introduced to the class as student teachers. They sat on the side or in front of the classroom where they would be able to detect tics. Observations were conducted for the entire lunch and recess periods (typically about 20 min) for the elementary school children. In the lunchroom and on the playground, observers maintained a position a short distance away from the children. Lunchroom and playground observations were not conducted for the sixth graders ($n = 6$) because they were considered to be sophisticated enough to be suspicious of "student teachers" who went to lunch and recess with the class. Data were not collected if the regularly scheduled lunch and recess periods were less than 15 min. In addition, one elementary school had no regularly scheduled recess period. The number of children observed in these settings was as follows: lunchroom ($n = 25$) and recess ($n = 19$).

Measures

Observation Codes. The Classroom Observation Code used in this study was a modified version (see Gadow, 1993) of the instrument adapted by Abikoff and Gittelman (1985), which was designed to assess primary hyperactivity symptoms and found to be a highly sensitive indicator of stimulant drug response (Gadow et al., 1990; Gadow et al., 1992; Gittelman-Klein et al., 1976). The Classroom Observation Code assesses interference (with other children), motor movement, noncompliance (failing to follow rules and being reprimanded by the teacher), nonphysical aggression, and off-task (not attending to the assigned task for 3 consecutive seconds).

A modified version of the Code for Observing Social Activity (COSA; Gadow, 1993; Sprafkin, Grayson, Gadow, Nolan, & Paolicelli, 1986) was used for the lunchroom and playground observations. The COSA was developed to evaluate aggressive and prosocial interactions between children and was found to be sensitive to stimulant drug effects (Gadow et al., 1990; Gadow et al., 1992). The COSA assesses appropriate social interaction; physical, nonphysical, and verbal aggression; and noncompliance. Detailed descriptions of both observation codes are available in other publications (Gadow, 1993; Gadow et al., 1991).

ADHD behaviors were coded in 15-sec intervals in the three school settings for the first 45 sec (three intervals) of each minute. Reliability was assessed approximately 25% of the time on 24 of the children in the sample by having a second observer independently code behavior in the school on one-fourth of the observation days. Reliabilities (Cohen's kappa) were calculated for each observation code category in each setting and ranged from .57 to .84.

Tic Assessment. Tics were measured two ways (in each of the three school settings): frequency counts and time sampling. Motor tic and vocal tic categories were added to both the Classroom Observation Code and the COSA. During the first three 15-sec intervals, observers coded the presence or absence of tics. Kappas for motor tics were .69, .67, and .61 (classroom, lunchroom, playground, respectively), and the kappas for vocal tics were .60, .81, and .67 (classroom, lunchroom, playground, respectively). The last 15-sec interval of each minute was used to obtain a frequency count of tics (motor and vocal separately).

The percentage of intervals of occurrence was calculated for each of the behavior and tic categories in each of the three settings for each day. To be consistent with the ADHD behavior categories, a percentage score was obtained for the frequency counts of tics by dividing the total number of tics counted (motor and vocal separately) each day by the number of intervals for that day and multiplying by 100.

Teacher Rating Scales. Teachers were asked to complete several rating scales measuring ADHD (and associated) behaviors and tics for each observation day. They were asked to base their impressions on the child's behavior during the morning that the observations were being conducted.

Teachers recorded their perceptions of tic frequency and severity on the Global Tic Rating Scale (GTRS; Gadow & Paolicelli, 1986). The GTRS contains five items on the frequency of tics: motor tics of the head (e.g., eye blinking, head jerking), neck, shoulder, torso (e.g., shoulder shrugging), and arms, hands, legs, and feet (e.g., arm thrusting, clapping, touching objects or other people); nonverbal sound tics (e.g., coughing, grunting); and verbal tics (e.g., saying repetitive phrases). Four additional items pertain to the severity of tics (i.e., noticeable to others, embarrassing for the child, interfere with school/home functioning, lead to social rejection). All items are rated on a 4-point scale (0 = not at all; 3 = very much). The scores for the three motor tic items and the two vocal tic items are summed to create a Frequency of Motor Tic index and a Frequency of Vocal Tic index, respectively. The four severity items are summed to provide a Tic Severity index.

The behavior rating scales completed by the teacher were as follows: Conners (1973) Abbreviated Teacher Rating Scale (ATRS), the IOWA Conners Teacher's Rating Scale (Loney & Milich, 1982), and the Peer Conflict Scale (Gadow, 1986; Nolan & Gadow, 1994).

Clinician Evaluations. The clinician ratings of tics were completed (by J.S.) at the end of each 2-week dose condition after interviewing the parent and observing the child. The measures used were the YGTSS and the 2-min Motor and Vocal Tic Counts from the Tourette Syndrome Unified Rating Scale. The YGTSS consists of the separate rating of severity for motor and phonic tics along five discriminant dimensions: number, frequency, intensity, complexity, and interference. A Total Motor Tic score and a Total Phonic Tic score are obtained by summing across the five dimensions for motor and phonic tics separately. The Overall Impairment rating focuses on the impact the tic disorder has had (over the previous week) on self-esteem, family life, social acceptance, and school functioning. The sum of the Overall Impairment rating and the Total Motor and Total Phonic Tic scores provides a Global Severity score. The YGTSS has demonstrated convergent and divergent validity and high interrater reliability (Leckman et al., 1989). The 2-min Motor and Vocal Tic Counts from the Unified Rating Scale are the number of motor and vocal tics, respectively, observed during 2 min of quiet conversation with the child. Because the clinician rarely observed vocal tics during the Tic Count procedure, these data were not included in the analyses.

RESULTS

The two methods of coding tics (frequency counts and percent of intervals of occurrence) were compared with pooled within-subject correlations, which account for variation associated with differences in the children as well as across the teachers. The correlations for motor tics were .51, .60, and .66 for classroom, lunchroom, and playground, respectively. For vocal tics the correlations were .75 (classroom), .65 (lunchroom), and .60 (playground). Given the reasonably high convergence between the two methods, we used the percentage of intervals measure for all of the analyses to be more consistent with the assessment of ADHD behaviors.

Variability of Tics (Time and Setting)

Several different aspects of tic phenomenology were examined with respect to variability (across time and setting) and their relationship to ADHD behaviors. Correlational analyses (Pearson) were conducted to assess the situational variability in tic occurrence across structured (classroom) and unstructured (lunchroom, playground) school settings. Because the goal was to assess the normal fluctuation of tic symptoms, and not variability attibutable to medication, the placebo data were used for these analyses. Only the first 3 days of placebo data were included in the analyses because not all the children were observed for 4 days. Motor tic occurrence was moderately to highly stable across the three settings: classroom versus lunchroom, $r = .79$, $p < .0001$; classroom versus playground, $r = .81$, $p < .0001$; lunchroom versus playground, $r = .64$, $p < .0001$. Vocal tics were also fairly stable between classroom and lunchroom ($r = .72$, $p < .0001$) and lunchroom and playground ($r = .47$, $p < .001$), but not between classroom and playground ($r = .16$). Difficulties in detecting vocal tics on the playground may partially account for the lower correlation.

Day-to-day variability in motor and vocal tic occurrences, in each of the three school settings was assessed with intraclass correlations. As can be seen in Table I, occurrence of motor tics was moderately to highly stable across days in all of the school settings and vocal tics were moderately stable in the classroom. Intraclass correlations were somewhat lower for lunchroom observations of vocal tics because of the relative difficulty of coding vocal tics in this setting. The difficulties associated with coding vocal tics on the playground precluded the calculation of a meaningful index of variability.

Finally, we examined the cooccurrence of motor and vocal tics in the same 15-sec intervals of time in the classroom. The resulting phi coefficient of .07 suggests that motor and vocal tics were temporally independent of each other. In fact, vocal tics cooccurred with motor tics less than 2% of the time.

Relationship Between ADHD Symptoms and Tics

To explore the overall relationship between the frequency of ADHD symptoms and tics, Pearson correlations were performed between the daily

Table I. Day-to-Day Variability in Motor and Vocal Tics

	Intraclass correlation			
	Classroom	Lunchroom	Playground	Teacher GTRS[a]
Motor tics	.71[b]	.61[b]	.52[b]	.78[b]
Vocal tics	.64[b]	.39[b]	—	.58[b]
Severity	—	—	—	.77[b]

[a]GTRS = Global Tic Rating Scale.
[b]$p < .01$.

percentage scores for each of the five classroom behavior categories and motor and vocal tics. Because medication had a differential effect on tics and ADHD behaviors (Gadow et al., 1992), only the data for the placebo condition were used in these analyses. None of the ADHD behaviors were significantly correlated with motor tics; the frequency of vocal tics correlated significantly with noncompliance (r = .39, p < .0001).

To further explore the temporal relationship between comorbid symptoms, the cooccurrence of ADHD behaviors and tics in specific intervals of time was examined. Phi coefficients were calculated between the presence (or absence) of each of the five behavior categories and motor and vocal tics in each 1-sec interval of classroom observation for the entire placebo condition. Although several of these coefficients were statistically significant, they were all of extremely low magnitude (below .1), indicating that tics and ADHD symptoms were independent of each other with respect to specific units of time (i.e., the symptoms of the two disorders did not occur concurrently).

Convergence Between Measures

Correlational analyses were conducted to examine the relationship between clinician and teacher ratings and school observation of tics. For all comparisons involving the clinician ratings, observation and teacher rating scale data were weighted according to the actual number of days of data within a drug condition, which for the clinician scales was always one. Due to the large number of correlations, the alpha level of .05 was adjusted (Bonferroni) to control for chance findings. Correlations reported as significant therefore are those significant at an adjusted alpha level of .0004.

Agreement Between Observations and Ratings. Pearson correlations between clinician ratings and school observations (using data from the placebo and drug conditions) revealed several low to moderate relationships (see Table II). Observed rates of motor tics in the classroom and lunchroom correlated significantly with all of the clinician YGTSS ratings, and on the playground with all but the Global Severity score. Observed vocal tics correlated with the clinician's Total Phonic Tic score for the classroom observations. The clinician's 2-min Motor Tic Count significantly correlated with observed motor tics in the classroom and lunchroom (r = .16 and r = .22, respectively).

Pearson correlations (unweighted) between direct observations of tics in the classroom and teacher-completed GTRS indices revealed little concordance. Observed frequency of vocal tics correlated with teacher-rated vo-

Table II. Correlations Between Clinician Tic Ratings (YGTSS) and School Observations of Tics[a]

	Total motor tics	Total phonic tics	Overall impairment rating	Global severity score
Class				
Motor tics	.33[b]	.22[b]	.22[b]	.26[b]
Vocal tics	.09	.31[b]	.01	–.01
Lunch				
Motor tics	.42[b]	.27[b]	.27[b]	.30[b]
Vocal tics	.10	.05	.03	.07
Playground				
Motor tics	.31[b]	.42[b]	.27[b]	.22
Vocal tics	.08	.09	.18	.22

[a]YGTSS = Yale Global Tic Severity Scale.
[b]$p < .0004$.

cal tic frequency ($r = .21$). Observations of the frequency of motor tics were not significantly correlated with any of the teacher-rated GTRS indices.

Symptom Severity and Convergence Between Measures. Convergence between measures was examined further by dividing the sample into two groups on the basis of combined Total Motor and Total Phonic Tic scores (YGTSS) obtained during the diagnostic evaluation. Children with a combined score of less than 25 were assigned to the mild tic severity group, and those with a score greater than 25 comprised the moderate tic severity group ($n = 17$ for each group).

None of the correlations between clinician ratings and observations was significant in the mild tic severity group. For the moderate tic severity group, the clinician's Total Phonic Tic score correlated with observed frequency of vocal tics in the classroom ($r = .28$) and with motor tics on the playground ($r = .39$). Although not significant at the stringent .0004 alpha level, observed motor tics in the lunchroom correlated ($r = .24, p < .003$) with both the clinician's Total Motor Tic score and the Overall Impairment rating and with the Global Severity score ($r = .27, p < .001$). The clinician's 2-min Motor Tic Count was significantly related to the observed frequency of motor tics in the school for the children with mild tic disorder in the classroom, $r = .26$, and the lunchroom, $r = .49$. The correlation with playground observations, $r = .34$, did not meet the .0004 alpha level criterion ($p = .002$).

As was the case for clinician ratings, none of the correlations between teacher GTRS ratings and classroom observations of tics for the mild tic severity group was significant. In the moderate severity group, observed vocal tics correlated with teacher-rated tic severity ($r = .31$) and vocal tic frequency ($r = .26$, $p < .003$), but the latter did not meet the criterion for significance at the adjusted alpha level.

Agreement Between Teacher and Clinician Ratings. Analyses of clinician and teacher ratings revealed low significant relationships between the clinician's YGTSS Total Motor Tic score and the teacher's GTRS Motor Tic Frequency ($r = .25$) and Tic Severity ($r = .20$). When correlations were performed separately for the tic severity groups, there was little evidence of rater convergence. In the mild severity group, the only significant correlation ($r = .32$) was between the teacher's GTRS vocal tic frequency score and the clinician's YGTSS Total Motor Tic score. None of the correlations for the moderate severity group was significant.

The clinician's 2-min Motor Tic Count was significantly correlated with teacher-rated motor tic frequency ($r = .30$) for the total sample and for the mild tic severity group ($r = .27$).

Reliability of Teacher Ratings

Intraclass correlations with the placebo data revealed moderate to high reliability for all three of the teacher GTRS indices (see Table I).

DISCUSSION

The results of this study indicate a fair degree of temporal and situational stability for motor tics. The apparent variability in vocal tic rates, particularly in the unstructured school settings, probably resulted from difficulties in detecting vocal tics in these settings. Examination of the specific temporal relationship between the symptoms of ADHD and tic disorders revealed that motor tics were not temporally related to the behavioral symptoms of hyperactivity. This was true for the daily rates of behaviors and tics (i.e., total frequency) as well as for 15-sec intervals of time (i.e., actual occurrence). Observed daily rates of vocal tics correlated with noncompliance, but it is possible that vocal tics may have elicited reprimands from the teacher because they are generally more disruptive than motor tics. However, vocal tics and ADHD symptoms were independent for specific intervals of time. The lack of a relationship between off-task and tics is intriguing, and suggests that tics are not generally less frequent during periods of concentration, contrary to common clinical lore. This finding is also compatible with the results of our methylphenidate response analyses, which showed that although stimulant drug therapy can induce marked improvement in attention span, it does not necessarily reduce the frequency or severity of tics (Gadow et al., 1992; Sverd, Gadow, Nolan, Sprafkin, & Ezor, 1992).

In general, the different measures of tics (school observations, teacher ratings, clinician ratings) yielded nonoverlapping information. This was true for comparisons involving the entire sample, as well as for those with the two tic severity groups separately. This situation is not, of course, unique to the assessment of tics. Our own studies comparing teacher ratings and school observations of hyperactive behaviors (motor activity, off-task), found that correlations are in the low to moderate range (Nolan & Gadow, 1994). Some divergence between the clinician ratings and observations is not surprising given the differences in how the data were collected. More important, however, is the fact that the observation code measures the frequency of tic occurrence, whereas the clinician scales are primarily measures of tic severity. Further, teachers are more accurate observers of disruptive than nondisruptive behaviors (Nolan & Gadow, 1994), and most of the children in this study exhibited tics that were relatively subtle. The fact that the physician's observations of tic frequency (i.e., the 2-min Motor Tic Count) were not consistent with school observations of the frequency of tic occurrence is certainly in agreement with research on ADHD (Sleator, 1982). However, a longer time interval may have resulted in greater concordance.

The results of this study should not be interpreted as supporting the superiority of one type of measure (teacher ratings vs. observations) in the assessment of changes in tic status. Rather, our findings suggest that different measures may provide important information about different aspects of symptomatology. For example, teacher- and clinician-completed rating scales may play an important role in making decisions about whether or not the severity of the tic disorder has, in fact, changed in a socially meaningful way. We have previously found that caregivers do not always perceive treatment-induced increases in rates of mild tic occurrence as an exacerbation of the severity of the child's tic disorder (Gadow, Sverd, Nolan, & Sprafkin, 1994). This could have important clinical implications, especially if the available alternative therapies carried greater risk of behavioral or somatic toxicity. Conversely, the failure of severity-sensitive clinician-completed rating scales to detect treatment-induced changes in the rate of tic occurrence could obfuscate the search for understanding the neurophysiological basis of tic expression. For example, studies designed to examine the etiology of tic disorders based on changes in the frequency of tic occurrence in response to different types of drugs (e.g., Caine, Ludlow, Polinsky, & Ebert, 1984; Feinberg & Carroll, 1979; Friedhoff, 1982) may require repeated direct observations of tics in natural settings, which appear to provide a more accurate assessment of tic frequency than informal clinician observations.

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