Treatment of Tourette Syndrome by Habit Reversal: A Waiting-List Control Group Comparison

NATHAN H. AZRIN
Nova University

ALAN L. PETERSON
Nova University
and
Wilford Hall, U.S.A.F. Medical Center

The present investigation employed a waiting-list control group design to evaluate the effectiveness of the habit reversal treatment procedure in eliminating the multiple motor and vocal tics in 10 subjects with Tourette Syndrome. The mean percent reduction in tics for all 10 subjects at the last month of treatment was 93.0% at home and 93.3% in the clinic. Reductions occurred for vocal tics as well as each type of motor tic, for the children as well as the adults, for those subjects receiving TS medications as well as those not doing so, and for tic severity as well as tic frequency; there was no evidence of symptom substitution. These results suggest that Tourette Syndrome can be treated effectively with this type of behavior therapy.

Tourette Syndrome (TS) is a neurological disorder that is hypothesized to be of organic etiology; it consists of multiple motor and vocal tics. The incidence of TS has been estimated to be .046%, and it has been found to occur about three times more often in males than in females (Tourette Syndrome Association, 1984). Treatment for TS has been primarily pharmacological with haloperidol, clonidine, and pimozide (Shapiro & Shapiro, 1982). The largest drug study to date (Shapiro, Shapiro, Bruun, & Sweet, 1978) included 80 TS patients treated with haloperidol in an uncontrolled evaluation that utilized subjective measures of improvement and found the average decrease in tics to be 80%. Other well controlled studies have found lesser reductions in tics.

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Three studies (Ross & Moldofsky, 1978; Shapiro, & Shapiro, 1984; Shapiro et al., 1989) stand out as the most definitive pharmacological treatments, or outcome studies of TS conducted to date. All three studies used double-blind designs and utilized frequency counts of tics to evaluate treatment effectiveness. The results of these studies showed that total tics were reduced by 38-51% with haloperidol and by 34-52% with pimozide. These studies and others (Borison et al., 1982; Bruun, 1982; Cohen, Detlor, Young, & Shaywitz, 1980; Moldofsky & Brown, 1982; Nee, Caine, Polinsky, Eldridge, & Ebert, 1980; Shapiro, Shapiro, & Eisenkraft, 1983) found that the reduction of tics varied greatly on an individual basis from almost complete remission of tics in some individuals to no noticeable decrease or even an increase in symptoms in other individuals. Consequently, single case study reports are to be interpreted with caution.

A major limitation of drug treatments of TS has been the unwanted side effects of these medications. In an epidemiological study of 75 TS patients (Jagger et al. 1982) one or more unwanted side effects was noted by 80% of the patients receiving haloperidol. Lethargy, impaired functioning, and depression accounted for the majority of the complaints.

Habit reversal is a behavioral treatment approach which has recently shown promise as an effective treatment for TS (Azrin & Peterson, 1988a; Finney, Rapoff, Hall, & Christopherson, 1983; Franco, 1981; Zikis, 1983). The method was developed initially to treat behavioral stereotypy of retarded and autistic persons (Azrin, Kaplan & Foxx, 1973; Foxx & Azrin, 1973) and then extended to tics and nervous habits of normals (Azrin & Nunn, 1973; Azrin, Nunn & Frantz, 1980). The rationale for the method, as stated in Azrin & Nunn (1973) is that a tic or habit may originally start in early childhood or as a reaction to a trauma or stress. Normally, the tic/habit would decrease with maturity because of the negative social reaction to its peculiarity. The movement may, however, have escaped personal awareness and adverse social reaction and blended into other movements as a part of a response chain that assumes a compulsive character. The habit reversal procedure was designed to counteract these influences primarily by use of a competing response to prevent the tic, relaxation to reduce contributory stress, awareness training to permit prevention or interruption and reinforcement contingencies for motivation. In a recent pilot study with this method (Azrin & Peterson, 1988a), the frequency of tics was reduced by 93 to 95% in the clinic and by 64 to 95% at home after 6-8 months of treatment. This study was limited, however, in that it included only three subjects in a within-subjects experimental design.

Several other case studies of TS subjects have been conducted using massed negative practice, contingency management, relaxation training, or self-monitoring (see reviews by Azrin & Peterson, 1988b; Turpin, 1983). All of these studies have been controlled case studies of one or two TS subjects using within-subject designs and have yielded results of similar or lesser magnitude as the habit reversal method (Azrin & Peterson, 1988b). The absence of any published behavioral treatment studies of TS with more than three subjects may be influenced by the relatively low incidence of the disorder and the results of initial uncontrolled studies (e.g., Shapiro et al., 1978) that found substan-
tial reductions in tics with drug treatments. The purpose of the present study was to further evaluate the effectiveness of the habit reversal method in reducing the multiple motor and vocal tics of TS by using a larger number of subjects and a controlled between-subjects experimental design.

METHOD

Subjects

Subjects were obtained through newspaper articles and through the local Tourette Syndrome Association. Fourteen subjects who met the DSM-III-R diagnostic criteria for Tourette's Disorder (American Psychiatric Association, 1987) were evaluated during a 1-month baseline period. Subjects were not included who: (1) were severely retarded or autistic, (2) had recently received psychiatric/psychological treatment for emotional or personality disorders since their cooperation in the treatment program might have been uncertain, or (3) had plans to move from the geographical area or were to be absent for extended periods within the next year. A description of the characteristics of the individual subjects completing the study is given in Table 1. All of the subjects had numerous previous motor and vocal tics which were not present at the start of the study. Six subjects had previously used various medications to attempt to control their symptoms. The three subjects taking TS medications at the start of the study were asked not to increase the dosage nor change the type of medication they were taking for the duration of the study, unless medically advisable.

Recordings

The frequency of the tics of each of the subjects was measured both in the clinic and home settings. In the clinic, tics were measured by taking videotapes through a one-way mirror for 10 min at the beginning of each session. Subjects agreed to allow videotapes to be taken, but they were unaware of the precise time in which they would be taken. Each tape was scored subsequently by a trained observer who counted each different tic separately. For subjects with several high-frequency tics, tapes were reviewed successively with only one type of tic being scored at a time. Interobserver agreement was assessed for clinic recordings by having an additional trained observer independently score at least 25% of the tapes of each subject. An interobserver reliability criterion level of 80% or better was established for each type of individual tic. The observers were not informed as to which videotape segments represented the treatment versus baseline phase.

Tic frequencies were also recorded at home by direct unobtrusive observations by the subject's spouse or parent for a specified period of time each day (e.g., 10 minutes). Again, the subjects knew that home recordings were taken but were unaware of the exact time. Subjects also completed self-recordings during portions of the treatment, but their recordings were not used as data. Self-recordings were not assigned during the baseline phase because it was thought that this procedure might be a form of treatment and result in a decrease in tics. The initial home recordings were completed for a 10-min period.
<table>
<thead>
<tr>
<th>Subj</th>
<th>Age</th>
<th>Sex</th>
<th>Age of onset</th>
<th>Medications for TS</th>
<th>Motor tics</th>
<th>Vocal tics</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>31</td>
<td>Female</td>
<td>7</td>
<td>None</td>
<td>Head-shake</td>
<td>Cough</td>
</tr>
<tr>
<td>S2</td>
<td>13</td>
<td>Male</td>
<td>6</td>
<td>Clonidine</td>
<td>Head-shake</td>
<td>Throat-clear</td>
</tr>
<tr>
<td>S3</td>
<td>8</td>
<td>Male</td>
<td>4</td>
<td>None</td>
<td>Eye-blink</td>
<td>Hum</td>
</tr>
<tr>
<td>S4</td>
<td>16</td>
<td>Female</td>
<td>5</td>
<td>None</td>
<td>Eye-squint</td>
<td>Sniff</td>
</tr>
<tr>
<td>S5</td>
<td>31</td>
<td>Male</td>
<td>7</td>
<td>None</td>
<td>Teeth-clack</td>
<td>Sniff</td>
</tr>
<tr>
<td>S6</td>
<td>36</td>
<td>Male</td>
<td>13</td>
<td>None</td>
<td>Eye-squint</td>
<td>None</td>
</tr>
<tr>
<td>S7</td>
<td>13</td>
<td>Male</td>
<td>8</td>
<td>Trifluoperazine</td>
<td>Finger-tap</td>
<td>Grunt</td>
</tr>
<tr>
<td>S8</td>
<td>6</td>
<td>Male</td>
<td>3</td>
<td>None</td>
<td>Eye-blink</td>
<td>Cough</td>
</tr>
<tr>
<td>S9</td>
<td>13</td>
<td>Male</td>
<td>9</td>
<td>None</td>
<td>Head-shake</td>
<td>Yelp</td>
</tr>
<tr>
<td>S10</td>
<td>14</td>
<td>Female</td>
<td>7</td>
<td>Pimozide</td>
<td>Eye-squint</td>
<td>None</td>
</tr>
</tbody>
</table>
When tic frequencies were reduced (to a mean zero level for the 10-min period) the duration of the self-recordings was increased, up to a maximum of all-day recordings, to increase measurement sensitivity. Home recordings were reduced to once every other day after the 3rd month of treatment. To obtain interobserver reliability on the measures taken at home, another family member (in addition to the primary person taking home recordings) also was asked to observe and record the subject once per week at the same time as the primary recorder. Reliability of home observations was obtained only for the 5 subjects for whom a second observer was available.

**Experimental Design and Initial Assessment**

A standard wait-list experimental design was used. The subjects were assessed over a 1-month baseline period, matched, and then randomly assigned to either an immediate treatment or 3-month waiting-list control condition. Subjects were primarily matched on the basis of the recordings of tic frequency at home during the first 2 weeks of recordings and in the clinic from the initial assessment videotape. An attempt was also made to match for age and medication usage. A coin flip was used to determine which subject in each pair was assigned to the immediate treatment group, the other subject being assigned to the waiting-list control condition. During the first month of the baseline period, all subjects had 4 weeks of daily home recordings and had 3 clinic videotapes taken. After the 1-month baseline period, the habit reversal treatment was initiated with the immediate treatment group. The waiting-list group began treatment 3 months later.

**Habit Reversal Training.** The habit reversal treatment method has been previously outlined in detail (Azrin & Nunn, 1973, 1977; Azrin & Peterson, 1988a, 1988b). Habit reversal is a multicomponent behavior therapy program that consists of (a) awareness training, (b) self-monitoring, (c) relaxation training, (d) competing response training, and (e) contingency management.

Awareness training was accomplished by five procedures for increasing the subject's awareness of frequency and severity of tics, environmental variables influencing the symptoms, and the specific movements involved in the tics: (1) The subjects recorded the incidence of each different tic for a specified duration each day; (2) a response description procedure in which the subject described the response topography of each tic to the therapist, using a mirror or videotape if necessary; (3) the response detection procedure in which the therapist taught the subjects to detect the occurrence of each tic by alerting the subject when an instance of the tic occurred; (4) the early warning procedure wherein the subjects were given practice in self-detection of the earliest physical sign or sensory precondition of a tic (Bullen & Hemsley, 1983); and (5) situation awareness training which helped the subjects identify the specific situations in which tics were more frequent or severe.

Relaxation training was provided, which consisted of progressive muscular relaxation (Jacobson, 1938), deep breathing (Cappo & Holmes, 1984), visual imagery (Suinn, 1975), and self statements of relaxation (Schultz & Luthe, 1959). The subjects were taught the relaxation training procedures during the first treatment session and were instructed to practice the procedures at least
once per day for a 10- to 15-min period. The subjects were also taught how to employ the relaxation procedures on a cue-controlled basis (Azrin, 1971) for about 1 min whenever they became anxious or emitted a tic.

Competing response training was the most distinctive aspect of the habit reversal procedure. This procedure involved the identification and practice of a competing response which was antithetical to a tic and would not allow the tic to occur. The competing response was designed to have the following characteristics: (a) being opposite to the tic movement, (b) being capable of being maintained for several minutes, (c) being socially inconspicuous, and (d) being easily compatible with normal ongoing activities. The incompatible response that was used for most tics was the isometric tensing of muscles which were opposite to the tic movement. The muscles were tensed sufficiently so that tic movement could not occur, even when the subject was instructed to attempt to do so. Some tics required competing responses other than isometric tensing of muscles, such as the use of a specific breathing pattern for vocal tics or an eye-blinking technique for eye tics. The subjects were instructed to perform the competing response for 1 min after: (a) Sensing the urge that a tic was about to occur, (b) after the actual occurrence of a tic, or (c) being in tic-prone situations.

The specific competing responses used for the various tics in this study were as follows: Head jerk: Isometric contraction of the neck flexors (sternocleidomastoid group) pull the chin slightly down and in, and maintain the head in an eyes forward position. Shoulder shrug: Isometric contraction of the shoulder depressors to strengthen the muscles which work in opposition to the upward jerking movement. Push elbow in toward hip. Head shake: Slow isometric contraction of the neck muscles with the eyes forward until the head can be maintained perfectly still. Arm jerk: Push hand down on thigh or stomach and push elbow in towards hip. Leg jerk: If sitting, place feet flat on floor and push downward. If standing, lock knees. Nose wrinkles: Pull upper lip down slightly and press lips together. Eye blink: Systematic, voluntary, soft blinking consciously maintained at a rate of one blink per 3-5 sec. Frequent downward shifting of gaze about every 5-10 sec. Oral vocal tics (barking, coughing, throat clearing, coprolalia, sneezing): Slow rhythmic deep breathing through the nose while keeping the mouth closed. Exhalation should be slightly longer than inhalation (e.g., 5 sec inhalation, 7 sec exhalation). The flow of air should not stop at any point other than briefly when shifting smoothly from inhalation to exhalation and vice versa. Nasal vocal tics (sniffing, nose exhalation): Same as for oral vocal tics except deep breathing through the mouth.

The tic that was the most frequent or most disruptive was treated first after the relaxation training. At least one session was devoted to training the subject to employ the competing response procedure for that tic. In subsequent sessions, each additional tic was treated one at a time until a specific competing response had been established for each tic. Instruction was also given for types of tics present in the past, as well as for types anticipated.

The family was instructed to reinforce the subject by having them comment favorably on any improved appearance of the subjects during tic-free periods.
or significant reductions in symptoms. The subject's motivation was further increased by using the habit inconvenience review, in which the therapist and subject reviewed in detail the inconveniences, embarrassment, and suffering that resulted from emitting the tics as well as the positive aspects of eliminating tics. The information was written on a card carried by the subjects to be reviewed frequently as a reminder of the intrinsic reinforcers available. For the children, a formal contingency management program was developed which provided daily, weekly, and long-term reinforcers by the parents contingent on the completion of the therapy assignments or for the reduction of tics below a specific goal level. As the subjects improved, they were encouraged to participate in enjoyable social activities that were previously avoided because of the social disruptiveness of their tics.

**Generalization Training.** To teach control outside the office setting, the symbolic rehearsal procedure was used whereby the subjects imagined tic-eliciting situations in which they detected the urge to emit a tic, and then overtly performed the required exercise. Additionally, after the cue-controlled relaxation or competing response procedure had been taught to the subjects, they were instructed to use the procedures thereafter. If the subject failed to detect a tic or self-initiate a procedure during the session, the therapist prompted them to do so. Prompts from the therapist were not provided during the initial portion of each treatment session when videotapes were taken.

**RESULTS**

Two of the initial 7 subjects in each group dropped out during the first 3 months of the study and could not be included in the data analysis, leaving 5 subjects in each group. One subject in each group dropped out because he or she moved away from the area. The third subject became severely ill and could not continue; the fourth subject dropped out because of disappointment about assignment to the Wait-List group. Examination of the incomplete data of the 2 subjects in the Immediate Treatment group showed that their tic reduction at the time of drop-out did not differ appreciably from that of the continuing subjects.

A mean of 20 sessions (range = 13-30) were given during the 8-11 months of treatment. Subjects were seen for treatment on a weekly basis for at least the first 4 weeks. Thereafter, the frequency of sessions was reduced to a minimum of one per month, with less frequent sessions for subjects progressing well. Interobserver agreement of tic frequency of the clinic videotapes for the 10 subjects was 92% for the two independent raters. The frequency ratio method (Kazdin, 1982, pp. 52-53) was used to calculate interobserver agreement in which comparisons were made between the totals of the two observers who independently scored videotapes. Interobserver agreement was calculated by dividing the lowest rating by the highest rating and multiplying by 100. Scoring of tapes for interobserver agreement was completed throughout the duration of the study. For 8 of the 10 subjects the minimum interobserver agreement of .80 was maintained throughout the study. For two subjects interobserver agreement was found to be less than .80 after the first four videotapes were scored.
The two raters then reviewed a brief portion of the videotape, discussed differences in scoring, and agreed upon a written description of the scoring criteria for each type of tic. All four of the videotapes for each of the two subjects were rescored, and the interobserver agreement was greater than the minimum .80 level; the interobserver agreement was maintained above the .80 level for the two subjects on the subsequent 25% of the tapes that were scored by the additional rater.

At home, an interobserver reliability measure was possible and taken for five of the subjects by having another family member (e.g., other parent) also observe the subject during the same recording period. These measures were taken about once every two weeks and the interobserver agreement was 82%.

Figure 1 shows the average tic frequency at home (left portion of the figure) and in the clinic (right portion of the figure) for the Immediate Treatment subjects (upper part of the figure) and the Waiting-List subjects (lower figure) for each of the 12 months in which the study was conducted. All data were prorated to tics per hour. Monthly data points for the home recordings represent the average total tics per hour for each subject based on the number of days in which recordings were taken. Monthly data points for clinic sessions are from the videotapes. A minimum of one and a maximum of four videotapes were taken each month.

**Figure 1.** Monthly average of Tourette Syndrome tics per hour measured in the clinic and home settings for subjects in the immediate treatment and waiting-list control groups.
It can be seen that the mean tic frequency remained fairly constant for the home recordings and increased somewhat for the clinic recordings during the 4-month wait-list period. For both groups, the mean tic frequency decreased substantially during the initial 2 months of treatment and more slightly during the later months. During the first month of treatment of the Immediate Treatment subjects, tics were reduced by 52% in the clinic and 32% at home and for the previously wait-listed subjects by 67% in the clinic and 79% at home.

The percent of change was calculated by comparing each subject's tic frequency during each treatment month to the frequency during the 1-month (immediate treatment) or 4-month (waiting-list) baseline periods. Using a percent of change score helped control for confounds that may occur when average frequencies are calculated for groups with individuals with very high tic frequencies.

**TABLE 2  
NUMBER OF TICS PER HOUR FOR EACH SUBJECT DURING EACH MONTH IN THE HOME AND CLINIC SETTINGS FOR THE IMMEDIATE TREATMENT AND WAIT-LIST GROUPS**

<table>
<thead>
<tr>
<th>Months</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>% Change pre-post</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Immediate treatment group</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1 Home</td>
<td>22</td>
<td>11</td>
<td>6.5</td>
<td>4.5</td>
<td>3.7</td>
<td>3.8</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>9</td>
<td>-59.1%</td>
</tr>
<tr>
<td>Clinic</td>
<td>97</td>
<td>11</td>
<td>6</td>
<td>3</td>
<td>0</td>
<td>9</td>
<td>18</td>
<td>6</td>
<td>36</td>
<td>66</td>
<td>54</td>
<td>24</td>
<td>-75.1%</td>
</tr>
<tr>
<td>S2 Home</td>
<td>474</td>
<td>152</td>
<td>44</td>
<td>23</td>
<td>27</td>
<td>16</td>
<td>13</td>
<td>18</td>
<td>4.5</td>
<td>6.3</td>
<td>25</td>
<td>4.8</td>
<td>-98.9%</td>
</tr>
<tr>
<td>Clinic</td>
<td>774</td>
<td>215</td>
<td>340</td>
<td>150</td>
<td>212</td>
<td>32</td>
<td>111</td>
<td>51</td>
<td>46</td>
<td>55</td>
<td>132</td>
<td>84</td>
<td>-89.1%</td>
</tr>
<tr>
<td>S3 Home</td>
<td>153</td>
<td>32</td>
<td>34</td>
<td>17</td>
<td>3.4</td>
<td>1.5</td>
<td>0</td>
<td>2.5</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>-100.0%</td>
</tr>
<tr>
<td>Clinic</td>
<td>93</td>
<td>108</td>
<td>12</td>
<td>12</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-100.0%</td>
</tr>
<tr>
<td>S4 Home</td>
<td>174</td>
<td>134</td>
<td>74</td>
<td>48</td>
<td>134</td>
<td>73</td>
<td>55</td>
<td>44</td>
<td>48</td>
<td>27</td>
<td>17</td>
<td>6</td>
<td>-96.6%</td>
</tr>
<tr>
<td>Clinic</td>
<td>76</td>
<td>36</td>
<td>12</td>
<td>4</td>
<td>12</td>
<td>10</td>
<td>0</td>
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<td>4.5</td>
<td>4.5</td>
<td>3</td>
<td>-96.1%</td>
</tr>
<tr>
<td>S5 Home</td>
<td>74</td>
<td>62</td>
<td>27</td>
<td>18</td>
<td>9</td>
<td>6.5</td>
<td>6.7</td>
<td>2.8</td>
<td>3</td>
<td>1.5</td>
<td>1.5</td>
<td>9</td>
<td>-87.8%</td>
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<tr>
<td>Clinic</td>
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<td>72</td>
<td>16</td>
<td>6</td>
<td>6</td>
<td>28</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-100.0%</td>
</tr>
<tr>
<td><strong>Wait-listed treatment group</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S6 Home</td>
<td>409</td>
<td>402</td>
<td>446</td>
<td>457</td>
<td>77</td>
<td>3.3</td>
<td>1.5</td>
<td>1</td>
<td>1</td>
<td>.3</td>
<td>0</td>
<td>2</td>
<td>-99.5%</td>
</tr>
<tr>
<td>Clinic</td>
<td>1799</td>
<td>NA</td>
<td>NA</td>
<td>3318</td>
<td>906</td>
<td>221</td>
<td>76</td>
<td>110</td>
<td>85</td>
<td>153</td>
<td>120</td>
<td>90</td>
<td>-95.3%</td>
</tr>
<tr>
<td>S7 Home</td>
<td>309</td>
<td>462</td>
<td>606</td>
<td>370</td>
<td>172</td>
<td>0</td>
<td>74</td>
<td>32</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-100.0%</td>
</tr>
<tr>
<td>Clinic</td>
<td>627</td>
<td>NA</td>
<td>NA</td>
<td>523</td>
<td>62</td>
<td>0</td>
<td>30</td>
<td>30</td>
<td>0</td>
<td>87</td>
<td>16</td>
<td>0</td>
<td>-100.0%</td>
</tr>
<tr>
<td>S8 Home</td>
<td>282</td>
<td>417</td>
<td>70</td>
<td>64</td>
<td>92</td>
<td>27</td>
<td>14</td>
<td>15</td>
<td>5</td>
<td>7</td>
<td>4</td>
<td>0</td>
<td>-100.0%</td>
</tr>
<tr>
<td>Clinic</td>
<td>93</td>
<td>NA</td>
<td>NA</td>
<td>64</td>
<td>81</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>19</td>
<td>34</td>
<td>27</td>
<td>9</td>
<td>-88.6%</td>
</tr>
<tr>
<td>S9 Home</td>
<td>171</td>
<td>231</td>
<td>270</td>
<td>301</td>
<td>37</td>
<td>35</td>
<td>16</td>
<td>12</td>
<td>24</td>
<td>35</td>
<td>31</td>
<td>26</td>
<td>-89.3%</td>
</tr>
<tr>
<td>Clinic</td>
<td>81</td>
<td>NA</td>
<td>NA</td>
<td>66</td>
<td>11</td>
<td>2.5</td>
<td>7.5</td>
<td>9</td>
<td>9</td>
<td>11</td>
<td>9</td>
<td>7.5</td>
<td>-89.8%</td>
</tr>
<tr>
<td>S10 Home</td>
<td>432</td>
<td>260</td>
<td>251</td>
<td>327</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>12</td>
<td>8</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>-98.7%</td>
</tr>
<tr>
<td>Clinic</td>
<td>315</td>
<td>NA</td>
<td>NA</td>
<td>36</td>
<td>6</td>
<td>0</td>
<td>3</td>
<td>6</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-100.0%</td>
</tr>
</tbody>
</table>

*Average of all subjects (N = 10):* Home - 93.0%  
Clinic - 91.5%
Table 2 presents the data for each of the 10 subjects for each month of the 12-month period, thereby allowing a within-subject analysis especially for the wait-list subjects who had a 4-month baseline. During the first month of treatment all 10 subjects exhibited a reduction of at least 50% relative to the baseline level either in the clinic or at home. During the second month of treatment, all subjects showed a decrease of at least 50% at home as well as in the clinic. At the last month of treatment 1 subject (S-I) had a reduction of less than 80%; each of the other 9 subjects showed reductions of at least 88% both in the clinic as well as at home. The mean percentage reduction for all 10 subjects at the last month of treatment was 93.0% at home and 93.5% in the clinic.

As a statistical measure of between-group differences, a Mann-Whitney U test was conducted using the percent change scores at the fourth month of the study, which was the last month of the waiting-list period of the Wait-List group and the third month of treatment for the Immediate Treatment group. The analysis showed a significant reduction of tics between groups (U = 2; w = 38; Z corrected = -2.19; p < .025, one-tailed) for the tics at home. For tics in the clinic, the reduction was also statistically significant at the .025 level (U = 2; W = 38; Z corrected = -2.20).

As a statistical measure of within-subject changes from baseline to treatment, a Wilcoxon matched-pairs signed ranks test was conducted on the data obtained in the clinic for both groups (N = 10) between the baseline and final month of treatment (12th month) points. Compared to the 1-month baseline measures, tic frequency was significantly reduced at the end of treatment for both the tics in the clinic (Z = -2.80; p < .01) and in the home (Z = -2.80; p < .01).

In addition to measures of tic frequency, subjective measures of the severity of motor and vocal tics were completed. Five-min tapes of each subject taken during the baseline and treatment phases were shown in a random order to two additional raters blind to the study. The raters observed each 5-min segment and rated the segments on a Likert scale from 0% to 100%, with 0% representing perfectly normal and 100% representing completely abnormal. The average baseline ratings by the two raters was 49% abnormal; the abnormality rating was 23% at the end of treatment. A Wilcoxon test found this reduction in abnormality rating to be statistically significant (Z = -2.67; p < .01).

Separate examinations were made comparing the average reductions in tics for: (1) Motor versus vocal tics; (2) children versus adults; (3) males versus females; and (4) each different type of motor tic. The results showed negligible differences in all of the comparisons. The range of the reduction of individual tics was from a maximum of 100% for tics in several of the subjects to a minimum of 11% for a full-body jerk in Subject 1. No new type of tic emerged for any subject during treatment that had not occurred prior to treatment. In the comparison of reductions for adults versus children, it should be noted
that both of the subjects that achieved 100% reductions in the home and clinic settings were children (Subjects 3 and 7 in Table 2).

Three subjects in the study were taking TS medication at the start of the study, all for at least 1 year, and had previously attained a partial reduction in TS tics from medication usage. The three subjects taking TS medications had a reduction in tics in this study of 99% at home and 96% in the clinic. The subjects who were not taking TS medications had a tic reduction of 90% at home and 92% in the clinic. One of the 3 subjects (Subject 10) had not experienced significant unwanted side effects from the TS medications and therefore maintained the same dosage throughout the study. The second subject (Subject 7) had experienced unwanted side effects (sluggishness, difficulties concentrating, etc.) from the TS medications. After achieving a significant reduction in tic frequency from the behavioral techniques (home - 99%; clinic - 100%), he was able to reduce his medication dosage level by 50% by the twelfth month of the study, thereby eliminating most medication side effects. Similarly, the third subject (subject 2) achieved a significant reduction in his tics (home - 99%; clinic - 89%), and then reduced his TS medication dosage by 83% by the twelfth month of the study; he also subsequently reported less side effects from the medications at the lower dosage. For both of these subjects the reductions in tic frequency was maintained while the medication dosage was decreased.


discussion

The present behavioral study of 10 Tourette Syndrome patients is the largest behavioral study to date, and the results replicate the earlier (Azrin & Peterson, 1988a) findings of the within-subject study with 3 patients that the habit reversal procedure substantially reduces the symptoms of the disorder. Since Tourette Syndrome is characterized by waxing and waning of the symptoms over time (Shapiro & Shapiro, 1982), the group wait-list design employed here was especially critical in controlling statistically for this possible temporal confound. The magnitude of the reduction of tics was fairly substantial, averaging 93% at the end of treatment, comparing favorably with the 50% average reduction found in three of the group drug outcome studies of TS (Ross & Moldofsky, 1978; Shapiro & Shapiro, 1984; Shapiro et al., 1989).

All 10 subjects were substantially improved. The least improved was a woman who obtained a reduction of about two-thirds in the frequency. Each of the other 9 of the 10 patients showed a reduction of at least 88% both in the clinic and home setting. A reduction of 100% was obtained for half of the patients in either the clinic or home setting with 20% (2 of the 10 patients) having a complete cessation in both settings.

The reduction of the TS tics was found to be less rapid than had occurred in a previous study (Azrin et al., 1980), which treated single tics with this method. The increased training time needed for multiple tics versus a single tic makes this difference reasonable. On the other hand, the average of 20 sessions provided here is probably greater than the number needed strictly for
treatment purposes since clinical sessions were scheduled frequently over the 12-month period in part to provide continuous and long-term data collection.

Since the Tourette Syndrome disorder consists of multiple tics, vocal and motor, the treatment may have benefited only some types of tics. A separate data analysis showed, however, that the different classes of tics—facial, body, vocal, head—were reduced substantially with slight average differences. Since vocal tics, especially coprolalia, are fairly distinctive to TS, a special interest pertains to their treatability. The results showed an almost identical reduction for the motor versus vocal tics.

It was initially expected that heightened symptom substitution during the treatment might nullify the treatment effect in this study because of the reported spontaneous changing of symptoms sometimes found in TS patients (Shapiro & Shapiro, 1982; Tourette Syndrome Association, 1984). However, symptom substitution was not observed; all tics were reduced, and no new tics developed. This may have occurred because the patients were taught the competing responses for each type of tic occurring presently, as well as those that occurred in the past or were anticipated to occur in the future. Perhaps symptom substitution did not occur because of inclusion of the relaxation training, which was not tic-specific.

Methodologically, the present study differed from previous non-drug behavioral outcome studies of TS in that it included more subjects, allowed for between- as well as within-group comparisons, measured tic frequency in both the experimental clinic setting as well as in the home setting, and measured tic frequency as well as tic severity. Certainly, the conclusions would have been more definitive by inclusion of more subjects and the completion of a post-treatment follow-up. Yet, at the stage of research on this infrequent disorder, the present study included more subjects than any previous behavioral outcome study; the largest number previously has been an N of 3 (Azrin & Peterson, 1988a).

An encouraging indication in the results was the elimination of tics in two children (Subjects 3 & 7). Since Tourette disorder is a developmental disorder beginning before adulthood, this result suggests the desirability for greater efficiency of early intervention.

The substantial effectiveness (99% reduction at home) of the behavioral procedure for the subjects receiving TS drugs suggests that the behavioral procedure is enhanced in effectiveness when used in combination with drugs. Since the behavioral treatment was also effective for those subjects not receiving TS drugs, the results suggest that behavioral treatment can be successfully employed as an alternative to drug treatment.

The present findings of a large reduction or elimination of the tics for all subjects by psychological procedures raises a question as to the prevailing view of Tourette disorder as being almost entirely neurological. The psychological procedures used here were not aversive events that served only to suppress neurologically-driven behaviors; the subjective urge to perform the tic was reported by the present subjects to have been greatly reduced or absent. A psychological conception of the aetiology of Tourette disorder need not be based on the implausible theory that the disorder is learned because of direct
reinforcement of the tics. All of the tics in the Tourette disorder seem to be
seen in isolation by many persons; especially among young children and during
stress; neurological influences may well play a role: The normal reduction of
these tics with maturity may not occur because of an absence of negative so-
cial reaction, due partly to the ability of the child to conceal, disguise, or ex-
cuse the tic. The tic then becomes a strongly established habitual response.
Subjectively, the person partially loses awareness of its occurrence, thereby
preventing self-control. The present treatment was designed in accord with
this conception of the aetiology and persistence of TS. The procedures were
designed to produce greater awareness of the specific tic movements by the
patient, to increase the reactions by others, to reduce general bodily tension
(relaxation training) and to teach a method of assured prevention (competing
response training). The present findings suggest that psychological influences
play a major role in the maintenance, and perhaps the aetiology, of the disorder.

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