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Psychometric Properties of a Self-Report Instrument for the Assessment of Tic Severity in Adults With Tic Disorders

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The gold-standard measure of tic severity in tic disorders (TD), the Yale Global Tic Severity Scale (YGTSS), is a semistructured clinician-administered interview that can be time consuming and requires highly trained interviewers. Moreover, the YGTSS does not provide information regarding frequency and intensity of specific tics because all motor and all vocal tics are rated as a group. The aim of the present study is to describe and test the Adult Tic Questionnaire (ATQ), a measure for the assessment of tic severity in adults, and to report its preliminary psychometric properties. The ATQ is a brief self-report questionnaire that provides information regarding frequency, intensity, and severity of 27 specific tics. In addition, the ATQ produces total frequency, intensity, and severity scores for vocal and motor tics, as well as a global total tic severity score. Results showed that the ATQ demonstrated very good internal

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consistency and temporal stability. The total, vocal, and motor tic severity scales of the ATQ showed strong correlation with corresponding subscales of the YGTSS, indicating strong convergent validity. Weak correlations with measures of severity of obsessive-compulsive disorder and attention deficit/hyperactivity disorder, indicated strong discriminant validity. The ATQ, a promising measure for the assessment of tic severity in adults with TD, may be a valuable supplement to the current recommended assessment battery for TD. Furthermore, the ATQ enables clinicians and researchers to track changes in the frequency and intensity of specific tics, which is important given their complex and dynamic nature.

Keywords: Tourette's disorder; Tourette's syndrome; chronic tic disorder; persistent tic disorder; adults; questionnaire

THE CLINICAL PRESENTATION OF TICS is complex and dynamic, as tics fluctuate and change in frequency, intensity, and form over time (Lin, et al., 2002; Peterson & Leckman, 1998). In addition, tic severity is influenced by a multitude of situational state-dependent factors (for a review see Conelea & Woods, 2008), such as settings (Goetz, Leurgans, & Chmura, 2001), social interaction (Piacentini et al., 2006), stress (Eapen, Fox-Hiley, Banerjee, & Robertson, 2004), and anxiety (Silva, Munoz, Barickman, & Friedhoff, 1995), making clinical assessment challenging.

The dynamic, complex, and interactive nature of tics accentuates the need for psychometrically reliable measures for the assessment of tics in adults, tapping the number, type, intensity, and frequency of tics. The most widely used measure for the assessment of tic severity is the Yale Global Tic Severity Scale (YGTSS; Leckman et al., 1989), a clinician-administered semistructured interview assessing tic severity and impairment over the previous week. The YGTSS includes a symptom checklist for motor and phonic (vocal) tics. As a group, all motor and all vocal tics are then rated for their number, frequency, intensity, complexity, and interference on a 0–5 Likert scale (separately for vocal and motor). Scores can then be summed to reflect motor tic severity (0–25), phonic tic severity (0–25), and combined tic severity (0–50). There is also a separate tic-related impairment scale ranging from 0–50. The YGTSS demonstrates excellent internal consistency (α = .92 – .94; Storch, et al., 2005). The measure possesses satisfactory temporal stability and displays adequate convergent and discriminant validity (Leckman et al., 1989; Storch et al., 2005). In addition, a confirmatory factor analysis verified a two-factor structure for phonic and motor tics with acceptable internal consistency for each factor (Storch et al., 2007).

Nevertheless, administration of the YGTSS is relatively time consuming (approximately 20 to 25 minutes) and requires a highly trained, experienced interviewer in order to ensure accurate and reliable use of the measure (Chang, Himle, Tucker, Woods, & Piacentini, 2009). In addition, the YGTSS does not provide information on individual tics. That is, tic scores on the YGTSS pertain to all motor and vocal tics, but do not provide information pertaining to specific tics (e.g., intensity of blinking versus intensity of grunting). Thus, there is a need for a psychometrically sound, brief self-report measure for the assessment of tic severity in adults with tic disorders (TD) that would correspond to the need for a rapid clinical assessment. Such a measure would facilitate high-resolution measurement of treatment progress, allowing clinicians to assess the impact of treatment on specific tics that may improve more than others, including specific information regarding improvement in frequency or intensity. In addition, such an instrument would enable assessment of tics in online studies, an increasingly prevalent methodology (Gosling & Mason, 2015). Notably, self-report methodology is susceptible to a number of biases (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003), including relying on the level of patient awareness. However, even in clinician-administered settings, clinicians rely in part on patient awareness; that is, not all tics present during the interview and actual tics may not be observed in, or affected by, interview settings (Conelea & Woods, 2008).

A few self-report measures assessing global tic severity are available. The Tourette Syndrome Symptom List (TSSL; Cohen, Detlor, Young, & Shaywitz, 1980) is a 35-item scale assessing phonic and motor tics and TS-related behaviors over the past week on a 5-point Likert scale. The Tic Symptom Self-Report (TSSR; Scahill, Leckman, Schultz, Katsovich, & Peterson, 2003)—a revised version of the TSSL—is a 40-item self-report measure, in which 20 items tapping phonic tics and 20 items tapping motor tics are rated on a 0–3 Likert scale. However, psychometric data for these two measures are not available (for a review of assessment measures for TD see McGuire et al., 2012). Other self-report scales for adults with tic disorders may be either too specific, such as the Premonitory Urge to Tic Scale (PUTS; Reese et al., 2014), assessing subjective awareness of urges preceding tics; or too general, such as the Motor Tic, Obsessions and Compulsions, Vocal Tics Evaluation Survey (MOVES; Gaffney, Sieg, & Hellings, 1994), which incorporates items tapping OCD symptoms.

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The present study presents the first psychometric data on the Adult Tic Questionnaire (ATQ), a brief (10 minutes) self-report measure of tic severity, from 122 individuals aged 16 and older with Tourette Syndrome (TS) or Chronic Tic Disorder (CTD).

Method

DEVELOPMENT AND SCORING OF THE ADULT TIC QUESTIONNAIRE (ATQ)

The ATQ (see Appendix) was directly modeled after the Parent Tic Questionnaire (PTQ; Chang et al., 2009), a self-report inventory administered to parents for the assessment of tic severity in youth. The PTQ demonstrates strong psychometric properties, including construct validity, internal consistency, and test-retest reliability (Chang et al., 2009). Similar to the PTQ, the ATQ includes a list of 14 common motor tics and 13[1] common vocal tics. Each of those lists includes an open item (i.e., other vocal or other motor tic) allowing individuals to add a type of tic that does not appear in the standard list. For each type of tic, participants are asked to indicate its presence during the past week by selecting "yes" or "no." Subsequently, *for each tic endorsed*, participants indicate its frequency and intensity, both on a 4-point Likert-type scale.[2] For the frequency ratings, scores range from *a few times a week or less* (1), to *constantly, almost all the time during the day* (4). For the intensity ratings, participants are asked to check (1) if the specific tic was *very mild in intensity* in the past week, (2) or higher if the tic was *obviously noticeable to others*; and 3 or higher if the tic was *much more forceful and very noticeable to others* during the past week. A separate score of tic severity was calculated by summing the intensity and frequency score, resulting in a score between 2 (*minimal frequency and intensity*) to 8 (*maximum frequency and intensity*) for each tic endorsed. Subsequently, all severity scores for all vocal and motor tics were summed to produce a total tic severity score. A preliminary version of the ATQ was found to be sensitive to behavior therapy in a randomized controlled trial for comprehensive behavioral intervention for tics versus psychoeducation and supportive therapy in adults with Tourette's disorder (Wilhelm et al., 2012). The authors reported an effect size of 0.63, exemplifying a reduction on the ATQ total (severity) score following a 10-week (8 sessions) comprehensive behavioral intervention for tics, and an effect size of 0.28 for a supportive psychotherapy control group. Corresponding effect sizes for the total tic score on the YGTSS were 0.96 and 0.39 (Wilhelm et al., 2012).

[1] The original version of the ATQ included 14 items assessing vocal tics. However, in the initial version one item assessed "other vocal tics" and the other assessed "other" in general. In the data analysis stage these items were found to result in identical scores. For this reason these two items were collapsed resulting in a total of 13 items assessing vocal tics.

[2] In the original version of the ATQ, the "intensity" of each tic was ranked on an 8-point Likert-type scale. However, in the data analysis stage this scale was transformed to a 4-point Likert-type scale, similar to the "frequency" scale. The following algorithm was used: ≤2 = 1; 3, 4 = 2; 5, 6 = 3; 7, 8 = 4). This transformation was performed in order to allow equal weights for both scales comprising the severity score.

PROCEDURE

This study was a part of a multisite randomized controlled trial comparing a comprehensive behavioral intervention to psychoeducation and supportive psychotherapy for individuals 16 years old and older with TS and CTD (see Wilhelm, et al., 2012 for full description). Participants were enrolled at the Massachusetts General Hospital / Harvard Medical School, the University of Texas Health Science Center at San Antonio, and Yale University. Data from clinician-administrated and self-report measures were collected at screening, baseline, midtreatment, posttreatment, and follow-up. For the purpose of the present study, we report data from the screening and baseline time points only. These two administration points took place 7 days apart. Clinician-rated measures were administered by experienced master- or doctoral-level clinical psychologists who received extensive training, including examination of reliability assessed via video-recorded sessions. Detailed information regarding the training and supervision of raters and the interviewers' reliability analysis has been published elsewhere (Wilhelm et al., 2012). This study was approved by the Institutional Review Boards at each of the participating sites, and all participants signed a written informed consent.

PARTICIPANTS

A total of 122 participants, ages 16 to 69, participated in the present study. Of the entire sample, 103 participants (84%) were diagnosed with primary TS (64% males), and 19 (16%) were diagnosed with primary CTD (63% males). At study entry, 23 participants (18.9%) were on stable doses of medications for tics, together with additional psychiatric medications; 8 participants (6.6%) were on a stable dose of tic medications only; 20 participants (16.4%) were on stable dose of other medications; and 71 participants (58.3%) were unmedicated. (See Table 1 for detailed demographic and clinical data.)

MEASURES

Assessment Measures

The present study employed the diagnostic

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Table 1
Demographic and Clinical Indices

Variable	N(%) / M(SD)
Mean Age	31.6 (13.7)
Gender	
Male	78 (63.9%)
Female	44 (36.1%)
Ethnicity	
Caucasian	98 (80.3%)
Hispanic	17 (13.9%)
African-American	1 (0.8%)
Asian-American	4 (3.3%)
Pacific Islander	1 (0.8%)
Other	1 (0.8%)
IQ	106.0 (9.6)
YGTSS Baseline	
Motor Total	15.2 (3.2)
Vocal Total	7.8 (5.2)
Overall Total	22.9 (6.6)
Y-BOCS Baseline	
Obsessions	1.9 (3.8)
Compulsions	3.3 (4.7)
Total	5.2 (7.8)
ADHD Inattention Baseline	6.9 (6.2)
Tic Diagnosis	
TS	103 (84.4%)
CTD	19 (15.6%)
Comorbidity Status	
ADHD	34 (27.9%)
Major Depressive Episode	3 (2.5%)
Dysthymic Episode	4 (3.3%)
Bipolar Disorder	1 (0.8%)
Panic Disorder	1 (0.8%)
Obsessive-Compulsive Disorder	19 (15.6%)
Social Phobia	3 (2.5%)
Specific Phobia	12 (9.8%)
Generalized Anxiety Disorder	8 (6.6%)
Hair Pulling Disorder	1 (0.8%)
No Comorbid Disorder	66 (54.1%)

Note. Values represent means (SD) and frequency (%); IQ = Intelligence Quantity; YGTSS = Yale Global Tic Severity Scale; Y-BOCS = Yale-Brown Obsessive-Compulsive Scale; ADHD = Attention Deficit/Hyperactivity Disorder; TS = Tourette's Syndrome; CTD = Chronic Tic Disorder.

assessment procedure recommended by the Tourette Syndrome Association International Consortium for Genetics (TSAICG; 2007).

Structured Clinical Interview for DSM-IV-TR Axis I Disorders, research version, patient edition. The SCID (First, Spitzer, Gibbon, & Williams, 2002), a semistructured clinician-administered interview, was administered in order to establish and screen for DSM-IV diagnoses. Tic disorder diagnosis was established using a semistructured interview developed by the TSAICG. Attention-deficit/hyperactivity disorder (ADHD) diagnosis was established using a rigorous diagnostic procedure commonly employed in adult ADHD research, including the use of the K-SADS (e.g., Safren et al., 2010).

Yale Global Tic Severity Scale (YGTSS; Leckman et al., 1989). The YGTSS is a clinician-administered structured interview assessing tic severity over the past week. Tic severity is assessed separately for motor and phonic (vocal) tics, by evaluating the number, frequency, intensity, complexity, and interference associated with tics. Psychometric properties of the YGTSS are described above. In the present sample, the YGTSS total score demonstrated good internal consistency (α = .78).

Yale-Brown Obsessive-Compulsive Scale (Y-BOCS; Goodman, Price, Rasmussen, Mazure, Delgado, et al., 1989; Goodman, Price, Rasmussen, Mazure, Fleischmann, et al., 1989). The Y-BOCS is a clinician-administered semistructured measure used for the assessment of OCD symptom severity. The Y-BOCS includes five items assessing obsessions and five assessing compulsions, yielding three scores (i.e., obsessions, compulsions and total score). The Y-BOCS demonstrates good psychometric properties, including convergent and discriminant validity, and internal consistency (Goodman, Price, Rasmussen, Mazure, Delgado, et al., 1989; Goodman, Price, Rasmussen, Mazure, Fleischmann, et al., 1989). In the present study, the Y-BOCS total score was found to have excellent internal consistency (α = .94).

Wechsler Test of Adult Reading (WTAR; The Psychological Corporation, 2001). The WTAR was used to estimate overall intelligence (IQ). Participants are asked to read 50 words aloud and earn one point for each word pronounced correctly. The WTAR has very good psychometric properties, including test-retest reliability, internal consistency, and convergent validity. The test has demonstrated strong correlations (r = .73) with the Wechsler Adult Intelligence Scale, third edition (The Psychological Corporation, 2001).

Attention-Deficit/Hyperactivity Disorder Rating Scale (ADHD-RS; DuPaul, Power, Anastopoulos, & Reid, 1998). The ADHD-RS is a self-report measure comprised of 18 items that correspond to the 18 ADHD DSM-IV criteria. Items are ranked on a 4-point Likert scale, ranging from 0 (*never or rarely*) to 3 (*very often*). Initially developed for pediatric populations, but regularly used in adult studies (e.g., Spencer et al., 1995), the ADHD-RS demonstrates excellent psychometric properties (Collett, Ohan, & Myers, 2003). In the present study, the ADHD-RS demonstrated excellent internal consistency (α = .93).

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STATISTICAL ANALYSIS

All psychometric properties apart from test-retest reliability are presented for the baseline time point. Internal consistency of the ATQ subscales was computed using Cronbach's alpha. Test-retest reliability (temporal stability) for the ATQ total severity, motor, and vocal tic severity subscales was assessed by means of Pearson's correlations between administration at screening and baseline. Convergent construct validity was calculated using Pearson's product-moment correlations between the ATQ and YGTSS subscales. Discriminant construct validity was assessed using Pearson's correlations between the ATQ and the total Y-BOCS scores, as well as the total ADHD-RS inattention and hyperactivity-impulsivity subscales. Within-group differences on tic characteristics were assessed using paired-samples *t* tests.

The structure of the ATQ prevents the implementation of conventional factor analytic methodologies. This is due to the fact that ratings are provided only for tics that are present. Thus, most participants did not have data for all tics, which is a prerequisite for factor analysis. The common resolution for missing data (i.e., multiple imputation methodologies) could not be implemented given that these are not conventional missing data (e.g., neglecting to respond to an item) but genuine lack of presentation of specific tics. In addition, the quantity of the "missing" data points, if imputed, would result in nonreliable data. Thus, in lieu of factor analysis we calculated the motor, vocal, and total factors' internal consistency (Cronbach's alpha) as well as between-factors Pearson's correlations, and correlations with corresponding YGTSS factors.

Results

Demographic and clinical indices are presented in Table 1. The sample had an average IQ score (106). The mean YGTSS total score indicated a moderate to severe degree of tic severity (according to severity ranges offered by Bloch et al., 2006). Overall severity of OCD symptoms was in the nonclinical range. More than half the sample (54%) was not diagnosed with any comorbid condition. Of those with a co-occurring condition, the most prevalent comorbid conditions were ADHD (28%) and OCD (16%). These rates are commonly reported in adults with tic disorders (e.g., Crossley & Eugenio Cavanna, 2013; Freeman, 2007). Means and standard deviations for frequency, intensity, and severity of each motor and vocal tic included in the ATQ, as well as total scores, are presented in Table 2. On average, participants reported the presence of 8.1 tics (SD = 4.5). Participants reported experiencing significantly more motor tics (M = 5.8, SD = 2.8) in the past week compared to vocal tics (M = 2.3, SD = 2.3; $t[120] = 14.6$, $p < .001$), and had a mean frequency score of 2.6 (SD = 0.6), mean intensity scores of 2.3 (SD = 0.7) and a mean severity score of 39.5 (SD = 25). Compared to vocal tics, motor tics were also ranked as significantly more frequent, $t(92) = 3.7$, $p < .001$, and more intense, $t(92) = 2.4$, $p = .017$. This effect corresponded to an overall increased severity for motor tics compared to vocal tics, $t(92) = 13.1$, $p < .001$.

The two most common motor tics (which were also the most common across all tics) were "eye blinking" and "head jerk," presented by 72% and 67% of the sample, respectively. These motor tics were among the most frequent (M = 2.9), but only "head jerk" was also among the most intense (M = 2.6). The least common tic was "copropraxia" (obscene gestures), experienced by only 4% of participants. However, participants presenting with this tic reported relatively increased frequency (M = 3.0) and intensity (M = 2.6) ratings. The most common vocal tic, presented in 42% of the sample, was "sniffing," which was relatively frequent (M = 2.7). Only 7% of the sample reported the presence of "coprolalia" (obscene words), which was the least common vocal tic reported (7%). However, similar to "copropraxia," participants who presented with this type of tic reported it to be the most frequent (M = 3.0) and intense (M = 2.9) compared to other vocal tics.

RELIABILITY ANALYSIS

The overall reliability of the ATQ severity scores (including intensity and frequency items), assessed using Cronbach's alpha, indicated very good internal consistency for motor tic severity (α = .86), vocal tic severity (α = .87), and excellent internal consistency for the total tic severity (α = .91). Very good internal consistency was found for the total frequency factor (α = .83), and acceptable internal consistency was found for motor frequency (α = .75) and vocal frequency (α = .75). Very good internal consistency was found for the total intensity factor (α = .83), and acceptable internal consistency was found for motor intensity (α = .73) and vocal intensity (α = .75).

FACTOR INTERCORRELATIONS

Correlations between motor and vocal intensity and frequency subscales (i.e., factors) are presented in Table 3. Very strong correlations were found between the total frequency and total intensity factors (r = .89). Moderate to strong correlations were found between the motor and vocal factors, (r = .57 to .63). These coefficients were all significant (<.01). Intercorrelations between the ATQ and YGTSS subscales are presented in Table 4, demonstrating strong positive correlations among corresponding factors. Notably,

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Table 2
Descriptive Statistics of Presence, Frequency, Intensity, and Severity of Individual Tics

Tic	Present (%; n/N)	Frequency M(SD)	Intensity M(SD)	Severity M(SD)
Motor				
Eye Blinking	72% (87/121)	2.9 (1.1)	2.2 (1.0)	5.0 (1.8)
Eye rolling/darting	31% (38/121)	2.8 (1.2)	2.2 (1.1)	5.0 (2.0)
Head Jerk	67% (81/121)	2.9 (0.9)	2.6 (1.0)	5.5 (1.8)
Facial Grimace	55% (66/120)	2.6 (0.9)	2.3 (0.9)	4.9 (1.4)
Mouth/Tongue Movements	55% (58/120)	2.8 (1.0)	2.1 (1.0)	4.8 (1.8)
Shoulder Shrugs	56% (68/121)	2.6 (0.9)	2.3 (0.9)	4.9 (1.4)
Chest/stomach tightening	37% (45/121)	2.3 (0.9)	2.3 (1.2)	4.6 (1.8)
Pelvic Tensing Movements	17% (20/121)	2.4 (0.9)	1.9 (0.9)	4.2 (1.5)
Leg/Feet Movements	50% (60/121)	2.5 (0.9)	2.0 (1.0)	4.5 (1.7)
Arm/Hand Movements	61% (74/121)	2.8 (1.0)	2.3 (1.0)	5.1 (1.7)
Echopraxia (copying another's gestures)	8% (10/121)	2.1 (1.0)	2.0 (1.0)	4.1 (1.7)
Copropraxia (obscene gestures)	4% (5/121)	2.8 (0.8)	2.4 (1.1)	5.2 (1.1)
Other Motor Tics	32% (36/112)	3.0 (0.9)	2.6 (0.9)	5.5 (1.7)
Complex Motor Combinations (multiple tics at once)	47% (54/114)	2.7 (0.9)	2.8 (0.9)	5.4 (1.7)
Total Motor Tics M(SD)	5.8 (2.8)[1]	2.7 (0.7)	2.3 (0.7)	29.6 (15.6)
Vocal				
Grunting	31% (38/121)	2.3 (0.9)	2.0 (1.0)	4.3 (1.6)
Sniffing	42% (50/120)	2.7 (1.0)	2.0 (1.0)	4.6 (1.8)
Snorting	12% (14/120)	2.6 (1.1)	2.2 (1.0)	4.8 (1.7)
Coughing	23% (27/120)	2.4 (0.9)	2.0 (0.9)	4.4 (1.6)
Animal Noises	8% (10/120)	2.4 (1.0)	2.5 (1.1)	4.9 (1.9)
Syllables	10% (12/120)	2.5 (0.8)	2.2 (0.7)	4.7 (1.2)
Words	15% (18/119)	2.3 (0.9)	2.3 (0.9)	4.6 (1.5)
Phrases	11% (13/119)	2.5 (1.1)	2.2 (0.8)	4.7 (1.4)
Echolalia (repeating vocalizations of others)	12% (14/120)	2.0 (0.8)	2.2 (1.0)	4.2 (1.4)
Coprolalia (obscene words)	7% (8/120)	3.0 (0.8)	2.9 (1.2)	5.9 (1.8)
Blocking/stuttering	19% (23/120)	2.4 (1.0)	2.5 (0.9)	4.8 (1.8)
Other Vocal Tics	29% (34/117)	2.5 (1.0)	2.5 (0.9)	4.9 (1.6)
Complex Vocal Combinations (multiple tics at once)	14% (16/117)	2.3 (0.8)	2.5 (0.7)	4.6 (1.6)
Total Vocal Tics M(SD)	2.3 (2.3)[2]	2.4 (0.9)	2.1 (0.8)	13.4 (12.1)
Total Scores	8.1 (4.5)	2.6 (0.6)	2.3 (0.7)	39.5 (25.0)

Note. Present = number of different types of tics presented in the last week; Frequency = frequency of tics in the past week (1-4 Likert-type scale); Intensity = intensity of tics in the past week (1-4 Likert-type scale); Severity = severity of presented tics; [1] n = 121; [2] n = 96.

correlations among total scores appear somewhat stronger than among motor and vocal factors. This is expected due to the scoring methodology: on the YGTSS, raters score all motor tics and all vocal tics together; on the ATQ, motor and vocal factors are produced by amalgamating individual tic scores.

TEMPORAL STABILITY

Test-retest reliability calculated using Pearson's *r* product moment correlations between the two administrations (screening and baseline) yielded very good temporal stability for the ATQ's motor tic severity (r = .81), vocal tic severity (r = .88), and total severity (r = .87).

Table 3
ATQ Interscale Correlations

	Motor Frequency	Vocal Frequency	Total Frequency	Motor Intensity	Vocal Intensity
Vocal Frequency	.63**				
Total Frequency	.92**	.85**			
Motor Intensity	.83**	.52**	.77**		
Vocal Intensity	.57**	.92**	.78**	.60**	
Total Intensity	.78**	.76**	.89**	.92**	.85**

Note. ** Significant on 0.01 level (2-tailed); ATQ = Adult Tic Questionnaire.

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Table 4
Correlations Between the ATQ and YGTSS Factors

	YGTSS Total Score	YGTSS Motor Total	YGTSS Phonic Total	YGTSS Motor Intensity	YGTSS Phonic Intensity	YGTSS Total Intensity	YGTSS Motor Frequency	YGTSS Vocal Frequency	YGTSS Total Frequency
ATQ Total Severity	**.73****	.57**	.57**	.41**	.47**	.57**	.35**	.46**	.57**
ATQ Motor Severity	.61**	**.62****	.41**	.43**	.35**	.48**	.40**	.32**	.44**
ATQ Vocal Severity	.68**	.32**	**.65****	.26*	.45**	.48**	.24*	.47**	.51**
ATQ Motor Intensity	.60**	.61**	.39**	**.46****	.35**	.50**	.31**	.29**	.38**
ATQ Vocal Intensity	.66**	.33**	.62**	.29**	**.45****	.50**	.20	.40**	.43**
ATQ Total Intensity	.71**	.57**	.55**	.44**	.47**	**.59****	.28**	.41**	.50**
ATQ Motor Frequency	.58**	.57**	.39**	.36**	.32**	.43**	**.45****	.33**	.46**
ATQ Vocal Frequency	.68**	.30**	.66**	.22*	.43**	.44**	.28**	**.51****	.57**
ATQ Total Frequency	.70**	.54**	.55**	.36**	.44**	.53**	.40**	.45**	**.58****

Note. ** = significant at the 0.01 level (2-tailed); * = significant at the 0.05 level (2-tailed); YGTSS = Yale Global Tic Severity Scale; ATQ = Adult Tic Questionnaire.

CONVERGENT CONSTRUCT VALIDITY

Pearson's product moment correlations between the YGTSS and ATQ subscales revealed strong correlations for motor tic severity (r = .62), vocal tic severity (r = .65), and total tic severity (r = .73).

DISCRIMINANT CONSTRUCT VALIDITY

Discriminant validity was assessed using Pearson's product moment correlations between the ATQ and the Y-BOCS total score, and the ADHD-RS inattention and hyperactivity-impulsivity scores. As opposed to the strong positive correlation found with the YGTSS total score (r = .73, $p < .05$), weaker correlations were found between the ATQ and the Y-BOCS total scores (r = .23, $p < .05$), the ADHD-RS inattention score (r = .21, $p < .05$), and the ADHD-RS hyperactivity-impulsivity score (r = .34, $p < .05$), that were small to medium in magnitude, indicating good discriminant validity.

Discussion

The aim of the present study was to present initial psychometric data on the ATQ, a brief self-report measure for the assessment of tic severity in adults with TD. The ATQ demonstrated very good internal consistency and temporal stability between the screening and baseline assessment. The ATQ subscale scores correlated strongly with the YGTSS, demonstrating strong convergent construct validity. Correlations between the ATQ and Y-BOCS and ADHD-RS subscales were weaker compared to the correlations between the ATQ and YGTSS, indicative of good discriminant validity. In addition, strong interscale correlations were found between the total tic severity score, the motor, and the vocal tic severity scores, as well as between the latter two. The structure of the ATQ prevents computation of confirmatory or exploratory factor analysis. However, the ATQ factors demonstrate good internal consistency, as well as intercorrelations, and strong correlations with corresponding YGTSS factors. Finally, a preliminary version of the ATQ demonstrated sensitivity to change with CBT for adults with TS (Wilhelm et al., 2012). These results, while not including conventional factor analysis, indicate that the ATQ has very good psychometric properties overall.

The most widely used gold-standard measure for the assessment of tic severity, the YGTSS (Leckman et al., 1989) is a well-validated clinician-administered semistructured interview (Storch et al., 2007; Storch et al., 2005). However, the YGTSS is time-consuming (~20-25 minutes), requires administration by highly trained interviewers, and does not provide information regarding frequency, intensity, and severity of specific tics. The ATQ was designed to address these issues by providing a brief (~10 minutes), reliable, self-report measure assessing tic severity in adults. To our knowledge, the ATQ is the only self-report measure for the assessment of tics that has been evaluated psychometrically. This measure provides clinicians and researchers with the opportunity to assess multiple dimensions of tic phenomenology, including presence, frequency, and intensity of specific individual tics as well as overall scores. The need for a comprehensive, multimethod, evidence-based assessment of TD has been repeatedly stated (Cath et al., 2011; McGuire et al., 2012; Swain, Scahill, Lombroso, King, & Leckman, 2007). The ATQ contributes to the existing multimethod battery of measures, addressing some of the shortcomings of other measures, and may be important in providing accurate tic-specific information.

As a self-report measure, the ATQ enables online administration, facilitating access to different samples, including remote community samples. Furthermore, the ATQ allows participants to choose the time and place to complete the ATQ. In addition, the

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wealth of specific information provided by the ATQ enables clinicians and researchers to track changes in specific facets of individual tics. Indeed, many behavior therapists target the most frequent and most intense tics early in the treatment. Furthermore, if this measure is completed repeatedly, it allows for the assessment of changes in the severity of specific tics over the course of therapy, which in turn would allow for better treatment planning (e.g., the treatment team would better understand if the targeted tic indeed improved as a result of specific interventions). A potential weakness of the ATQ may be that it requires participants to have a certain degree of insight as to the presence, and other aspects, of their tics. However, even in a clinician-administered setting, the interviewer relies heavily on participants' insight, as interviewees may not present with the full range of tics during the interview. In fact, the interview setting may have an impact on presentation of tics, where some could be more or less pronounced (Conelea & Woods, 2008).

This study is not without limitations. The structure of the ATQ does not permit factor analysis. However, the reliability of individual ATQ factors, their intercorrelations, their strong correlations with corresponding YGTSS factors, and especially the similarities between the YGTSS and the ATQ items provides support for the overall very good psychometric properties of the ATQ. In addition, as noted above, in order to obtain equal weights for frequency and intensity of tics when calculating severity, the intensity scale was transformed from an 8-point Likert-type scale to a 4-point scale at the data analysis stage. Theoretically, it is plausible that participants' responses would have been slightly different if a 4-point scale was presented to them at time of administration. However, we suspect that given the anchor points, this hypothetical effect would not be of significant impact. With regard to anchor points, as presented in the Appendix, instructions for the ATQ Intensity scale outline 3 anchor points for a 4-point scale. However, we do not expect this to have had a meaningful effect on the accuracy of scores, as the instructions do describe the option to rank a fourth anchor point: "*A much more forceful tic that would be very noticeable to others and may even be painful would be rated as a '3' or even higher.*"

Another potential limitation of the present study is that participants were all treatment-seeking individuals. Patients who seek treatment may potentially be more aware of their tics, which may have the potential to inflate correlations between the YGTSS, a clinician-administered measure, to the ATQ, a self-report measure. However, the vast majority of participants interviewed using the YGTSS would likely be treatment-seeking individuals, and thus it would be difficult to assess the hypothetical impact of this issue on psychometric aspects of the ATQ. Notably, the ATQ's total severity score is comprised of the sum of frequency and intensity ratings of all tics, so that the total severity score is influenced by the number of tics presented. This may lead to an instance where an individual with a few highly intense and very frequent tics may obtain the same total severity score as an individual with numerous very mild and infrequent tics. However, the ATQ provides clinicians and researchers with a high-resolution clinical picture, including the advantage of looking at per-tic frequency and intensity scores. If desired, clinicians and researchers can calculate an average per-tic severity score (total score divided by number of tics), which would result in an index of severity that is much less sensitive to tic number. Finally, larger samples are required in order to facilitate the development of severity ranges for the ATQ (e.g., mild, moderate, severe).

Conclusion

The ATQ is a promising addition to the current assessment battery of TD. It demonstrates very good psychometric properties, provides valuable multidimensional tic-specific information, and a highly needed option to assess tics online. Furthermore, previous preliminary examination of the ATQ in a randomized clinical trial demonstrated its sensitivity to change with BT for tic disorders, but more research is needed in order to examine the utility and sensitivity of the ATQ in clinical trials.

Conflict of Interest Statement

Drs Abramovitch and Reese declare no conflict of interest.

Drs Wilhelm, Peterson, Piacentini, Woods, and Scahill report receiving royalties from Oxford University Press for a treatment manual on tic disorders.

Drs Wilhelm, Peterson, Piacentini, Woods, and Scahill report receiving honoraria for continuing education presentations from the Tourette Syndrome Association. Drs Piacentini, and Woods, receive royalties from Guilford Press for a book on Tourette disorder.

Dr Wilhelm reports receiving support in the form of free medication and matching placebo from Forest Laboratories for clinical trials funded by the National Institutes of Health and receiving book royalties from Elsevier Publications, Guilford Publications, New Harbinger Publications, and Oxford University Press. Dr. Wilhelm is a presenter for the Massachusetts General Hospital Psychiatry Academy in educational programs supported through independent medical education grants from pharmaceutical companies. Dr. Wilhelm has also received speaking honorarium from various academic institutions and foundations, including the International Obsessive Compulsive Disorder. In addition, she received payment from the Association for Behavioral and Cognitive Therapies for her role as Associate Editor for the Behavior Therapy journal, as well as from John Wiley & Sons, Inc. for her role as Associate Editor on the journal Depression & Anxiety. Dr. Wilhelm has also received salary support from Novartis.

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Dr Piacentini reports receiving royalties from Oxford University Press for treatment manuals on child obsessive-compulsive disorder, research support from the Tourette Syndrome Association and Pfizer, speaking fees from the International OCD Foundation, and consultant fees from Bayer Schering Pharma.

Dr Woods reports receiving book royalties from New Harbinger and Springer Publications.

Dr Scahill has received royalties from Oxford University Press, Guilford and American Psychiatric Press; has served as a consultant for Biomarin, Bracket and Pfizer; and has had research support from Shire Pharmaceutical, Roche, and Pfizer. He also reports receiving support in the form of free medication and matching placebo from Shire Pharmaceuticals for a clinical trial funded by the National Institute of Mental Health.

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Appendix. Adult Tic Questionnaire

For each of the tics listed below, please mark "YES" or "NO" as to whether or not you have experienced the tic in the past week.

For each tic you mark as "YES", please mark how **FREQUENTLY** the tic occurred over the past week, according to the following:

Constant, almost all the time during the day
Hourly, at least once per hour
Daily, at least several times per day
Weekly, just a few times or less

Under **INTENSITY**, rate how intense the tic felt to you during the past week. For example, if it was very mild, like a weak twitch, that would be a "1". A much more forceful tic that would be very noticeable to others and may even be painful would be rated as a "3" or even higher. Any tic that would be obviously noticeable to others should be rated as at least a "2".

Motor Tics

	Present		Frequency				Intensity
	Yes	No	C	H	D	W	(1-4)
	1	*0*	*4*	*3*	*2*	*1*	
Eye Blinking	□	□	C	H	D	W	_____
Eye rolling/darting	□	□	C	H	D	W	_____
Head Jerk	□	□	C	H	D	W	_____
Facial Grimace	□	□	C	H	D	W	_____
Mouth/Tongue Movements	□	□	C	H	D	W	_____
Shoulder Shrugs	□	□	C	H	D	W	_____
Chest/stomach tightening	□	□	C	H	D	W	_____
Pelvic Tensing Movements	□	□	C	H	D	W	_____
Leg/Feet Movements	□	□	C	H	D	W	_____
Arm/Hand Movements	□	□	C	H	D	W	_____
Echopraxia (copying another's gestures)	□	□	C	H	D	W	_____
Copropraxia (obscene gestures)	□	□	C	H	D	W	_____
Other Motor Tics _____	□	□	C	H	D	W	_____
Complex Motor Combinations (multiple tics at once)	□	□	C	H	D	W	_____

Vocal Tics

	Present		Frequency				Intensity
	Yes	No	C	H	D	W	(1-4)
	1	*0*	*4*	*3*	*2*	*1*	
Grunting	□	□	C	H	D	W	_____
Sniffing	□	□	C	H	D	W	_____
Snorting	□	□	C	H	D	W	_____
Coughing	□	□	C	H	D	W	_____
Animal Noises	□	□	C	H	D	W	_____
Syllables	□	□	C	H	D	W	_____
Words	□	□	C	H	D	W	_____
Phrases	□	□	C	H	D	W	_____
Echolalia (repeating vocalizations of others)	□	□	C	H	D	W	_____
Coprolalia (obscene words)	□	□	C	H	D	W	_____
Blocking/stuttering	□	□	C	H	D	W	_____
Other Vocal Tics _____	□	□	C	H	D	W	_____
Complex Vocal Combinations (multiple tics at once)	□	□	C	H	D	W	_____

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References

Bloch, M. H., Peterson, B. S., Scahill, L., Otka, J., Katsovich, L., Zhang, H., & Leckman, J. (2006). Adulthood outcome of tic and obsessive-compulsive symptom severity in children with tourette syndrome. *Archives of Pediatrics and Adolescent Medicine*, *160*, 65–69.

Cath, D., Hedderly, T., Ludolph, A., Stern, J., Murphy, T., Hartmann, A., . . . Rizzo, R. (2011). European clinical guidelines for Tourette Syndrome and other tic disorders. Part I: assessment. *European Child & Adolescent Psychiatry*, *20*, 155–171.

Chang, S., Himle, M. B., Tucker, B. T. P., Woods, D. W., & Piacentini, J. (2009). Initial Psychometric Properties of a Brief Parent-Report Instrument for Assessing Tic Severity in Children with Chronic Tic Disorders. *Child & Family Behavior Therapy*, *31*, 181–191.

Cohen, D. J., Detlor, J., Young, J., & Shaywitz, B. A. (1980). CLonidine ameliorates gilles de la tourette syndrome. *Archives of General Psychiatry*, *37*, 1350–1357.

Collett, B. R., Ohan, J. L., & Myers, K. M. (2003). Ten-Year Review of Rating Scales, V: Scales Assessing Attention-Deficit/Hyperactivity Disorder. *Journal of the American Academy of Child & Adolescent Psychiatry*, *42*, 1015–1037.

Conelea, C. A., & Woods, D. W. (2008). The influence of contextual factors on tic expression in Tourette's syndrome: A review. *Journal of Psychosomatic Research*, *65*, 487–496.

Crossley, E., & Eugenio Cavanna, A. (2013). Sensory phenomena: Clinical correlates and impact on quality of life in adult patients with Tourette syndrome. *Psychiatry Research*, *209*, 705–710.

DuPaul, G. J., Power, T. J., Anastopoulos, A. D., & Reid, R. (1998). *ADHD rating scale - IV: Checklists, norms, and clinical interpertation*. New York, NY: Guilford Press.

Eapen, V., Fox-Hiley, P., Banerjee, S., & Robertson, M. (2004). Clinical features and associated psychopathology in a Tourette syndrome cohort. *Acta Neurologica Scandinavica*, *109*, 255–260.

First, M. B., Spitzer, R. L., Gibbon, M., & Williams, J. B. W. (2002). *Structured Clinical Interview for DSM-IV-TR Axis I Disorders, Research Version, Patient Edition. (SCID-I/P)*. New York: Biometrics Research, New York State Psychiatric Institute.

Freeman, R. D. (2007). Tic disorders and ADHD: answers from a world-wide clinical dataset on Tourette syndrome. *European Child & Adolescent Psychiatry*, *16*, 15–23.

Gaffney, G. R., Sieg, K., & Hellings, J. (1994). The MOVES: A self-rating scale for Tourette's syndrome. *Journal of Child and Adolescent Psychopharmacology*, *4*, 269–280.

Goetz, C. G., Leurgans, S., & Chmura, T. A. (2001). Home alone: methods to maximize tic expression for objective videotape assessments in Gilles de la Tourette syndrome. *Movement Disorders*, *16*, 693–697.

Goodman, W. K., Price, L. H., Rasmussen, S. A., Mazure, C., Delgado, P., Heninger, G. R., & Charney, D. S. (1989). The Yale-Brown Obsessive Compulsive Scale. II. Validity. *Archives of General Psychiatry*, *46*, 1012–1016.

Goodman, W. K., Price, L. H., Rasmussen, S. A., Mazure, C., Fleischmann, R. L., Hill, C. L., Heninger, G. R., & Charney, D. S. (1989). The Yale-Brown Obsessive Compulsive Scale. I. Development, use, and reliability. *Archives of General Psychiatry*, *46*, 1006–1011.

Gosling, S. D., & Mason, W. (2015). Internet Research in Psychology. *Annual Review of Psychology*, *66*, 877–902.

Leckman, J. F., Riddle, M. A., Hardin, M. T., Ort, S. I., Swartz, K. L., Stevenson, J., & Cohen, D. J. (1989). The Yale Global Tic Severity Scale: initial testing of a clinician-rated scale of tic severity. *Journal of the American Academy of Child and Adolescent Psychiatry*, *28*, 566–573.

Lin, H., Yeh, C. B., Peterson, B. S., Scahill, L., Grantz, H., Findley, D. B., . . . Leckman, J. F. (2002). Assessment of symptom exacerbations in a longitudinal study of children with Tourette's syndrome or obsessive-compulsive disorder. *Journal of the American Academy of Child and Adolescent Psychiatry*, *41*, 1070–1077.

McGuire, J., Kugler, B., Park, J., Horng, B., Lewin, A., Murphy, T., & Storch, E. (2012). Evidence-Based Assessment of Compulsive Skin Picking, Chronic Tic Disorders and Trichotillomania in Children. *Child Psychiatry & Human Development*, *43*, 855–883.

Peterson, B. S., & Leckman, J. F. (1998). The temporal dynamics of tics in Gilles de la Tourette syndrome. *Biological Psychiatry*, *44*, 1337–1348.

Piacentini, J., Himle, M., Chang, S., Baruch, D., Buzzella, B., Pearlman, A., & Woods, D. (2006). Reactivity of Tic Observation Procedures to Situation and Setting. *Journal of Abnormal Child Psychology*, *34*, 647–656.

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. *Journal of Applied Psychology*, *88*, 879–903.

Reese, H. E., Scahill, L., Peterson, A. L., Crowe, K., Woods, D. W., Piacentini, J., Walkup, J. T., & Wilhelm, S. (2014). The Premonitory Urge to Tic: Measurement, Characteristics, and Correlates in Older Adolescents and Adults. *Behavior Therapy*, *45*, 177–186.

Safren, S. A., Sprich, S., Mimiaga, M. J., Surman, C., Knouse, L., Groves, M., & Otto, M. W. (2010). Cognitive behavioral therapy vs relaxation with educational support for medication-treated adults with ADHD and persistent symptoms: a randomized controlled trial. *JAMA*, *304*, 875–880.

Scahill, L., Leckman, J. F., Schultz, R. T., Katsovich, L., & Peterson, B. S. (2003). A placebo-controlled trial of risperidone in Tourette syndrome. *Neurology*, *60*, 1130–1135.

Silva, R. R., Munoz, D. M., Barickman, J., & Friedhoff, A. J. (1995). Environmental factors and related fluctuation of symptoms in children and adolescents with Tourette's disorder. *Journal of Child Psychology and Psychiatry*, *36*, 305–312.

Spencer, T., Wilens, T., Biederman, J., Faraone, S. V., Ablon, J., & Lapey, K. (1995). A double-blind, crossover comparison of methylphenidate and placebo in adults with childhood-onset attention-deficit hyperactivity disorder. *Archives of General Psychiatry*, *52*, 434–443.

Storch, E. A., Murphy, T. K., Fernandez, M., Krishnan, M., Geffken, G. R., Kellgren, A. R., & Goodman, W. K. (2007). Factor-analytic study of the Yale Global Tic Severity Scale. *Psychiatry Research*, *149*, 231–237.

Storch, E. A., Murphy, T. K., Geffken, G. R., Sajid, M., Allen, P., Roberti, J. W., & Goodman, W. K. (2005). Reliability and validity of the Yale Global Tic Severity Scale. *Psychological assessment*, *17*, 486–491.

Swain, J. E., Scahill, L., Lombroso, P. J., King, R. A., & Leckman, J. F. (2007). Tourette Syndrome and Tic Disorders: A Decade of Progress. *Journal of the American Academy of Child & Adolescent Psychiatry*, *46*, 947–968.

The Psychological Corporation. (2001). *Wechsler Test of Adult Reading Manual*. San Antonio, TX: The Psychological Corporation.

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Tourette Syndrome Association International Consortium for Genetics (TSAICG). (2007). Genome scan for Tourette disorder in affected-sibling-pair and multigenerational families. *American Journal of Human Genetics*, *80*, 265–272.

Wilhelm, S., Peterson, A. L., Piacentini, J., Woods, D. W., Deckersbach, T., Sukhodolsky, D. G., . . . Scahill, L. (2012). Randomized trial of behavior therapy for adults with Tourette syndrome. *Archives of General Psychiatry*, *69*, 795–803.

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