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The impact of a stress induction task on tic frequencies in youth with Tourette Syndrome

Christine A. Conelea, Douglas W. Woods*, Bryan C. Brandt

University of Wisconsin–Milwaukee, United States

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ABSTRACT

Tourette Syndrome (TS) is a neuropsychiatric disorder characterized by motor and vocal tics. Tic fluctuations are common and thought to be attributable in part, to contextual variables. Stress is one such variable, but its effects and mechanism of action are poorly understood. The current study measured the effects of a stress induction task on tic frequencies during periods of suppression and non-suppression of tics. Ten youth with TS between the ages of 9 and 17 were exposed to four conditions in random sequence: free-to-tic baseline (BL), reinforced tic suppression (SUP), reinforced tic suppression plus a stress induction task (SUP + STRESS), and a stress induction task alone (STRESS). Tic frequencies did not differ during STRESS and BL. Tic frequencies were greater in SUP + STRESS than SUP. Stress may impact tics through disrupting suppression efforts. Clinically, results suggest that interventions designed to improve tic inhibition in the presence of acute stressors may be beneficial.

Tourette Syndrome (TS) is characterized by tics, which are sudden, rapid, recurrent vocalizations or motor movements (American Psychiatric Association [APA], 2000). Tics are often preceded by aversive somatic sensations called "premonitory urges" that are temporarily alleviated following a tic (Leckman, Walker, & Cohen, 1993). TS affects approximately 0.8% of the population, is more common in males, and frequently co-occurs with Obsessive Compulsive Disorder (OCD) and Attention Deficit Hyperactivity Disorder (ADHD; Kurlan et al., 2001; 2002).

Tics typically fluctuate in form, frequency, intensity, and severity. Neurological models of TS postulate that tic variability may be the result of neuroanatomical changes over the course of the disorder, such as altered neuronal activity in the striatum (Mink, 2006). Behavioral models suggest tic fluctuations may also be attributable to contextual or emotional variables (Conelea & Woods, 2008a). Although an integration of the two models will likely best account for symptom fluctuations, additional work within the behavioral model must first be done to identify specific contextual variables that impact tic expression and understand their mechanisms of action.

Several contextual variables have been found to exacerbate (e.g., fatigue, social events) and reduce (e.g., interactions with familiar people, passive activities) tics (Bornstein, Stefl, & Hammond, 1990; Eapen, Fox-Hiley, Banerjee, & Robertson, 2004; Silva, Munoz, Barickman, & Friedhoff, 1995). One of the most common factors believed to produce short-term tic exacerbation is physiological and psychosocial stress. Across several self-report studies, the majority of individuals with TS report that their tics are exacerbated by stress (Bornstein et al., 1990; Eapen et al., 2004; O'Connor, Brisebois, Brault, Robillard, & Loiselle, 2003; O'Connor, Gareau, & Blowers, 1994; Robertson, Banerjee, Eapen, & Fox-Hiley, 2002; Silva et al., 1995).

Correlational and experimental research has revealed significant relationships between stress and tics. Compared to normal controls, individuals with TS experience more stress (Findley et al., 2003; Lin et al., 2007) and have a heightened biochemical response to stressful stimuli (Chappell, Leckman, Goodman, & Bissette, 1996; Chappell, Riddle, Anderson, & Scahill, 1994; Corbett, Mendoza, Baym, Bunge, & Levine, 2008; Leckman, Riddle, Berrettini, & Anderson, 1988). Daily stressors impact tic expression more than major life stressors (Findley et al., 2003; Hoekstra, Steenhuis, Kallenberg, & Minderaa, 2004), and there is evidence that tic severity may be related to diurnal cortisol rhythms (Corbett et al., 2008). In terms of the direction of the tic–stress relationship, longitudinal research suggests that stressors may lead to tic increases (Lin et al., 2007).

Abbreviations: BL, baseline condition; SUP, suppression condition; STRESS, stress condition; SUP + STRESS, stress and simultaneous suppression condition; TPM, tics per minute.

* Corresponding author. Department of Psychology, University of Wisconsin–Milwaukee, Box 413, Milwaukee, WI 53201, United States. Tel.: +1 414 229 5335; fax: +1 414 229 5219.
E-mail address: dwoods@uwm.edu (D.W. Woods).

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The aforementioned studies provide valuable information about the tic–stress relationship, but tic severity ratings in the majority of the investigations described above (Corbett et al., 2008; Findley et al., 2003; Hoekstra et al., 2004; Lin et al., 2007) were based on the Yale Global Tic Severity Scale (YGTSS; Leckman, Riddle, Hardin, & Ort, 1989). Although the YGTSS is a standard measure in TS treatment outcome research, it only provides global information about tic symptoms aggregated across a one week period and is therefore insensitive to changes in tic frequency that may occur over shorter and discrete time intervals.

Some research has tried to capture these discrete fluctuations and found that tic increases are associated with anticipation (Wood et al., 2003), timed mental arithmetic (Lees, Robertson, Trimble, & Murray, 1984), and thermal stress (Lombroso, Mack, Scahill, & King, 1991; Scahill et al., 2001). Interestingly, two of these studies found discrepancies between parent or self-report of emotional triggers and actual observation of tics under similar conditions (Wood et al., 2003; Scahill et al., 2001), suggesting that self-report of factors that exacerbate tics may be inaccurate.

Taken together, the existing literature suggests that there is a relationship between stress and tics. However, the nature of the relationship remains unclear. First, we still do not know if stress increases tics above baseline levels. Research shows that stress is correlated with increases in tic frequency, but this idea has never been experimentally tested in youth with TS. Second, it is unclear how stress impacts tic frequency. Researchers have suggested that some "tic exacerbating" variables are actually events that make tic suppression more difficult. When exposed to such factors, tics revert to baseline frequency, as tic suppression efforts are disrupted (Conelea & Woods, 2008a). Therefore, it may be the case that stress disrupts optimal suppression but does not actually increase tic frequencies above baseline levels. However, no research to date has examined this aspect of the tic–stress relationship.

In order to clarify the tic–stress relationship, the current study used an experimental paradigm capable of creating reliable tic suppression (Himle & Woods, 2005; Woods & Himle, 2004), which has enabled researchers to conduct controlled examinations of contextual variables hypothesized to disrupt tic suppression (Conelea & Woods, 2008b). The relationship between tics and stress was examined in this study by measuring the effects of a stress induction task on tic frequencies to determine if 1) tic frequencies change relative to baseline during a stress induction task and 2) tic suppressability changes during a stress induction task. The first aim was examined by comparing tic frequencies during a free-to-tic, no-stress baseline (BL) to a stress induction condition (STRESS). Based on research suggesting that stress is associated with increased tic frequency and severity (e.g., Bornstein et al., 1990; Scahill et al., 2001), it was hypothesized that youth would have higher tic frequencies during STRESS as compared to BL. The second aim was examined by comparing tic frequencies during a suppression task involving a simultaneous stress induction (SUP + STRESS) to a condition involving suppression of tics in the absence of the stress induction (SUP). It was hypothesized that youth would demonstrate a decreased ability to suppress tics during SUP + STRESS. Perceived premonitory urge intensity was also assessed across conditions to explore possible links between the urge, stress, and tics given the important role the urge is thought to play in behavioral models of tic maintenance (Woods et al., 2008).

Methods

Participants

Youth (ages 9–17) were eligible to participate if they 1) had a diagnosis of TS or Chronic Tic Disorder (either motor or vocal), 2) had a YGTSS Tic Severity Score of $\geq$14 for TS and $\geq$10 for CTD, 3) had at least 1 discernable tic per minute, as observed during the initial assessment, and 4) had a score of $\geq$80 on the Wechsler Abbreviated Scale of Intelligence. Exclusionary criteria included a history of $\geq$3 sessions of Habit Reversal Therapy (HRT) or other treatment primarily comprised of suppression strategies and/or comorbid ADHD, Conduct Disorder, or Oppositional Defiant Disorder that prevented full participation (defined as a severity rating of 6 or more on the Anxiety Disorders Interview Schedule – Fourth Edition; youth with these diagnoses but severity $\leq$5 were included). Ten youth and their parents were recruited, met eligibility requirements, and provided written informed consent/assent.

Materials

Anxiety Disorders Interview Schedule – Fourth Edition (*ADIS-IV*; Silverman & Albano, 1996). The ADIS is a structured diagnostic interview administered to the parent and youth that yields a comprehensive listing of all positive DSM-IV-TR diagnoses.

Premonitory Urge for Tics Scale (*PUTS*; Woods, Piacentini, Himle, & Chang, 2005). The PUTS is a 9-item self-report measure in which children rate premonitory urge descriptions on a 0–4 point scale anchored by "not at all true" and "very true." The PUTS has been shown to be internally consistent ($\alpha = .81$) and temporally stable (Woods et al., 2005). In the current sample, $\alpha = .85$.

Videotaped Observation. Each youth was covertly videotaped alone in a room for 10 min. Investigators simultaneously monitored the youth from behind a one-way mirror to determine whether the child met the inclusion criteria of 1 tic per minute and to create operational definitions of all tics displayed. Tape scoring and reliability procedures are described in the data analysis section below.

Wechsler Abbreviated Scale of Intelligence (*WASI*; The Psychological Corporation, 1999). The WASI is a psychometrically acceptable measure of intellectual functioning designed for use with individuals' ages 6–89 years. The 2-subscale version of the WASI was administered to each youth.

Yale Global Tic Severity Scale (*YGTSS*; Leckman et al., 1989). The YGTSS is a semi-structured parent and child interview that produces separate severity ratings for motor and vocal tics and an overall score of tic severity. The YGTSS has demonstrated acceptable psychometric properties, including good internal consistency, good interrater reliability, and acceptable convergent and divergent validity (Leckman et al., 1989). In the current sample, $\alpha = .76$.

Procedures

The study was approved by the University of Wisconsin–Milwaukee Institutional Review Board. Written informed consent from the parents/legal guardians and written assent from the youth were obtained prior to study administration. The participant was video recorded from behind a one-way observation mirror during all experimental conditions. Parents were informed of the recording and youth were uninformed until debriefing at the end of the study. Subtle deception was used because previous research has shown that tics can be unpredictably reactive to observation (Piacentini et al., 2006). At the end of the study, the investigator debriefed the youth and obtained a second written assent allowing the researchers to utilize the experimental data.

Each participant and his/her parent(s) underwent an initial assessment using the measures described above. During all experimental conditions, the youth was seated alone in a $10' \times 15'$ observation room equipped with a one-way observation mirror that allowed for covert observation and video recording from an adjacent room. A $12'' \times 12'' \times 24''$ token dispenser was placed in front of the youth. Following the protocol established by Woods