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Examining the impact of distraction on tic suppression in children and adolescents with Tourette syndrome

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ABSTRACT

Tourette syndrome (TS) is characterized by motor and/or vocal tics. Tics are thought to be temporarily suppressible, and it is believed that suppression requires significant attentional resources. The aim of the current study was to examine the impact of an attention-demanding distraction task on tic suppression. A secondary aim was to examine whether performance on that task decreased during concomitant periods of suppression. Nine children with TS, ages 9–15, participated in the study. An alternating treatment design was used to compare three conditions, free-to-tic baseline (BL), reinforced tic suppression (SUP) and reinforced tic suppression plus a distraction task (SUP + DIS). Tic frequencies were significantly higher during BL conditions than both SUP and SUP + DIS conditions, and tic frequencies during SUP and SUP + DIS did not differ. Accuracy on the distraction task decreased during SUP + DIS as compared to BL. Results suggest that contextual distractions may not negatively impact tic frequencies. In addition, accuracy on an attention-demanding task may be impacted if a child is simultaneously suppressing.

Introduction

Tourette syndrome (TS) is a childhood onset neuropsychiatric disorder characterized by recurrent, sudden, stereotyped motor movements and vocalizations called motor and vocal "tics," respectively (American Psychiatric Association [APA], 2000). Tic disorders are estimated to occur in 0.04–3.0% of the population (Hornsey, Banerjee, Zeitlin, & Robertson, 2001; Mason, Banerjee, Eapen, Zeitlin, & Robertson, 1998) and are more common in males than females. Over 50% of those with TS have a co-occurring psychiatric condition, the most common being attention-deficit hyperactivity disorder (ADHD) and obsessive-compulsive disorder (OCD; Freeman et al., 2000).

Although tics are involuntary, research has supported the notion that they can be temporarily suppressed to varying degrees (Jankovic & Fahn, 1986). Unfortunately, little is known about the development of tic suppression abilities or the mechanisms responsible for suppression. Research in this area has suggested that contextual factors and attentional processes may play key roles in tic suppression (Conelea & Woods, in press; Himle & Woods, 2005; Peterson et al., 1998).

Numerous studies using survey or otherwise uncontrolled research designs have suggested that tic expression can vary depending on one's context or emotional state (e.g., Bornstein, Stefl, & Hammond, 1990; Eapen, Fox-Hiley, Banerjee, & Robetrson, 2004; O'Connor, Brisebois, Brault, Robillard, & Loiselle, 2003; Silva, Munoz, Barickman, & Friedhoff, 1995). To better understand how such factors impact tic expression, researchers have begun to examine tic suppression in studies using controlled experimental designs. Meidinger et al. (2005) examined the impact of instructing children and adults with TS ($N = 7$) to suppress their tics. Using a withdrawal design, two conditions were compared: (1) a non-suppression baseline and (2) a condition in which the subject was told to suppress his/her tics. Significant reductions in tic frequencies were observed in almost one half of all suppression conditions, indicating that tics are somewhat suppressible in the presence of a verbal instruction to do so, at least for temporary amounts of time.

Woods and Himle (2004) suggested that natural suppression rarely involves reacting to simple instructions to suppress. Rather, they noted that children may encounter reinforcing consequences for successfully suppressing tics. For example, suppression may result in avoidance of teasing or increased ability to engage in activities that might be disrupted by tics, such as playing sports or talking with others. To determine if reinforcement for suppression could impact tic occurrence, Woods and Himle used a withdrawal design in which three 5-min conditions were administered repeatedly: (1) baseline, (2) verbal instructions to suppress, and (3) contingent reinforcement for suppression, in which tokens (exchangeable for a prize) were delivered for every 10-s tic-free period. Averaged across the four participants, the verbal

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instructions condition produced a 10.3% reduction in tic rates from baseline levels, whereas the reinforcement condition produced a 76.3% reduction. These results suggested that tic suppressability may be enhanced by operant contingencies.

Other studies have used the Woods and Himle (2004) preparation to further examine the relationship between contextual factors and tic suppression (Himle & Woods, 2005; Himle, Woods, & Bunaciu, 2008; Himle, Woods, Conelea, Bauer, & Rice, 2007; Woods et al., 2008). These studies have shown that tic suppression (a) does not necessarily produce a rebound in tic frequency (Himle & Woods; Woods et al.), (b) is capable of being maintained for up to 40 min (Woods et al.), (c) requires the contingent delivery of a reinforcer to produce maximum suppression (Himle et al., 2007), and (d) is functionally related to urges to tic (Himle et al., 2008). Combined, these studies have examined a number of factors that could give rise to tic suppression. However, contextual factors may also disrupt successful suppression. Identification of such factors may help to answer the question of how tic suppression is accomplished. In addition, it may help to inform behavioral interventions designed to enhance tic suppression ability (e.g., Azrin & Nunn, 1973; Deckersbach, Rauch, Buhlmann, & Wilhelm, 2006).

Many factors may be related to one's ability to suppress tics, but research to date has suggested that attentional processes may be particularly important. Himle and Woods (2005) found a significant negative correlation between the Attention Problems subscale of the CBCL and tic suppressability ($r(7) = -.89$, $p < .01$), suggesting that poorer suppressability is related to increasing attention problems. Likewise, Woods et al. (2008) found a significant correlation between the ability to suppress and omission errors on a continuous performance task ($r(11) = -0.63$, $p < 0.05$), leading the authors to conclude that poor task orientation was related to poor tic suppression ability. Brain imaging research also supports the notion that tic suppression involves attentional processes. Using fMRI, Peterson et al. (1998) observed significant changes in cortical regions thought to subserve attention-demanding tasks during periods of voluntary suppression. The authors concluded that tic suppression is an attention-demanding task that involves a constant monitoring of somatosensory information. Finally, it has been suggested that performance deficits on attention-demanding tasks may occur when attentional efforts are directed to tic suppression (Shimberg, 1995).

Although attentional processes have been implicated in tic suppression, the relationship has not been experimentally tested at the behavioral level. In the current study, we sought to explore the link between attentional processes and tic suppression by examining tic suppression in the presence and absence of a competing attention-demanding task. We proposed two hypotheses based upon research suggesting that tic suppression is an attention-demanding task. First, we hypothesized that tic frequencies would be higher during periods of suppression plus distraction as compared to periods of suppression alone. Second, we hypothesized that children would demonstrate decreased accuracy on an attention-demanding task during periods in which suppression was coupled with distraction as compared to performance on the task before and after the experimental portion of the study.

Methods

Participants

Children were recruited via referrals and print advertising at an outpatient tic disorders specialty clinic located at the University of Wisconsin – Milwaukee. Following informed consent/assent, an initial assessment with the parent and child was conducted to determine study eligibility. Children were deemed eligible for the study if they (1) met criteria for Tourette Disorder (i.e., Tourette Syndrome) or Chronic Tic Disorder according to the Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition-Text Revision (DSM-IV-TR; APA, 2000), (2) had a minimum level of total tic severity as indicated by a severity score of $\geq$14 for TS and $\geq$10 for CTD on the Yale Global Tic Severity Scale (YGTSS; Leckman et al., 1989), (3) had at least one discernable tic per minute, as observed in an initial videotaped observation, and (4) performed in the low average range or above in intellectual functioning as indicated by a score of 80 or greater on the Wechsler Abbreviated Scale of Intelligence (WASI; The Psychological Corporation, 1999). Children were excluded if they (1) had comorbid ADHD, Conduct Disorder, or Oppositional Defiant Disorder with a rating of >6 on the Anxiety Disorders Interview Schedule-Fourth Edition (ADIS-IV; Silverman & Albano, 1996) or (2) had a history of $\geq$3 sessions of behavioral treatment primarily comprised of tic suppression strategies. Psychiatric diagnoses were determined by combining information from the ADIS-IV, the YGTSS, and direct observation.

Eleven children were recruited and nine met the inclusion criteria. One child was excluded because she did not have 1 tic/min during an initial direct observation, and one child was excluded because he did not meet DSM-IV-TR criteria for TS or CTD. The nine participants had a mean age of 11.5 (range = 9–15) and consisted of seven boys and two girls. Comorbid diagnoses and their ADIS clinician rated severity scores, tic severity scores, and current tics for each participant are provided in Table 1. Six of the children had past or current medication treatment for TS, and three had no previous treatment for TS. None of the children had previously received behavior therapy for tics.

Written informed consent/assent was obtained prior to study participation. During the initial assent, children were not told about live observation and videotape recording procedures. Children were informed of these procedures at the end of the study, and written assent was obtained from the child following the debriefing. Parents were fully informed of study procedures prior to study participation. The study was approved by the University of Wisconsin – Milwaukee Institutional Review Board.

Setup and materials

During all experimental conditions, the child was seated by him/herself 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, with a clear plastic receptacle attached to the front, was placed in front of the child. Using a protocol established by Woods and Himle (2004) and Himle and Woods (2005), the child was informed that the dispenser was a "tic detector" that had the ability to monitor and count his/her tics (note: the device was actually a token dispenser manually operated by the investigator in the observation room). In order to enhance the likelihood that the dispenser appeared to be a "tic detector" capable of monitoring tics, a non-functioning Internet camera and power supply box were attached to the dispenser. In addition, a laptop computer was placed next to the dispenser and was used to run the auditory continuous performance test described below. The child was told that he/she would have the opportunity to earn tokens from the "tic detector" during various tasks. The child was told that tokens were exchangeable for a reward upon study completion, such that more preferred rewards required earning more tokens (note: the child always received his/her preferred reward at the end of the study regardless of the number of tokens earned). The child and investigator then identified preferred rewards and created a reward hierarchy prior to the start of the experimental conditions. To increase the salience of the reward for each child, preferred reward hierarchies were created individually for each child. Rewards were delivered by the experimenter following study completion.