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## Reply

# Translational attention: From experiments in the lab to helping the symptoms of individuals with Tourette's syndrome ☆,☆☆

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Over the past decade my colleagues and I have been able to demonstrate, using objective scientific paradigms, how top-down processes such as suggestion and expectation seem to override bottom-up effects in highly hypnotizable people. As appealing and as intriguing such demonstrations may be, however, these exemplars usually span a small set of circumscribed tasks, which are usually entrenched within the purview of experimental psychology. In his commentary, moreover, Kirsch (2011) emphasised the importance of including moderately suggestible participants in experiments involving hypnosis. In this paper we attempt to sketch out some preliminary data to support the potential generalizability of these findings to clinical situations. As a case in point, we focus on the neurodevelopmental motor disorder of Tourette's Syndrome (TS), which is part of a spectrum of motor impairments, ranging from simple transient motor tics to chronic debilitating symptoms, and which affect 0.5–24% of school-aged children around the world (Freeman et al., 2000; Jankovic, 1997; Kurlan et al., 2001; Robertson, 2003; Shapiro, Shapiro, Young, & Feinberg, 1988; Singer & Walkup, 1991). Conveniently, tic severity in TS peaks around the age of 11–12 years of age – a time marked by heightened compliance with suggestion and susceptibility to hypnosis (see Kohen & Olness, 2011; Raz, 2012).

Individuals with TS often have difficulty with executive functions, a term comprising a number of cognitive and behavioural constructs that include mental tracking, sustained attention, working memory, planning and organisation, goal-directedness, cognitive flexibility during problem-solving, impulse control, and self-regulation. Childhood motor disorders, including TS, are more widespread than is commonly acknowledged (Spessot & Peterson, 2006). The clinical hallmark of TS is the presence of motor or phonic tics: repetitive, stereotyped motions or vocalisations (APA, 2000). Motor tics range from simple motions, such as blinking or shoulder-shrugging, to more complicated motions, such as jumping, and kicking (Jankovic, 2001). Phonic tics range from simple squeaking or grunting sounds to echoing and, more rarely, cursing (Freeman et al., 2000; Jankovic, 2001). In addition, many individuals with TS report sensations of mounting urges or psychological tension prior to ticking (Hallett, 2001; Leckman, 2002). TS is often co-morbid with attention-deficit hyperactivity disorder (ADHD), obsessive-compulsive disorder (OCD) or both (Robertson, 2003). The combination of TS with any co-morbidity increases the risk of problems such as anger management, self-injurious behaviour, and sleep disorders (Freeman et al., 2000). Thus, the management of TS is of critical concern to healthcare professionals.

While pharmacological options exist for the treatment of TS (e.g., haloperidol, pimozide, or clonidine), general consensus posits that such therapies are suboptimal, and prominent researchers have lamented that “medication therapies for TS are, frankly, woefully inadequate” (Peterson & Cohen, 1998). Drug efficacy is inconsistent and unpredictable, and at best, offers only symptomatic relief (Phelps, 2008). Benefits often come at the expense of intolerable side-effects, including sedation, parkinsonism, tardive dyskinesia, cognitive dulling, dry mouth, fatigue, dizziness, weight gain, and metabolic problems (Swain, Scahill, Lombroso, King, & Leckman, 2007). TS specialists hence recognise the need for alternatives and therapeutic adjuncts (Phelps, 2008).

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\* I dedicate this collection of responses to the memory of Bill Banks, founding coeditor of *Consciousness and Cognition*. This project was the last professional interaction I had with him before his untimely parting.

☆☆ Reply to Kirsch, I. (2011). Suggestibility and suggestive modulation of the Stroop effect. *Consciousness and Cognition*, 20(2), 335–336.

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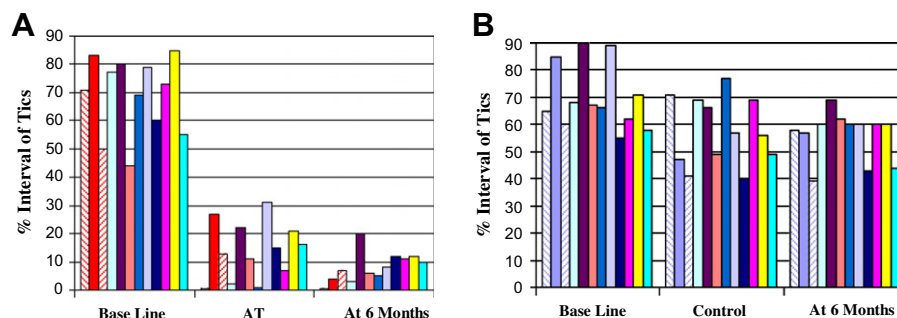
A recent research approach draws on brain imaging methodologies to identify the neurobiological basis of developmental neuropsychiatric disorders, particularly in impulse control disorders (ICD) involving premonitory urges (Blumberg et al., 2003; Bush, 2008; Raz et al., 2009; Shafritz, Collins, & Blumberg, 2006; Sowell et al., 2008). Many of these ICDs, extend to TS, OCD and ADHD and seem to involve common neurobiological substrates (Albin & Mink, 2006; Marsh et al., 2004; Mink, 2001; Mink, 2006). Findings from brain imaging studies suggest that ICDs involve impairments in the attention control networks, and implicate these modules as central vehicles to regulating the manifestations of the underlying symptomatology (Raz & Buhle, 2006). Attention networks are potent modulators of cognition, emotion, thought, and action (Posner & Rothbart, 2007). Indeed, my colleagues and I have shown how attention impacts self-regulation – the ability to manipulate one's own emotions, thoughts or actions on direction from the self or another person (Raz, Kirsch, Pollard, & Nitkin-Kaner, 2006; Raz, Moreno-Iniguez, Martin, & Zhu, 2007; Raz, Shapiro, Fan, & Posner, 2002). Attention and self-regulation have been studied in adults as well as children in both healthy and pathological populations (Baumeister & Vohs, 2004).

Attention training (AT) is an approach to early child education that places emphasis on improving self-regulation. Similar to other behavioural intervention such as habit-reversal, AT operates in close coordination with other trainable cognitive modules such as working memory (Klingberg, 2008). Evidence has shown that between the ages of 3 and 7, children develop a brain network that allows for self-regulation of thoughts and emotions (Rueda, Posner, & Rothbart, 2004). We have outlined how attentional interventions, including AT, can aid in overcoming the debilitating symptoms of impulse control disorders via improvements to this network, and have done so with a special focus on TS (Raz, Keller, Norman, & Senechal, 2007).

Similar to other recent behavioral interventions aimed at managing TS, AT reduced the symptoms of TS in a pilot spanning 12 experimental and 12 control participants. Our preliminary findings ( $N = 24$ ) suggest that, compared to a control condition – watching popular children's videos, relaxing, and playing general video games with intermittent dialogue pauses matching for child–adult interactions – AT decreased visible tics and impulsivity in young individuals with TS and increased their ability to regulate emotions and persist with goals in the face of distractions (Fig. 1). Findings from our pilot data further propose that these changes translate into an increase in the quality of life (QOL) as indexed by specific research instruments (Rabipour & Raz, 2012).

Such collective results accord with other recent clinical studies independently reporting that behavioural therapy may be an effective adjunct to treating TS (Feldman, Storch, & Murphy, 2011; Piacentini et al., 2010; Woods et al., 2011). Going beyond cognitive behavioural therapy (CBT), these collective findings recommend transporting behaviour modification to the neurology clinics, including the use of techniques such as programmed reinforcement procedures (Conelea & Woods, 2008b; Himle, Woods, & Bunaciu, 2008) and habit reversal training (Feldman et al., 2011; Himle, Woods, Piacentini, & Walkup, 2006; Piacentini et al., 2010; Twohig, Woods, Marcks, & Teng, 2003; Woods et al., 2011). These collective findings, moreover, raise issues such as the development of stimulus control over tics, contextually-based variability in the symptoms of TS, and the impact of distraction on tic suppression in children and adolescents with TS (Conelea & Woods, 2008a; Conelea & Woods, 2008b; Woods, Walther, Bauer, Kemp, & Conelea, 2009). Despite a common view alleging that TS is a neurological disorder to which psychology has little to contribute, attention training – via tic-awareness programs, recognising internal urges, switching to voluntary behaviours that are physically incompatible with the tic, relaxation guidance, and learning to identify antecedents of the tics – seems a powerful behavioural intervention for people with TS.

Compared to a control condition, which comprised of relaxation and general computer games, AT brought about a dramatic suppression of tics. These findings underline the importance of social support and attention in TS and – given our preliminary 6-month follow up data – suggest AT as a potential long-term solution for decreasing tic occurrence. Whereas in the control condition children with TS displayed a 10% reduction in tic occurrence relative to baseline, AT produced a 70% decrease in tic symptoms. These preliminary findings support the promise of AT as an experimental preparation for eliciting tic relief. Similar to other behavioural approaches (Feldman et al., 2011; Piacentini et al., 2010; Woods et al., 2011), AT



**Fig. 1.** Because of relatively high baseline frequencies and large number of tics across participants – matched 10–12-year-olds with TS – the graphs above show data based on a 10-s partial interval scoring method (standard scoring using the Yale Global Tic Severity Scale (Leckman et al., 1989) was comparable). The panels represent individual data from  $N = 12$  experimental (A) and  $N = 12$  control (B) participants, respectively.

manages the debilitating symptoms associated with tics. (In collecting the pilot data we used videotapes scored by a primary coder using a partial interval or event frequency method. A secondary coder scored 25% of sessions for inter-observer reliability and the overall agreement was 89%.) This approach also allows for a systematic investigation into “rebound” effects – when individuals with TS volitionally inhibit their tics they tend to tic more, or rebound, at the end of the tic suppression period. With AT we see a marked attenuation of symptomatology without rebound effects. Hence, the present experimental trajectory may elucidate the volitional component involved in such semivoluntary tic behaviours. These collective features render our paradigm especially attractive and useful in neuroimaging studies of tic suppression.

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