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Tourette Syndrome • OCD • ADHD  
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**Publishing:**

*Nix Your Tics! Eliminate Unwanted Tic Symptoms:  
A How-To Guide for Young People*

## **What Makes A Tic Tick?? Motoric Disinhibition, and The Incidental Associations Theory of Tic Formation**

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### **Abstract**

#### **OBJECTIVES:**

Evidence for inhibitory difficulties in individuals with 'pure' (no comorbid diagnoses) Tourette Syndrome (TS) is inconsistent, and a complete neurological understanding of how tics are formed is lacking.

In Experiments 1 and 2 we postulated that individuals with unmedicated TS, free of unmedicated comorbid symptomatology, would not differ from controls in cognitive inhibition or motor inhibition success at any age. However, individuals with TS would differ from controls in terms of motor inhibition failures once at an age where normal development of motor inhibition is expected to have stabilized.

In Experiments 3 and 4 we hypothesized that tics were the product of incidentally learned associations between various motor movements, elicited due to failures in motor inhibition.

#### **METHODS:**

In Experiments 1 and 2 the Stroop task and a tactile variant of the Simon task were used to measure "cognitive inhibition" and "motor inhibition" respectively. Both tasks measure the ability of individuals to inhibit a prepotent response (semantic activation of words in the Stroop, and ipsilateral motor responses in the Simon). Moreover interference in both tasks during incongruent trials depends upon the correspondence between the irrelevant stimulus attribute and the response. Reaction times and errors were analyzed in TS and control groups split into younger (7-9 years) and older (10-21) samples (n=40).

In Experiments 3 and 4 half of the older participants in each group were primed in an incidental motor association. A tactile stimulus, followed by a response button press, was defined as the goal oriented action. A RESET button press, allegedly to prompt the next trial, followed the response button press and was therefore incidentally associated to it. All older participants were later tested for problems inhibiting this association by being told that pressing the RESET button was no longer necessary. Inhibition problems were assessed in three different ways: number of times the incidental motor association (i.e. RESET Button Press) was engaged in, number of times the incidental motor association was initiated (i.e RESET Button Initiation), and reported urge to engage in the incidental motor association.



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**RESULTS:**

In Experiments 1 and 2 the younger groups did not differ on any measures of cognitive or motor inhibition success or failure. In the older groups, individuals with TS committed significantly more errors than controls on the Simon task.

In Experiments 3 and 4 all participants exposed to the incidental association procedure reported a greater urge to engage in the associated movement than unexposed participants. Only the exposed individuals with TS showed failures in inhibiting this incidental motor association.

**CONCLUSIONS:**

Experiment 1 suggested that cognitive inhibition difficulties are not present in TS when comorbid conditions are controlled for. Experiment 2 suggested that motor inhibition failures are a feature of TS. Experiments 3 and 4 suggest that stereotypical movements may become associated with numerous goal-directed behaviours. In the absence of appropriate motor inhibition these associations strengthen over time. When inhibition fails, these goal-directed behaviours elicit the stereotypical movements at seemingly random intervals and are considered 'tics'. This model gives direction to future diagnostic testing and treatment methods, provides explanations for a considerable body of phenomenological evidence and past research, and suggests many future areas of exploration.

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