

Abstract

Tourette's Syndrome is a neurodevelopmental disorder characterized by tics, which are fast, repeated but not rhythmic involuntarily and suddenly appearing movements or vocalizations (APA, 2013). These symptoms are associated with significant subjective and social burden (Elstner et al., 2001). To date, neuropsychological studies have primarily focused on deficits and, albeit findings are mixed, those generally implicate cognitive flexibility, inhibition, and verbal fluency in the disorder. However, mapping potential strengths is also key, as those may reflect relevant resilience factors. There is reason to believe that faster procedural processing, which results from hyperkinetic overactivity due to dysfunctional frontal lobe and basal ganglia processing (Walenski et al., 2007), is one such area of strength. The aim of this study was to explore the association between individual differences in procedural processing and verbal fluency in children with Tourette's Syndrome and typically developing peers.

Participants were 42 children (6 girls) with Tourette's syndrome ($M_{age}=148.43$, $SD=16.41$ months) and age- and gender-matched typically developing controls ($M_{age}=149.38$, $SD=16.98$) and were tested on three types of verbal fluency tasks: action, semantic and phonemic. We hypothesized that the Tourette's Syndrome (TS) group would perform better than the typically developing (TD) group on the action and phonemic fluency tasks.

Findings showed that in the phonemic fluency task, children with Tourette's Syndrome listed more verbs ($t(1)=295.23$, $p<0.001$) and made fewer errors (listing an incorrect word: $t(1)=7.81$, $p=0.005$; repeating a word $t(1)=8.19$, $p=0.004$) than controls. These results confirm a strength in phonemic fluency in patients with Tourette's Syndrome. In the poster, implications for clinical/ neuropsychological conceptualization and prevention and treatment will be discussed.

Introduction

- Tourette's syndrome is a neurodevelopmental disorder characterized by tics (APA, 2013).
- To date, neuropsychological studies have primarily focused on deficits. However, mapping potential strengths is also key, as those may reflect relevant **resilience factors**.
- Previous findings (Walenski et al., 2007; Dye et al., 2016) suggest dysfunctional frontal lobe and basal ganglia processing are associated with hyperkinetic overactivity, which, in turn, results in **faster procedural processing – a potential strength or resilience factor**.
- While in prior studies (Walenski et al., 2007; Dye et al., 2016) pertinent associations were examined at the morphological and phonological levels, those were not considered with regard to fluency or at the semantic level. Therefore, whether faster procedural processing appears at the **level of word meaning**, remains unclear.

AIM: The aim of this study was to explore the association between individual differences in procedural processing and verbal fluency in children with Tourette's Syndrome (TS) and typically developing (TD) peers.

- HYPOTHESES:** The TS group, relative to the TD group,
- would perform better (list more words) on action and phonemic fluency tasks
 - would make fewer errors on these two tasks
 - would list words with a higher verb to non-verb ratio on the phonemic fluency task

Methods and Materials

Participants:

- 42 children (6 girls) with Tourette's Syndrome ($M_{age}=148.43$, $SD=16.41$ months) and age- and gender-matched healthy controls ($M_{age}=149.38$, $SD=16.98$)

Experimental tasks:

- Participants completed three types of verbal fluency tasks, following methodological guidelines developed by Mészáros et al. (2011)
 - action** - to list verbs
 - semantic** - list animals or grocery store products, and
 - phonemic** - list words beginning with the letters „é” or „t”.

Procedure & Analytic plan:

- Each participant's verbal fluency performance was audiorecorded and then 15-second-interval data were transcribed into text. Quality and quantity analyses were then conducted by 4 independent raters. Interrater reliability was calculated; if correlation coefficients were $r>.9$, the 2-2 raters' results were averaged.
- Data preparation and preprocessing was followed by statistical analyses:
 - Mann-Whitney U test (in case of non-normally distributed, continuous data obtained in the action fluency task)
 - independent samples t -test (in case of normally distributed, continuous data obtained in the phonemic tasks)
 - chi-square test (in case of categorical or count data obtained in the phonemic and action fluency tasks)

Results

- On the phonemic fluency task,**
 - children with Tourette's Syndrome *listed words with a higher verb to non-verb ratio* than controls ($\chi^2(1; N=40)=295.23$; $p<0.001$; $\eta^2=2.24$) (see Table 1.)
 - children with Tourette's Syndrome listed fewer *incorrect words* than controls ($\chi^2(1, N=40)=7.81$; $p=0.005$; $\eta^2=0.59$) (see Table 2.)
 - children with Tourette's Syndrome *repeated* fewer words than controls ($\chi^2(1; N=40)=8.19$; $p=0.004$; $\eta^2=4.7$) (see Table 3.)
 - between-group difference could not be assessed for number of *perseverations* as the low number of perseverations (none in the TD group and 1 in the TS group) precluded formal statistical comparison
- There was no between-group difference in **action** ($p=0.632$) or in **phonemic** (*t fluency*: $p=0.75$; *k fluency*: $p=0.37$) **fluency** performance.
- There was also no between-group difference in number of errors during the **action fluency task** (i.e., no participant listed any *incorrect words*, the two groups did not differ with regard to *word repetitions* ($p=0.791$), and the small number of *perseverations* (none in the TS group and 2 in the TD group) precluded formal statistical comparison).

Table 1. Chi-square test for number of verbs in the phonemic fluency tasks

Group	Number of verbs	Number of non-verbs
TS	1479	8521
TD	719	9281
$p<0.001$		

Table 2. Chi-square test for number of incorrect words in the phonemic tasks

Group	Number of incorrect words	Number of right answers
TS	45	4270
TD	80	4520
$p=0.005$		

Table 3. Chi-square test for number of repetitions in the phonemic tasks

Group	Number of word repetitions	Number of correct answers
TS	20	4270
TD	45	4520
$p=0.004$		

Discussion

- Findings did not support **hypothesis A**, as the TS group did not outperform the TD group on action and phonemic fluency tasks. Differences between past and the current results may be attributable to differences in **task complexity**, i.e., picture naming in Walenski et al. (2007) vs. word generation in the current study.
- Results partially supported **hypothesis B**; although there were no differences in number of errors on the action fluency task, the TS group listed fewer incorrect words and made fewer word repetitions on the phonemic fluency tasks. As relative to action fluency, phonemic fluency depends more on **executive functions** (Takács et al., 2013), these findings suggest that children with Tourette's Syndrome may be able to generate words in a **more organised fashion**, and thus make less errors.
- Hypothesis C** was supported; the TS group listed words with a higher verb to non-verb ratio on the phonemic fluency tasks. Thus, although children with TS could not list more verbs on the action fluency task, they did list proportionally more verbs on phonemic fluency tasks. Possibly, recruitment of executive functions **intensified the effect** of faster procedural processing.

Conclusions

- Findings partially supported the stimulating effect of faster procedural processing.
- This effect emerges when **indirect factors**, such as the number of verbs or errors, are considered.
- Results shed light on a domain of strength or resilience in children with TS and thus have clinical implications, e.g., cognitive areas to capitalize upon as serving the role of potential compensatory functions and areas of performance to highlight when targeting self-esteem and -evaluation.

Future Directions

- Further comprehensive studies using **language and non-language-based tests** are needed to broaden and deepen our understanding of regarding procedural processing (including in TS).
- The role of **executive functions** in action fluency task performance should be explored.

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