But What Are We *Really* Measuring?

Assessing The Trail Making Task In Adolescents With ADHD

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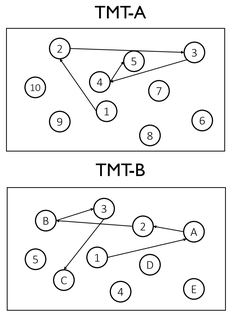
Introduction

- **Attention Deficit Hyperactivity Disorder** (ADHD) is a neurodevelopmental disorder affecting 1 in 20 children[1], and **40% of children with ADHD exhibit deficits in set shifting**[2].
- **Set shifting** is the **ability to flexibly shift** between **different tasks, ideas** or other demands[3].
- For several decades, the **Trail Making Task** (TMT) has been used to **assess set shifting**[4].
- Some research suggests that TMT suffers from **task impurity**[4] and may **measure different aspects** of **cognitive and executive function** between **neuropsychologically impaired and non-impaired individuals**[5].



Aims

- To assess the contributions of various cognitive domains to performance on a TMT analogue for typically developing controls (TDC) unmedicated and methylphenidate medicated ADHD (ADHD-BL and ADHD-MPH, respectively)

Hypotheses

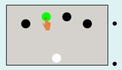
- The cognitive contributions to TMT performance will differ between ADHD-BL, ADHD-MPH and TDC groups.
- Methylphenidate therapy will normalize the cognitive contribution profile of the medicated ADHD group.

Data Collection & Methods

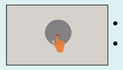
- ADHD participant data collected as part of the International Study to Predict Optimized Treatment – in ADHD (iSPOT-A)
- Cognitive and executive tests were administered via IntegNeuro™, a touchscreen-based emotion and cognition assessment battery (Brain Resource Ltd.).
- Instructions for each task were pre-recorded and administered to participants via headphones.

Cognitive Tasks

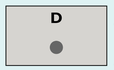
- Switching of Attention
- TMT analogue
- Set shifting



- Choice Reaction Time
- Processing speed



- Motor Tapping Task
- Motor speed

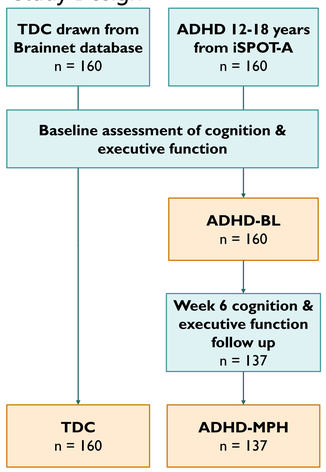


- Continuous Performance Task
- Sustained attention

- Go/No-Go Task
- Behavioural inhibition or impulsivity

- Digit Span
- Working memory

Study Design



Participant Demographics

	ADHD-BL (n = 160)	ADHD-MPH (n = 137)	TDC (n = 160)
Age ± SD	14.79 ± 1.67	14.83 ± 1.67	14.37 ± 1.57
Gender (% F)	31.25%	29.20%	31.58%
CPRS-R: ADHD Index (T Score)	74.18 ± 11.33	63.91 ± 12.50	—
Inattentive	71.48 ± 10.57	62.65 ± 11.95	—
Hyperactive-Impulsive	82.18 ± 25.34	69.65 ± 22.33	—

Analysis

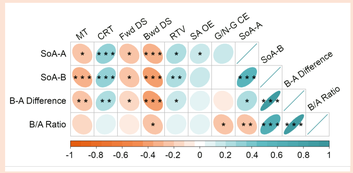
- Spearman's rank correlation coefficient, with pairwise tests for significance
- Benjamini-Hochberg procedure for multiple comparisons correction

- Cognitive measures which **significantly correlated with TMT scores** were used as **independent, predictor variables** in a **multiple linear regression analysis.**
- **Box-Cox transformation** to ensure a linear relationship between predictor and response variables.

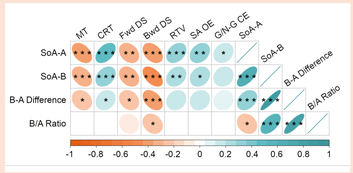
Results

Correlation Analysis

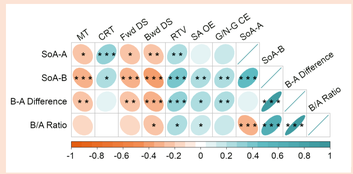
ADHD-BL



ADHD-MPH

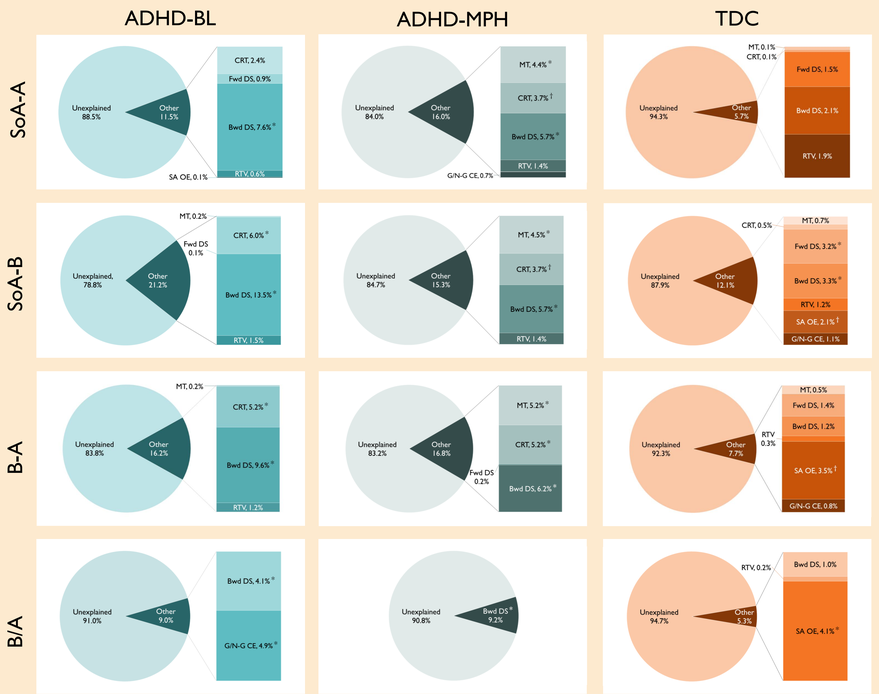


TDC



Correlation matrices for ADHD-BL (a), ADHD-MPH (b) and TDC (c).
MT (Motor Tapping), CRT (Choice Reaction Time); Fwd DS (Forward Digit Span); Bwd DS (Backward Digit Span); RTV (Reaction Time Variability); SA OE (Sustained Attention Omission Errors); G/N-G CE (Go/No-Go Commission Errors)
* $p < 0.05$; ** $p < 0.01$; ** $p < 0.001$

Multiple Regression Analysis



Bar in pie charts depict the proportion of variance explained by each cognitive measure for all regression models.
MT (Motor Tapping), CRT (Choice Reaction Time); Fwd DS (Forward Digit Span); Bwd DS (Backward Digit Span); RTV (Reaction Time Variability); SA OE (Sustained Attention Omission Errors); G/N-G CE (Go/No-Go Commission Errors)
* $p < 0.05$; † $p < 0.10$

Discussion & Conclusion

- **Processing speed** and **working memory** significantly **contributed to** the prediction of **task performance in ADHD, regardless of medication status**. **Motor speed** also seemed to **underpin the prediction** of most **task measures while medicated**.
- For **typically-developing adolescents, sustained attention** and **working memory contributed** to trail making **task performance**.
- Overall, the **cognitive contributions** to task performance at **medicated follow up appeared more similar to baseline contributions** than to those exhibited by the typically developing group.
- This suggests that **ADHD-BL and TDC recruit cognition differently** for the same task, and that, rather than normalising contributions, **methylphenidate may allow** people with ADHD to recruit **additional or different aspects of cognition** to aid in task completion.
- We believe these results demonstrate that "impure" cognitive tasks, like the TMT, **can still yield valuable insights** and **remain useful tools in understanding cognitive** and **executive functioning**.

References

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