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Discrete movements in ASD children: comparison between the isochrony principle and Fitts' law

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Introduction

- **Autism Spectrum Disorder (ASD)** is a neurodevelopmental psychiatric condition characterized by 1) difficulties with social interactions and communication and 2) repeated and stereotypical movements or restricted interests.
- ASD children also display **altered motor control** (Kanner, 1943) which remains poorly understood.
- Altered motor control was observed in ASD animal models and related to **cerebellum disorders** (Jaber, 2017).
- The cerebellum is involved in the control of both morphocinetic (evaluated by the **Isochrony task**; Habas et al., 2020) and topocinetic movements (evaluated by the **Fitts' task**; Boyd et al., 2009).

Isochrony task

Power relation between time and stimulus size : $MT = T_0 * A^\gamma$

T_0 = baseline time; $0 < \gamma$ = isochrony coefficient < 1

Around 6 years old: $\gamma \approx 0,4$ (Bidet-Ildei & Orliaguet, 2008)

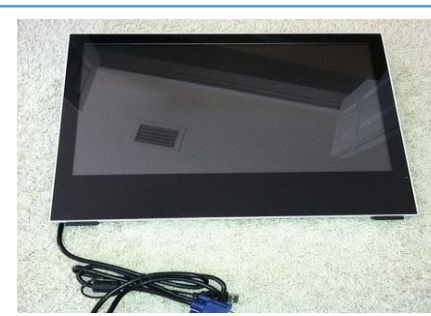
Fitts' task

Linear relation between time and ID : $MT = b \log_2(2A/W) + a$

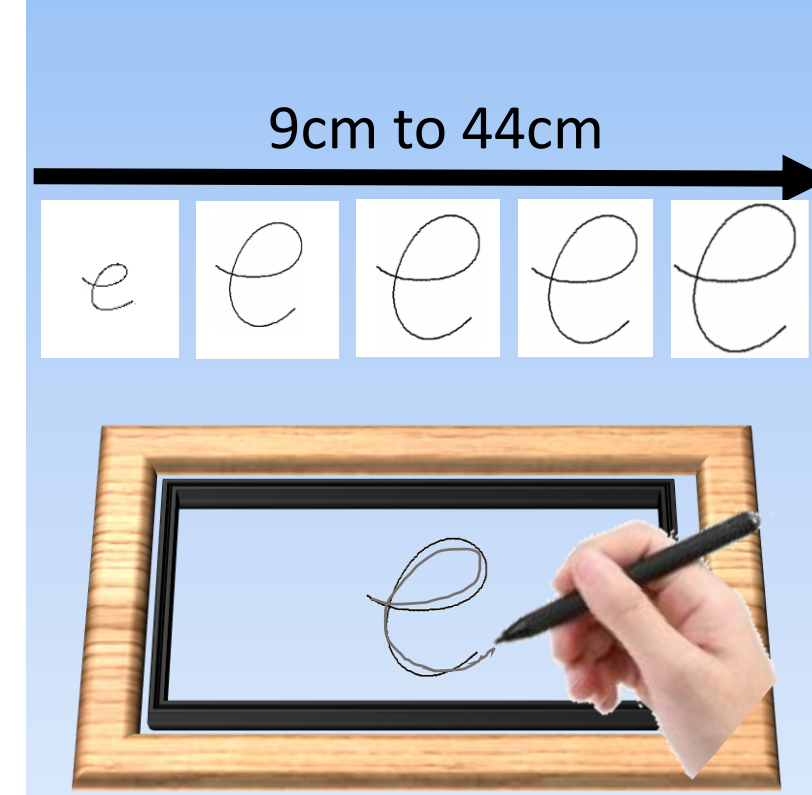
b = slope, $1/b$ reflects motor capacities (MC) (Bourgeois & Hay, 2003)

=> Can cerebellar deficits impact the motor control of discrete movements in ASD children ?

Method



For each task : tablet recording movement duration (MT) and metric coordinates.



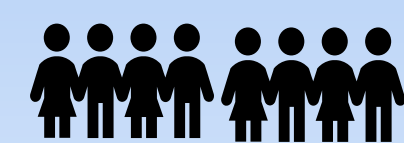
Isochrony task

5 "e" letters of 5 different sizes in cursive mode

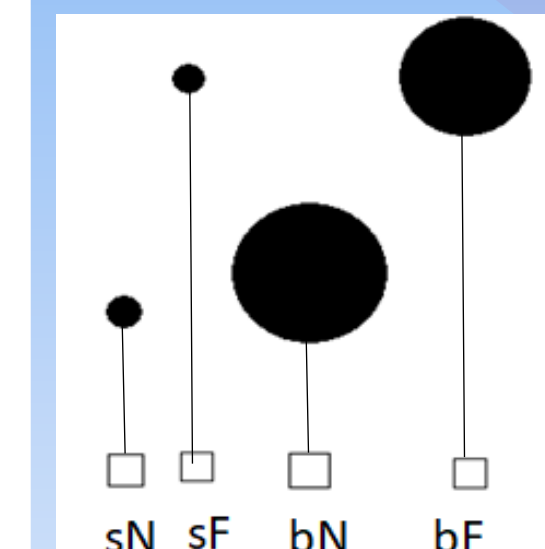
Variables extracted

γ = slope

T_0 = intercept



Children (6-12 years)
17 ASD & 25 TD



Fitts' task

4* (1 target of 2 sizes : Small - Big + at 2 locations: Near - Far)

Variables extracted

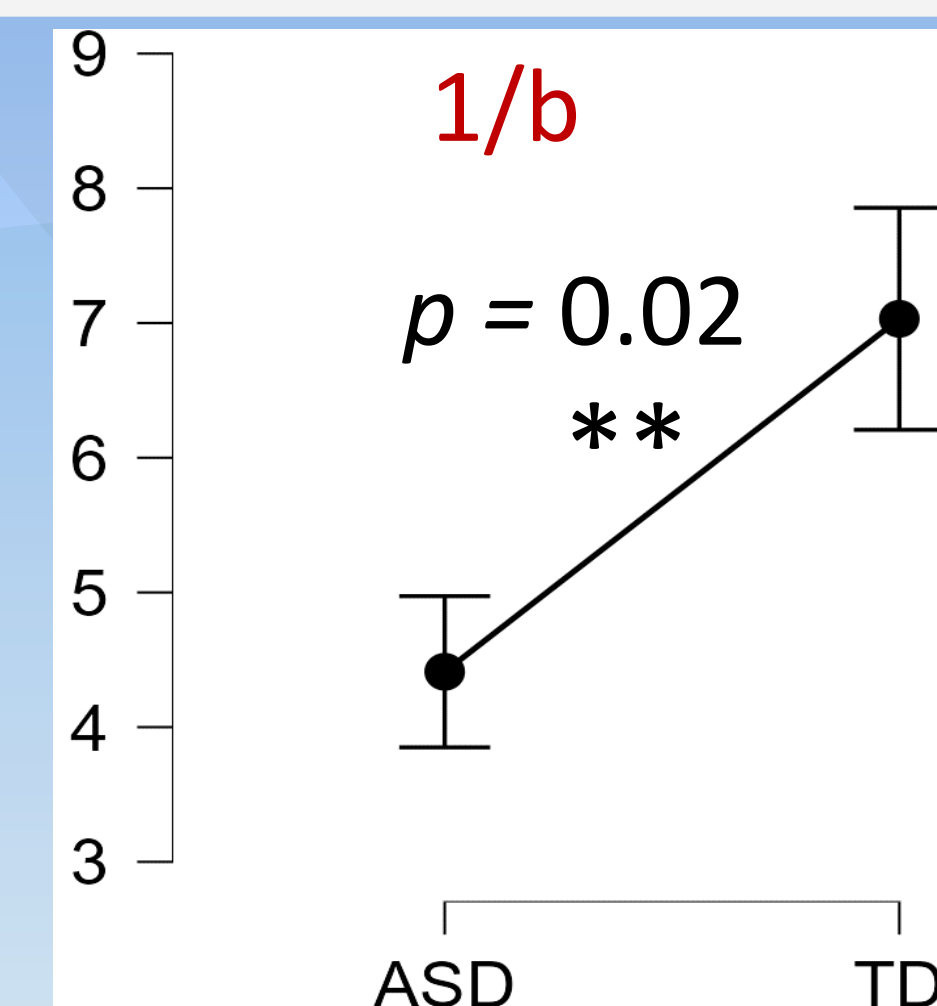
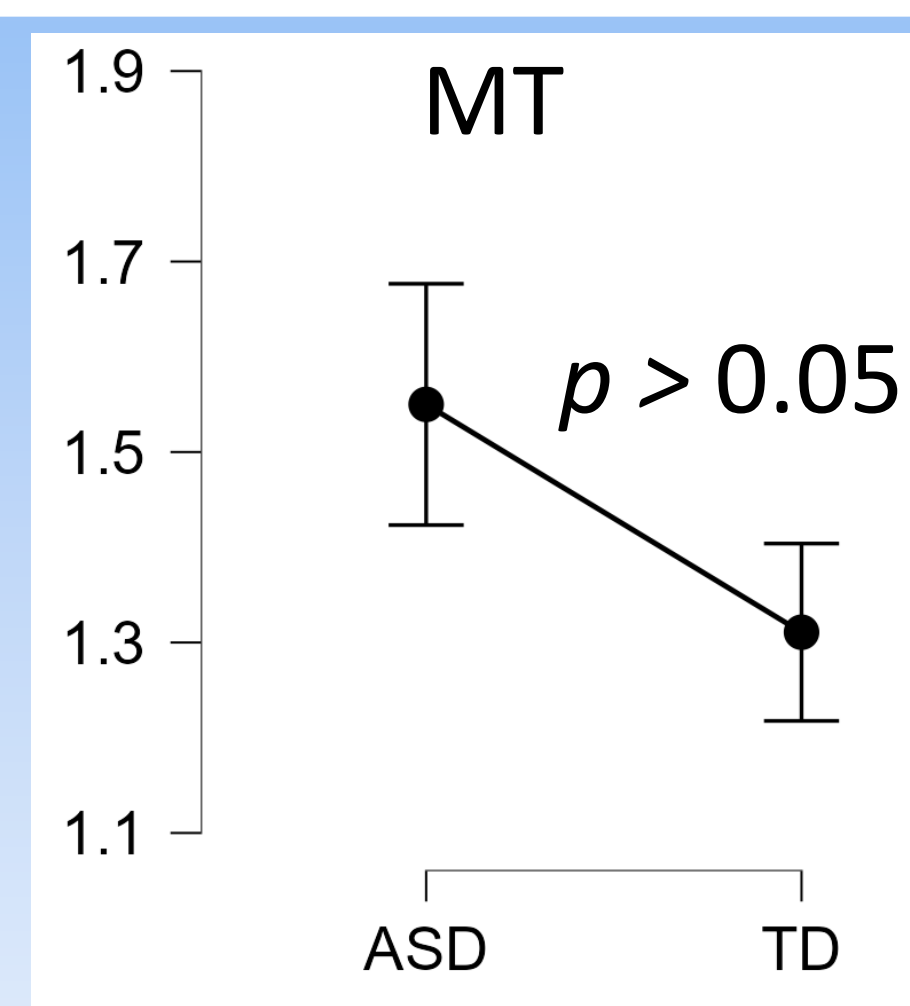
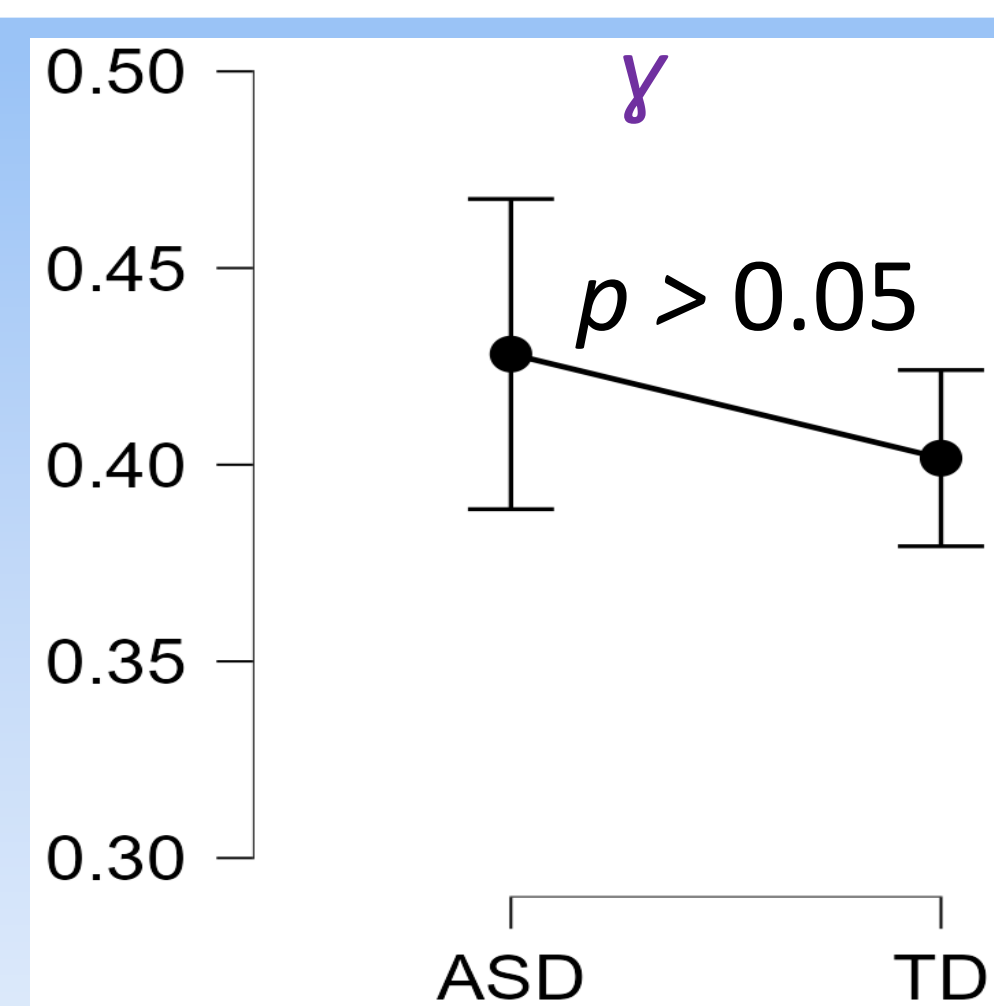
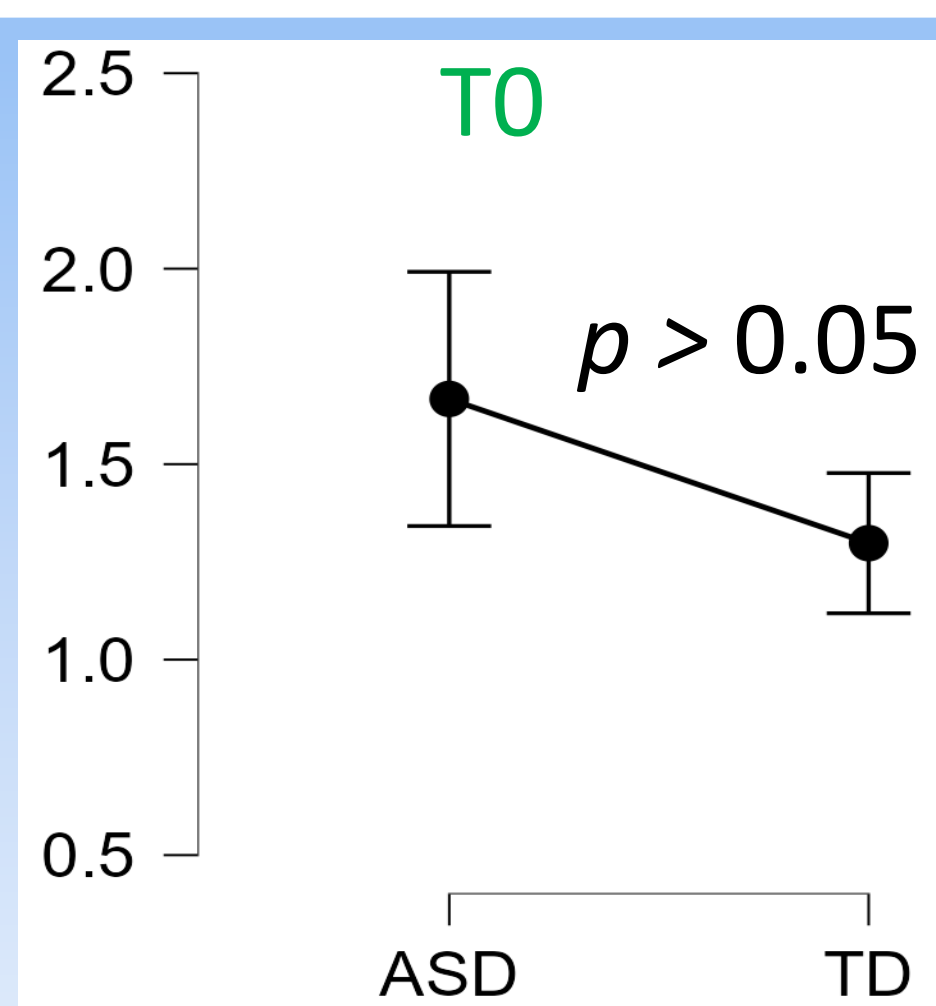
b = slope

$1/b$



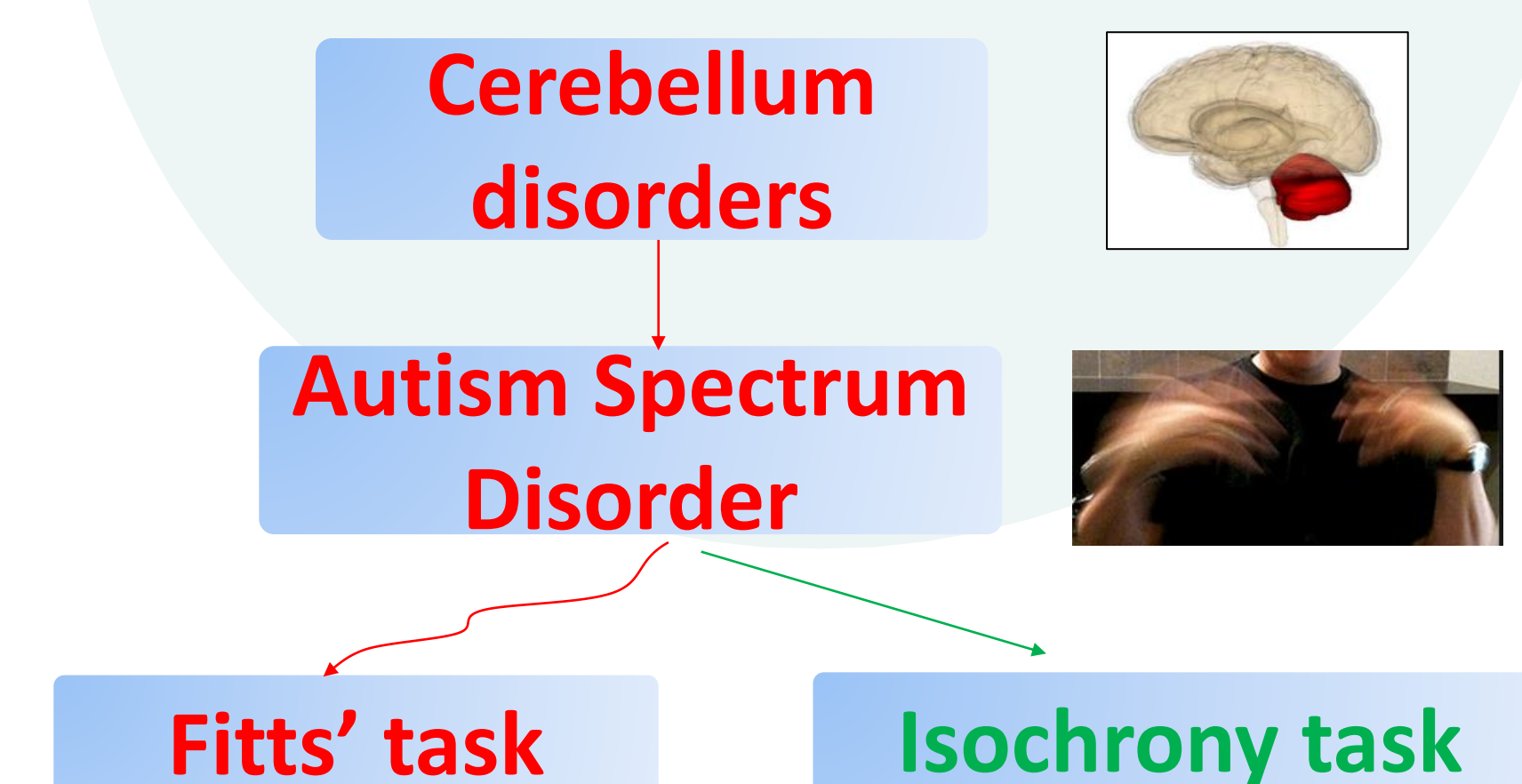
Children (6-12 years)
18 ASD & 25 TD

Results



Discussion / Conclusion

- In ASD children : **topocinetic** motions appear affected but not morphocinetic ones.
- Topocinetic motions are relatively dependent on **sensory inputs used**.
- Further research is necessary to understand whether suspected cerebellum deficits may contribute to **sensory processing disorders** diagnosed in ASD.



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