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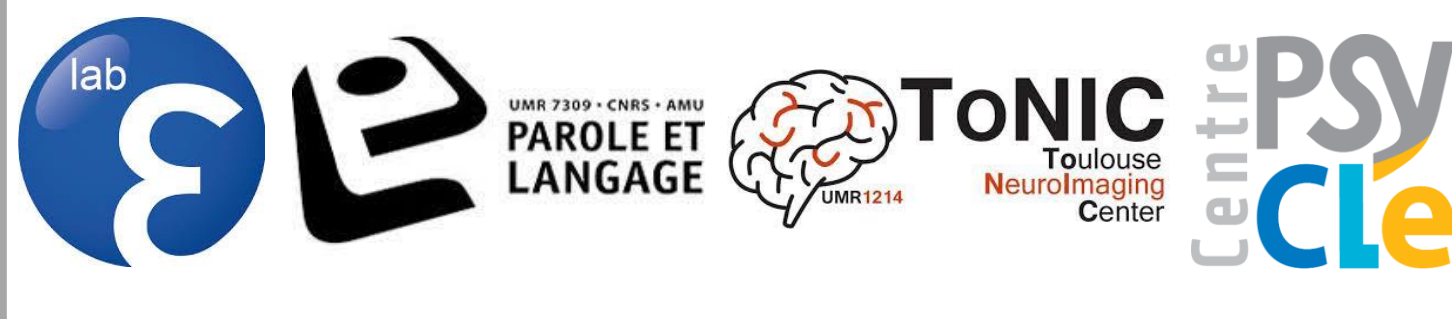
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# Effect of comorbid reading disorder on oculomotor behavior in children with DCD

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## Introduction

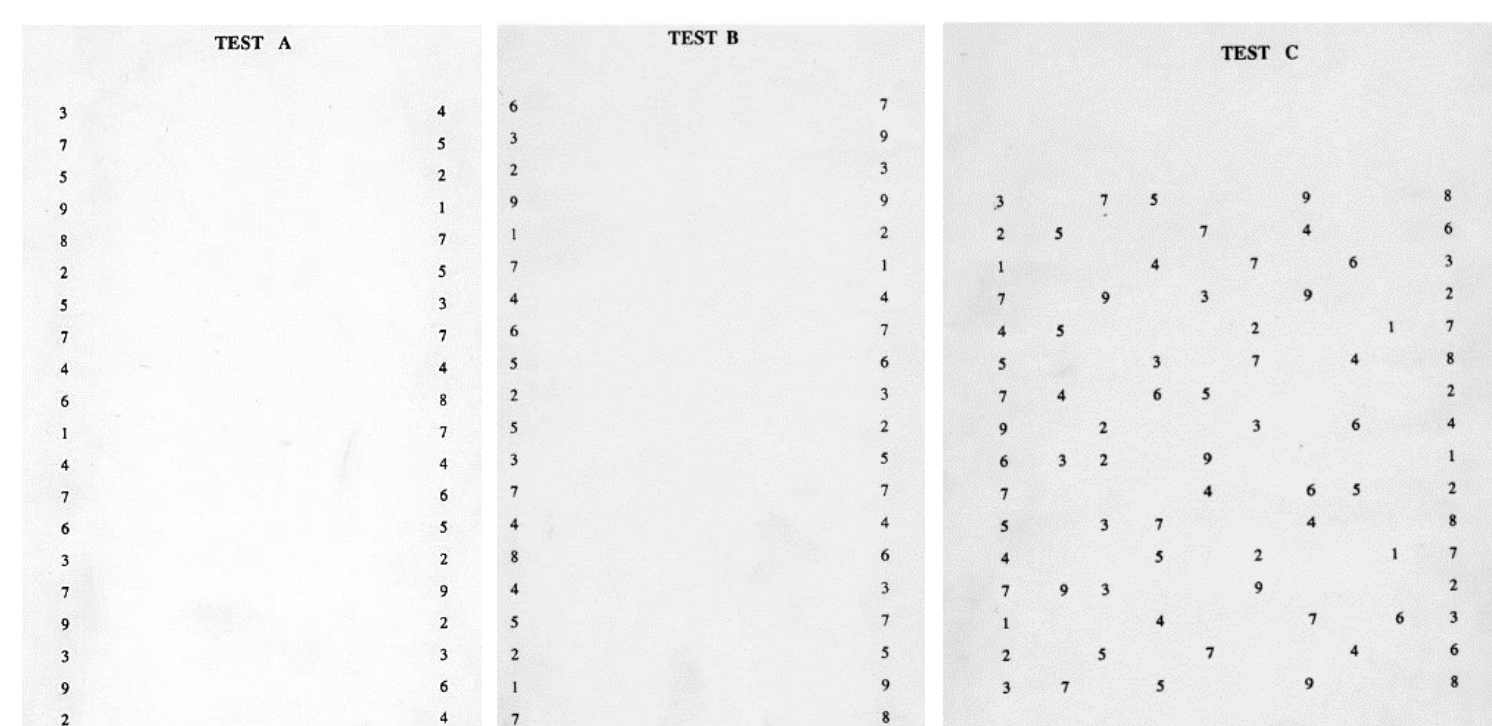
Studies have suggested a dysfunction in oculomotor skills in children with DCD (Robert et al., 2014; Sumner et al., 2016). The nature of these dysfunctions is still not clear, as DCD often appears together with other neurodevelopmental disorder (Bellocchi et al., 2015).

The Developmental Eye Movement (DEM) test (Garzia, et al., 1990) has been showed to be useful in exploring the oculomotor behavior of dyslexic children (DD; Moiroud et al., 2018). This standardized test comprises horizontal and vertical digit reading tasks and provides reading time and errors norms as well as oculomotor type of response.

**Pre-test:** "See these numbers? Please say these numbers out loud for me".

**Vertical Test (Test A and B):** "Please carefully read the numbers down the two columns like this as quickly as you can. Do not use your finger. Use only your eyes".

**Horizontal Test (Test C):** "Please carefully read the numbers across the rows like this as quickly as you can".



**Do DD and DCD children share the same oculomotor dysfunctions ?  
What is the effect of DD comorbidity on DCD's oculomotor skills ?**

### Aims of the study

- to explore oculomotor behavior in DCD children as assessed with DEM test
- to compare DCD children to DD children and to children with DCD+DD

## Method

### Participants

138 French children (8-12 years old) (DYSTAC-MAP cohort).  
22 DCD 47 DD 27 DCD+DD 42 TD (typically developing children)

All the children received a comprehensive cognitive assessment to evaluate criteria for inclusion in each group:

- intellectual functioning (WISC-5)
- reading skills (Alouette-R)
- phonological processing (ODEDYS)
- motor development (MABC-2)

### Materials

**DEM test** (Garzia et al., 1990): vertical time (VT), horizontal time (HT), RATIO HT/VT, number of errors (z scores) and oculomotor type.

BEHAVIOUR TYPE	CHARACTERISTICS
Type 1	Normal automaticity and oculomotor skills
Type 2	Oculomotor dysfunction
Type 3	Deficiencies in automaticity/number calling skills
Type 4	Deficiencies in automaticity and oculomotor skills

### Analysis

Z scores and oculomotor types (type 1 to 4)  
Non parametric statistics :  
Group differences : Kruskal-Wallis test and chi2. Pairwise comparisons with Bonferroni correction ( $p < .008$ ).

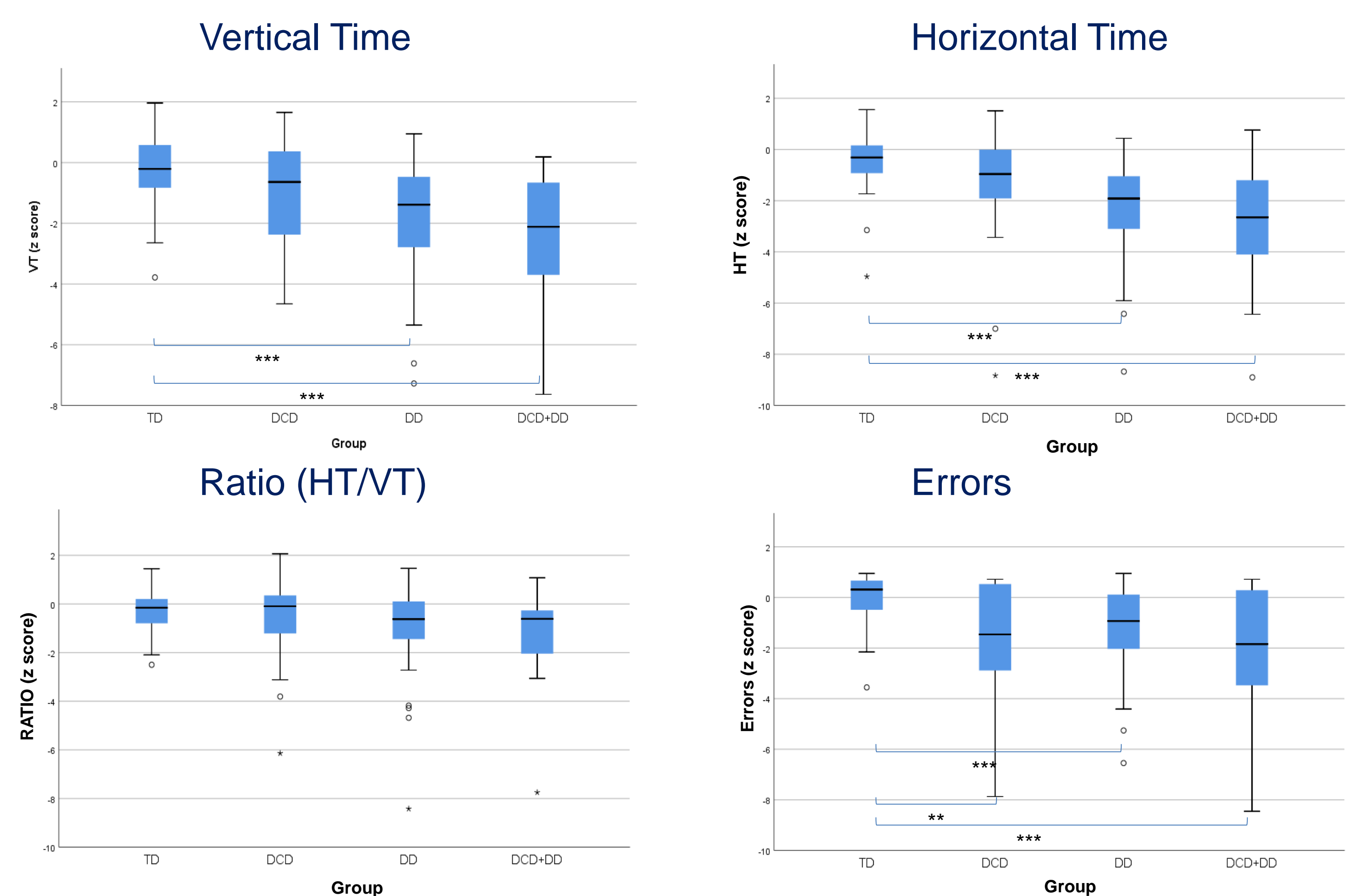
## Results

### Z-scores comparisons

Significant effect of Group for all indices (VT,  $H(3)=28.38$ ;  $p=.000$ ; HT,  $H(3)=38.85$ ;  $p=.000$ ; Ratio,  $H(3)=9.19$ ;  $p=.027$ ; Errors,  $H(3)=20.84$ ;  $p=.000$ ).

Pairwise comparisons :

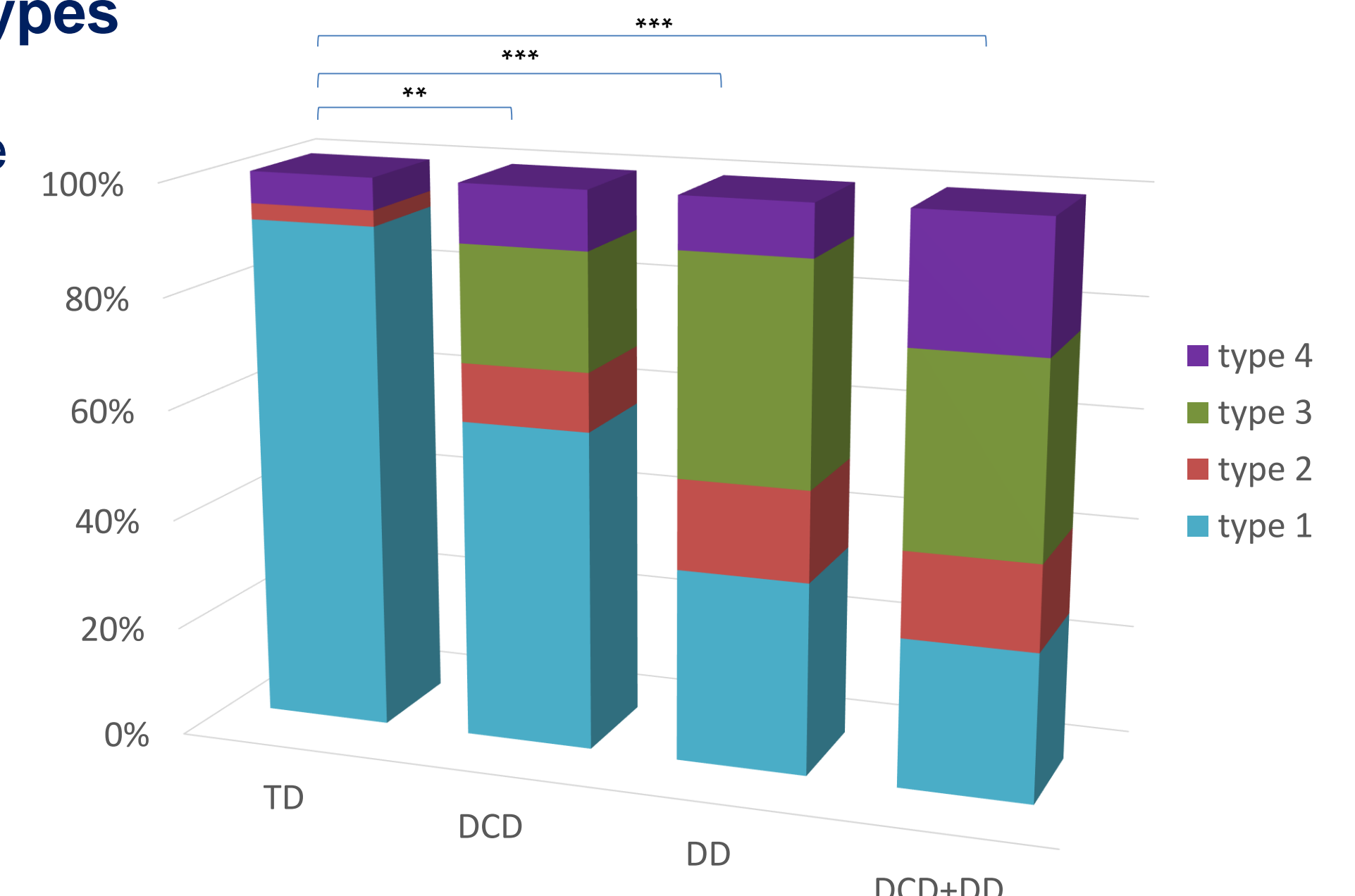
- DCD differed from TD children only for the Errors z-scores ( $p < .008$ );
- DD and DCD+DD had lower z-scores than TD for the horizontal time, vertical time and in the Errors z-score ( $p < .0001$ );
- Differences between DCD, DD and DCD+DD groups were not significant.



### Oculomotor response types

Distribution of the response types depended on the group ( $\chi^2=37.5$ ,  $p < .001$ ).

Pairwise comparisons showed differences between TD and other groups ( $p < .008$ ) but not between DD, DCD and DCD+DD groups.



## Conclusions

- Children with DCD frequently presented atypical scores at the DEM test, as attested by the number of reading errors and oculomotor type of response (Robert et al., 2014; Sumner et al., 2016).
- Reading disorder was clearly linked to lower performances at the DEM test : both children with DD and children with DCD+DD had higher vertical and horizontal reading time, more errors and more atypical motor responses (Moiroud et al., 2018).
- Research focusing on oculomotor skills in DCD should contain a reading test to exclude the effect of comorbid DD on visual behavior.
- Performance of children with DCD+DD were highly heterogeneous and more research is needed to understand the profile of these children.
- Eye tracking techniques should help to explore the nature of oculomotor disorder in DCD children, distinguish DD and DCD oculomotor behavior and better apprehend DCD+DD performance variability.

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