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An Investigation of Eye Movement Dysfunctions in Children with Neurofibromatosis type 1

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Background

Today’s estimates indicate that 30-60% of Neurofibromatosis type 1 (NF1) children suffer from learning disorder, including reading disabilities, secondary to language and/or visuospatial deficits (Chaix et al., 2017) with a profound impact on their academic achievement (Krab et al., 2008). Some studies suggest a delay in the maturation of low-level vision processes in children with NF1 (e.g. saccadic system, Lasker et al., 2003; magnocellular processing, Ribeiro et al., 2012). The findings from typically developing readers suggest a strong relationship between reading ability and visual processing (Leibnitz, et al., 2017). The main goal of this study was to investigate the occurrence of perceptual, visuo-attentional and oculomotor deficits in NF1 children and their potential to explain reading behavior and reading problems in this population.

Method

Forty-two children with NF1 (9.8 ± 1.5 years, 26 girls) and forty-two control children (TD, 10 ± 1.1 years, 20 girls) participated in the study. Parents and children gave their informed consent prior to the experiment, approved by the local ethics committee. Reading and visual processing skills were respectively evaluated with the Alouette test (Lefavrais, 2005) and the DEM test (Garzia et al., 1990). We also recorded eye movements while a subgroup of 17 NF1 children (9.8 ± 1.4 years, 10 girls) and 21 control children (9.4 ± 0.9 years, 10 girls) performed an oculomotor lateralized bisection task on words, strings of hash marks and solid lines.

Results

- Preferred Viewing Location (PVL) for TD and NF1-nonRD between the beginning and the middle of the word.
- More flattened curve for NF1-nonRD -> TD children locate their 1st fixation mostly around P2 whereas the landing positions cover a more expanded zone, P2-P3 with NF1-nonRD. No PVL for NF1-RD who were less accurate and more variable in saccadic programming.
- NF1-RD displayed poor results in visual attention and generation of saccadic processing (e.g., less accurate, more variability, no sensibility to the discreteness of the stimuli).

No significant correlations were found between DEM parameters and the density of landing positions (r=-0.368 and r=-0.011, for VT/density in P2-P3 and HT/density in P2-P3).

Conclusions

DEM test (especially the HT) can be used clinically to distinguish NF1 with RD from NF1 without RD. Analysis of eye movement patterns represents a potential way to identify differences in the cognitive processing and visuo-attentional mechanisms underlying reading in children before the occurrence of school failure. Both language and visual aspects of reading should be targeted in intervention programs.

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