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Dyslexic readers and saccade computation: effects of reading exposure and visuo-perceptual constraints



S. Bellocchi^{1,2}, J. Mancini³, M. Jover², A. Huau², A. Ghio¹, C. André¹, S. Ducrot¹

¹Aix-Marseille Université, CNRS, LPL UMR 7309, 13100, Aix en Provence, France

²Aix-Marseille Université, PsyCLE EA 3273, 13621, Aix en Provence, France

³APHM, Hôpital de la Timone, CERTA, 13385, Marseille, France



corresponding author: stephanie.bellocchi@univ-amu.fr

Some findings suggest the presence of preferred landing position (PLP) effects in children who are learning to read. Recently it has been shown that, in children from first to fifth grade, stimulus location has a strong effect on oculomotor development and lexical-decision time, in both central and parafoveal vision (Ducrot et al., 2013). The establishment of the PLP, which seems to be due to an eye-guiding mechanism based on a perceptual low-level processing, could also be influenced by print exposure.

How does saccadic programming develop in children with reading impairment?

As it is known, when no sensory and intellectual deficits can explain reading and/or writing disorders and when adequate instruction and socio-cultural opportunities are available but fail to result in an adequate level of performance, **developmental dyslexia** is diagnosed.

AIM OF THE PRESENT STUDY: the present study examines whether reading exposure/impairment and visuo-perceptual characteristics of the stimulus affect saccade computation.

Methods

Participants

- ✓20 dyslexic children (**D**) (CA: m=125,56; ds=12,93 months; RA: m=91,02; ds=10,73 months)
- ✓25 unimpaired reading-level controls (**RL**) (CA: m=83,48; ds=7,34 months; RA: m=86,04; ds=6,31 months)
- ✓25 unimpaired chronological-level controls (**CA**) (CA: m=121,44; ds=8,31 months; RA: m=91,02; ds=10,73 months)

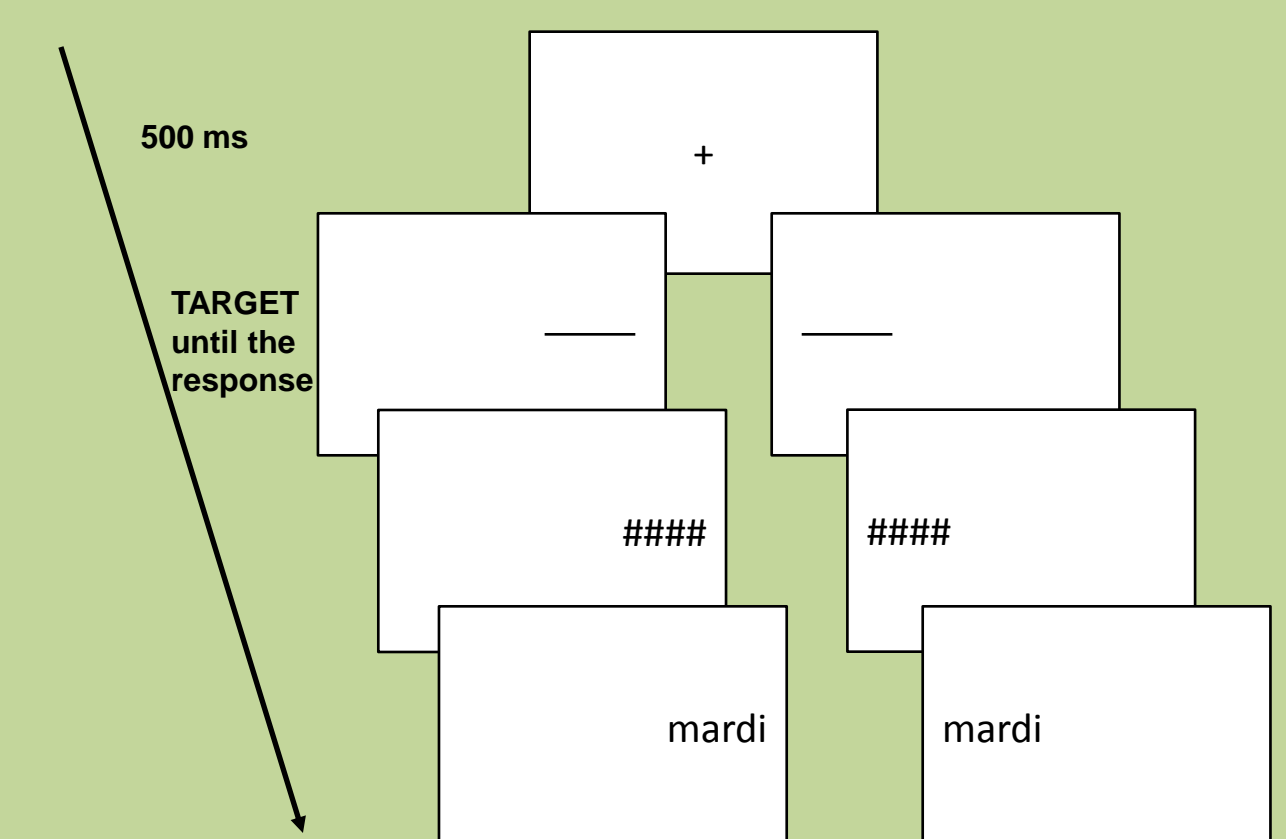
MATERIALS:

- ✓60 words (counterbalanced for frequency);
- ✓60 strings of hashes;
- ✓60 solid lines;
- controlled for length: all these stimuli were 4-5-6 characters long.



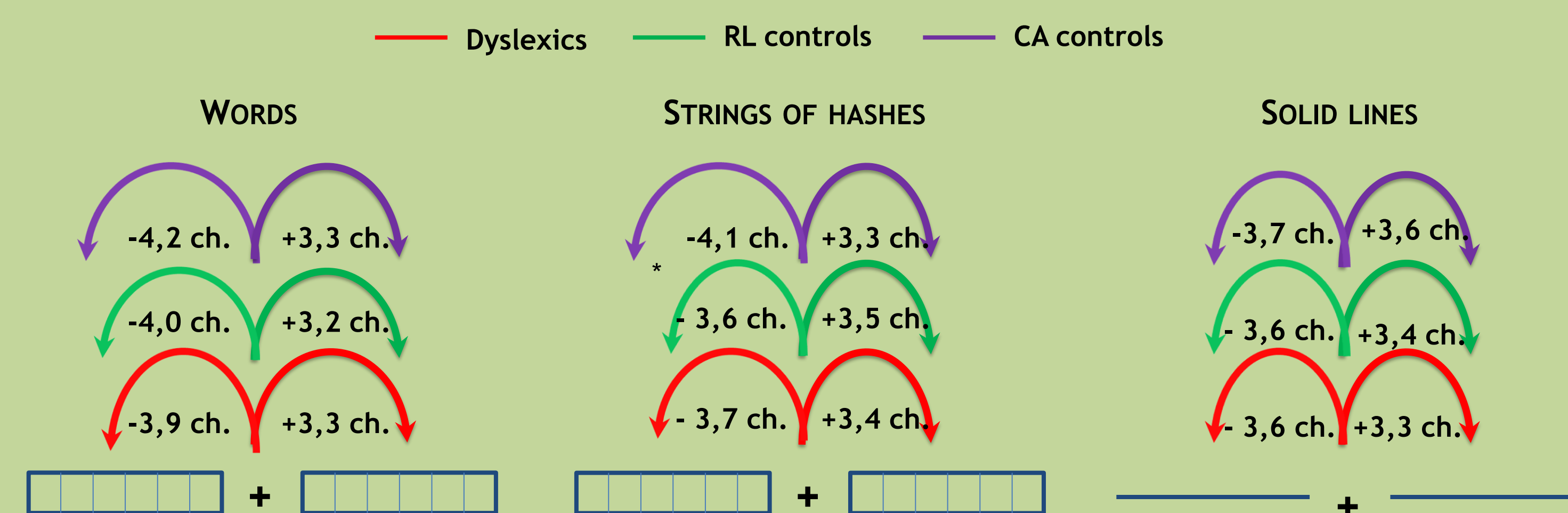
Eye tracking system: mobile infrared head mounted eye tracker (EYELINK II, SR Research Ltd.)

BISECTION TASK: participants were asked to move their eyes as quickly as possible to a position they thought to be the middle of the stimulus and to validate this position by pressing a button.

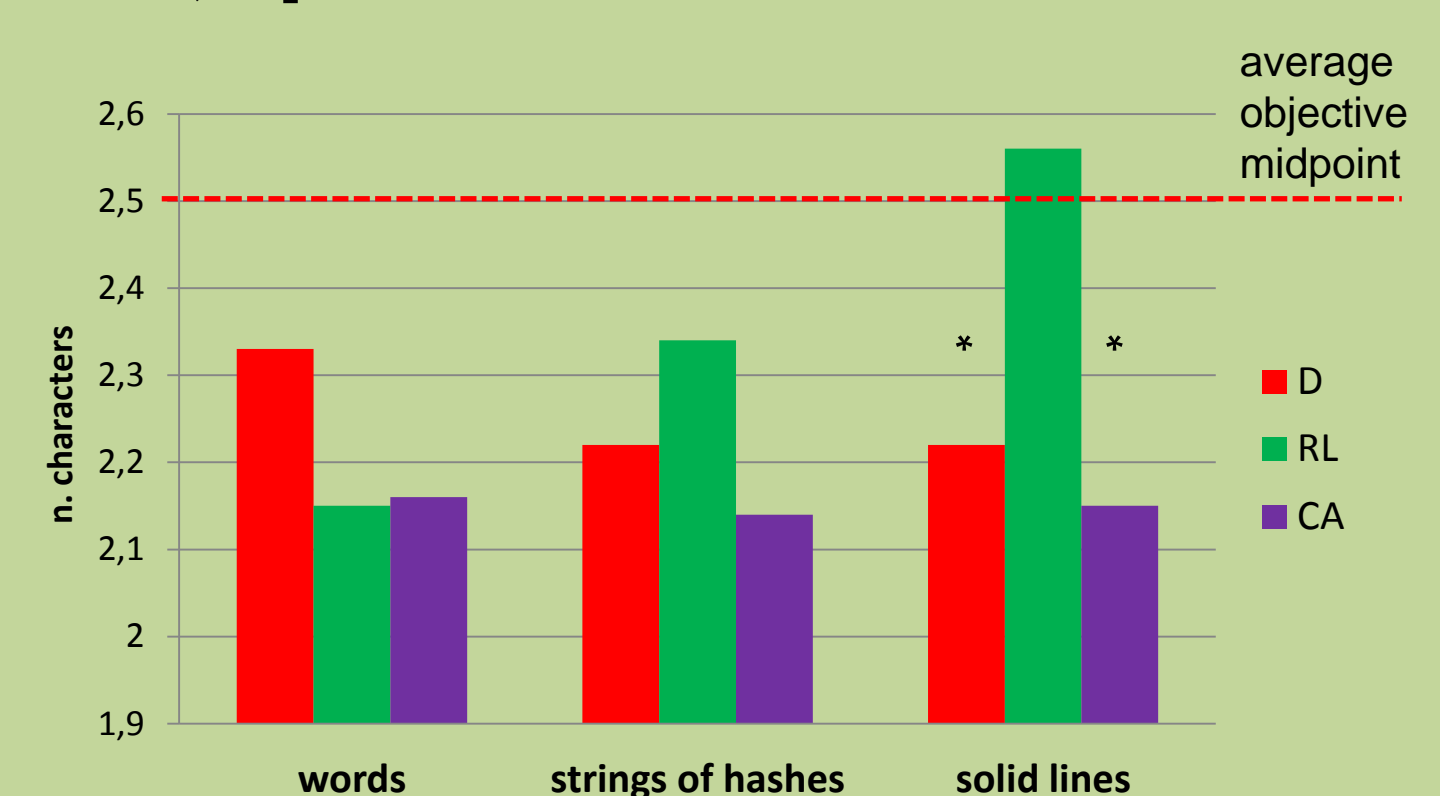


Results

SACCADE SIZE: stimulus type * visual field * group [$F_{(4,134)}=7,13$; $p < .001$]



SUBJECTIVE MIDPOINT: stimulus type * group [$F_{(4,134)}=5,46$; $p < .001$]; visual field [$F_{(1,67)}=69,41$; $p < .001$] [RVF: m=2,45; s.d.=0,45; LVF: m=2,06; s.d.=0,52].



SACCADE LATENCY: stimulus type [$F_{(2,134)}=199,20$; $p < .001$] [words: mean=169,85; std.e.=2,40 ms; strings of hashes: mean=174,92 ms; std.e.=2,41 ms; solid lines: mean=204,09; std.e.=2,67 ms]; group [$F_{(2,67)}=18,04$; $p < .001$] [D: m=178,85; std.e.=4,21 ms; RL: m=200,66; std.e.=3,76 ms; CA: m=169,36; std.e.=3,76 ms].

Discussion

✓First of all, the most important result of the study shows a **saccade-size asymmetry** between left and right presentations, even if the asymmetry was more pronounced for CA-controls than for dyslexics and RL-controls. Moreover, within CA-controls group, the asymmetry was more marked for discrete stimulus (words and string of hashes) than for continuous one (solid lines) (Ducrot & Pynte, 2002). However, dyslexics and RL-controls show a more marked asymmetry for linguistic (words) than for non-linguistic stimuli (strings of hashes and solid lines) → dyslexics show a pattern of results similar to RL-controls.

✓Longer initial **saccade latency** was found for continuous stimuli. Furthermore, RL-controls reveal longer saccade latency compared to dyslexics and CA-controls who show a similar pattern → dyslexic readers seem to show normal saccadic programming.

✓With regard to the **subjective midpoint**, like adult readers, CA-controls show no differences between type of stimuli (Ducrot & Pynte, 2002). On the contrary, RL-controls show differences with regard to the type of stimulus suggesting that this strategy is going to be developed by young children.

→In conclusion, this study suggests that, regarding words, the basic oculomotor metrics of saccade landing positions are already well developed during the 1st grade of print exposure (McConkie et al., 1991); however this is not true for non-linguistic/discrete stimuli;

→dyslexia is associated with an accurate saccadic programming even if characterized by a delay with regard to the landing position pattern.