

Cognitive Benefits of Arrowsmith Symbol Relations Task In Two Groups: Children with Dyslexia and High Achievers

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ARROWSMITH PROGRAM

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BACKGROUND AND AIMS

The Arrowsmith Symbol Relations task

- Computer based analogical clocks reading.
- Involves counting, perceptual-recognition strategies (Siegler & McGilly, 1989) and establishing relationships on clocks faces (Friedman, & Laycock, 1989) with different tasks in increasing levels of difficulty.

Previous findings

- Significant improvements in:
- Processing speed and global cognitive efficiency in children with learning disabilities (Rose & Jagger-Rickels, 2019)
- Spatial construction, visuospatial memory and attention in typically developing children (Herrero et al., 2023).

Aims

- Analyze the impact of the Symbol Relations task on children with dyslexia (LD) and high achievers (HA) and whether this impact differs between groups.

METHOD

Participants

- 24 Primary School students ranged from 8 to 11 years ($M = 9.7$, $SD = 0.96$)
- High achievers (HA): $n = 12$
- Learning difficulties (LD): $n = 12$

Measures

- Processing speed (d2)
- Attention (d2 con)
- Short-term visuospatial memory (number-symbol)
- Response inhibition (stroop)
- Planning (Tower of London)
- Survey for children and parents

Procedure

- 5 months of training (2 hours per week)
- Supervised (school) and self-directed (home)
- Pre-post assessment.

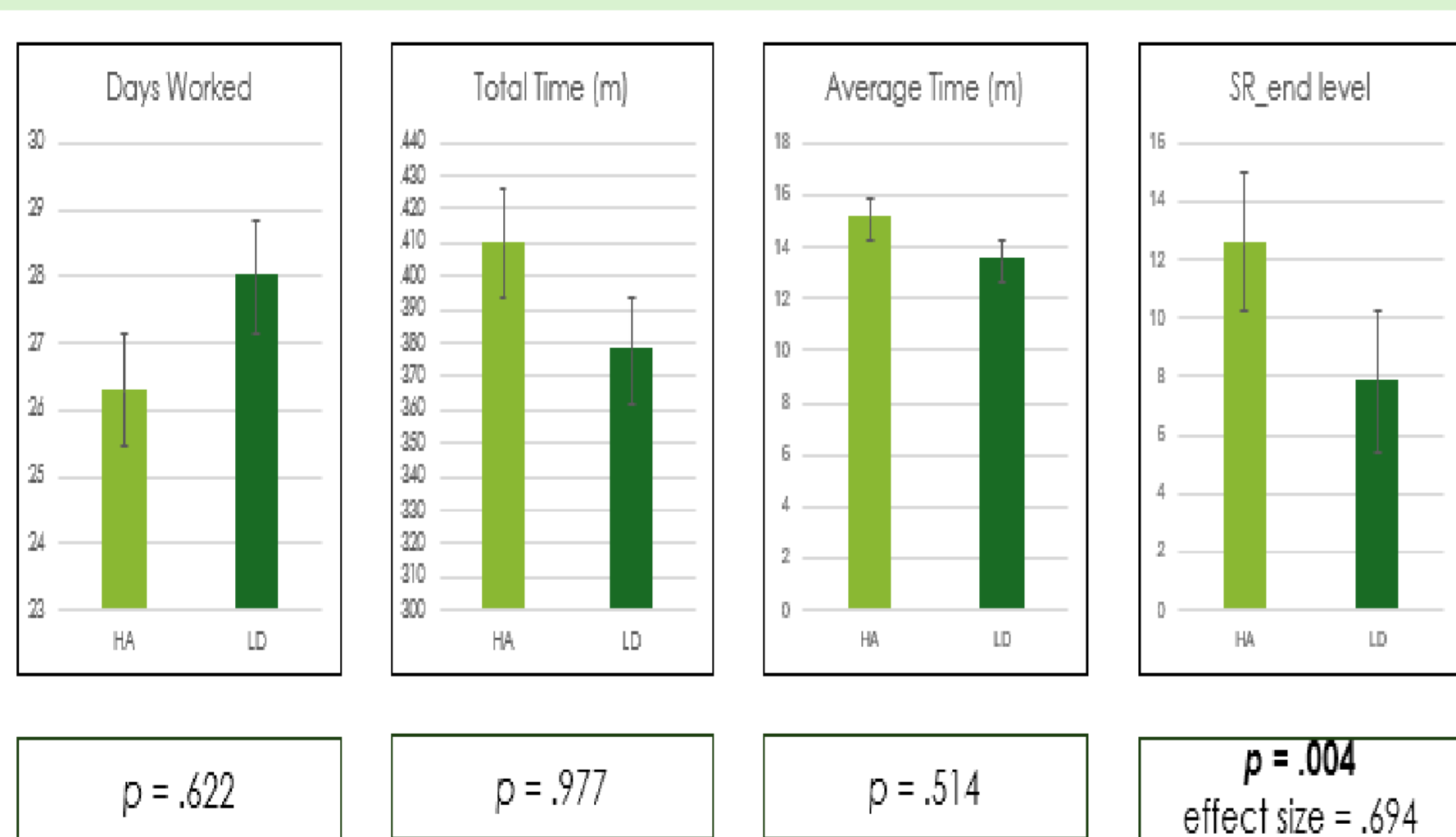
RESULTS

Jamovi (v. 2.7.26) was used for the analyses. Non-parametric test were carried out for quantitative data (U Mann Withney, Wilcoxon Ranks) and Spearman's correlation). Surveys were summarized by percentage of responses. Significant results are in bold.

Table 1. Descriptives of initial assessment by group

	Group	Mean	SD
AGE	HA	10.1	0.675
	LD	9.29	1.05
FLUID INTELLIGENCE	HA	41.7	6.301
	LD	31.17	7.78
IMS_PRE	HA	123.1	17.855
	LD	147.75	16.87
PRE_RESPONSE INHIBITION	HA	36.2	8.6
	LD	26.83	7.37
PRE_PLANNING	HA	19.4	3.202
	LD	17.67	4.68
PRE_PROCESSING SPEED	HA	391.1	73.185
	LD	263	19.41
PRE_ATTENTION	HA	159.9	31.613
	LD	101.08	16.61
PRE_STV_MEMORY	HA	45.8	8.497
	LD	36.25	7.5

Figures 1-4. Working time and level of performance by group



Figures 5-9. Within group improvements



Table 2. Initial differences between groups

	U	Mann-Whitney	p	Mean diff	Effect size
AGE	46	0.139	0.98	0.361	
FLUID INTELLIGENCE	20.5	0.003	11	0.715	
IMS_PRE	23.5	0.006	-23	0.674	
PRE_RESPONSE INHIBITION	26	0.015	10	0.606	
PRE_PLANNING	54	0.477	2	0.182	
PRE_PROCESSING SPEED	12	<.001	123	0.833	
PRE_ATTENTION	6	<.001	59.792	0.917	
PRE_STV_MEMORY	24.5	0.006	8.637	0.660	

Figure 10. General improvements

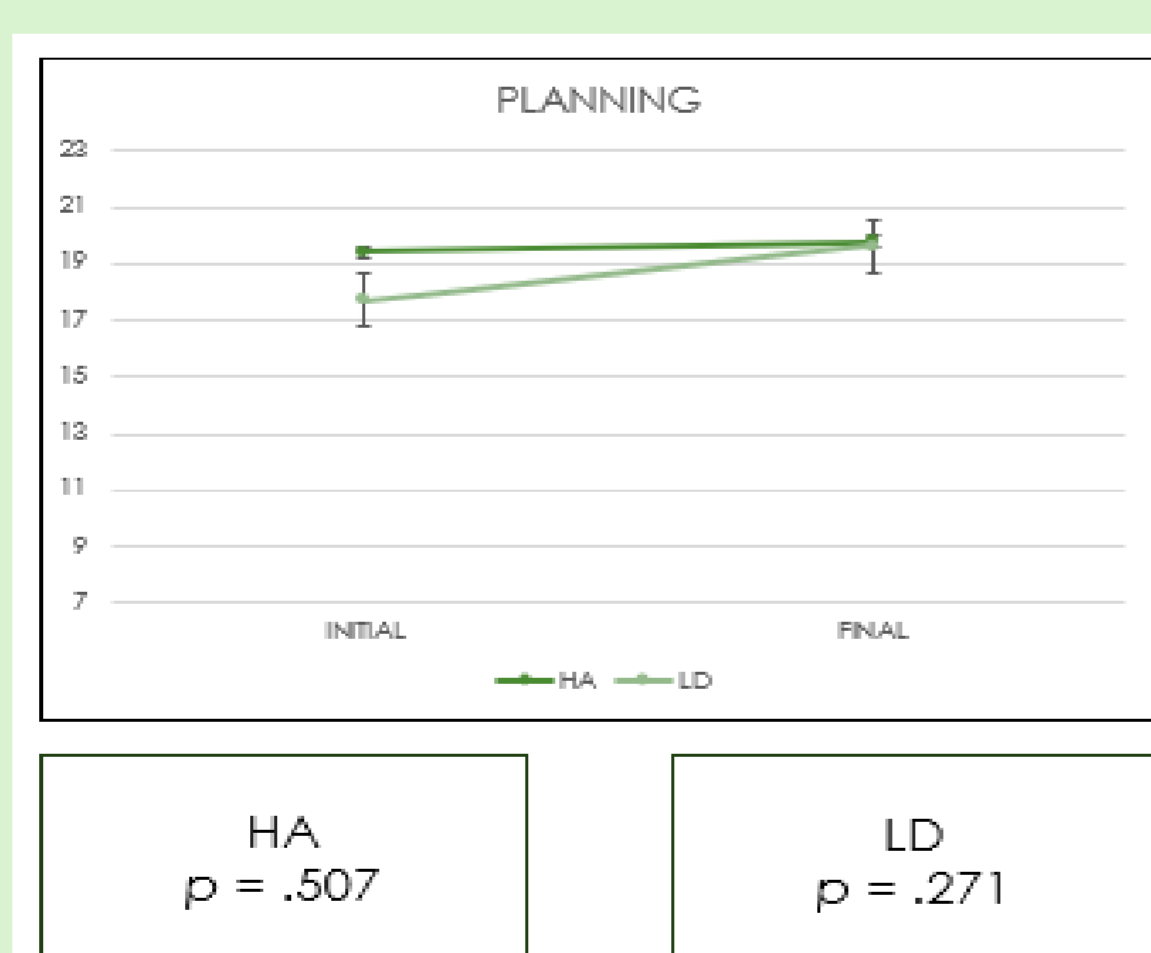


Figure 11. Improvements by level in HA

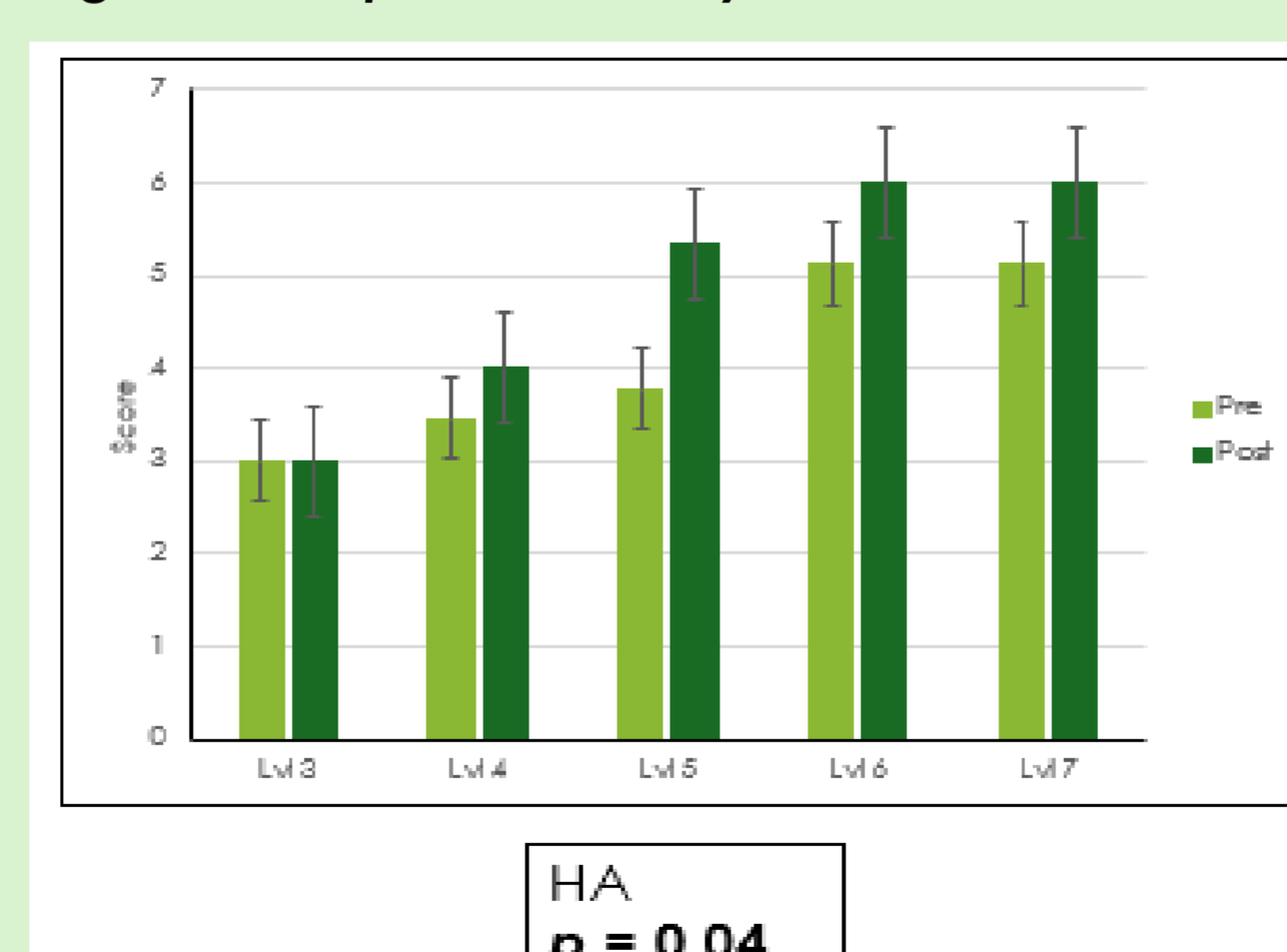


Figure 12. Improvements in time to initiate level in LD

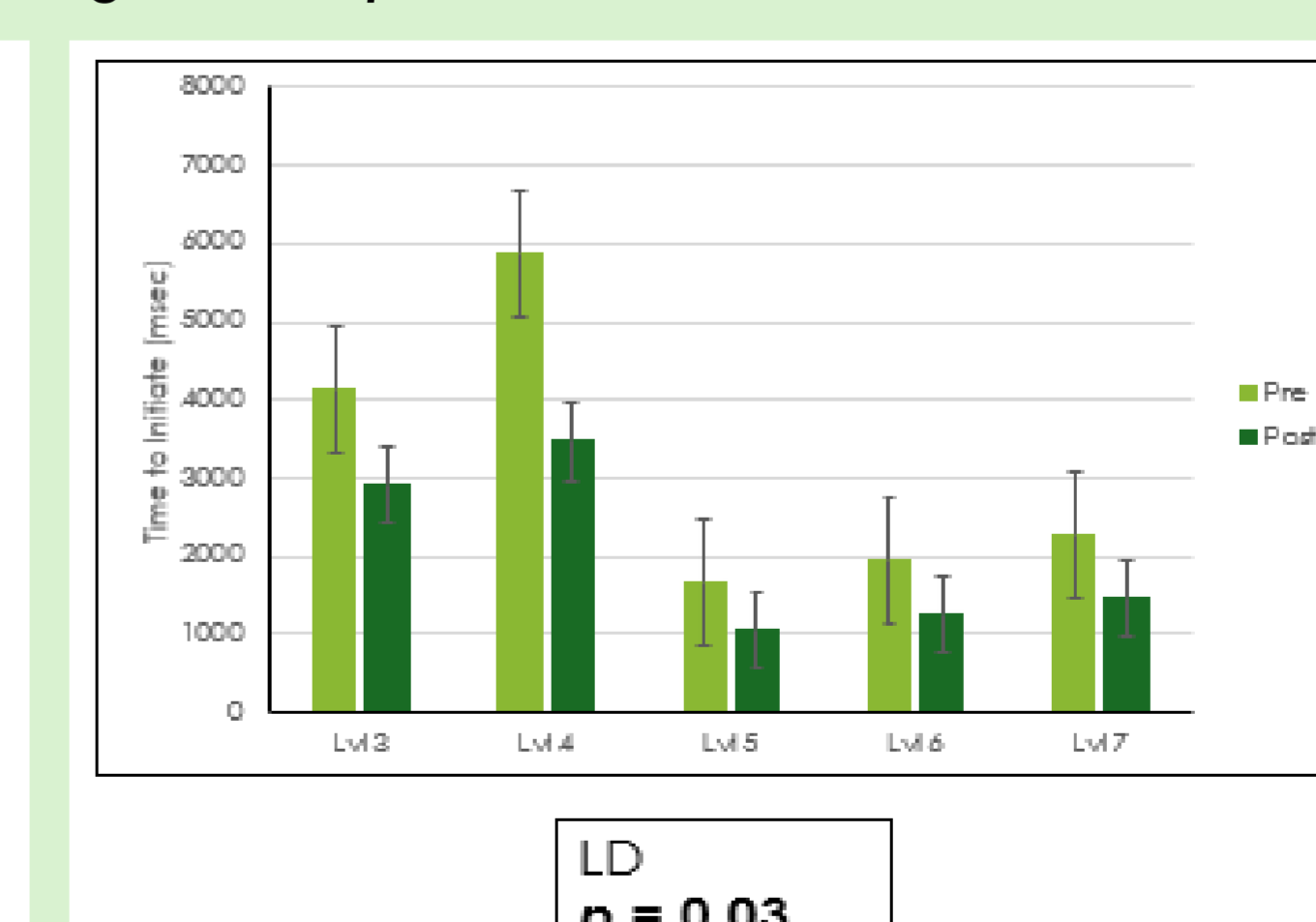


Table 3. Partial correlation between training and planning

	Total Time (m)	SR_end level
SR_end level	0.575**	—
POST_PLANNING	0.566**	0.209

Controlling for FLUID INTELLIGENCE
*p < .05, **p < .01, ***p < .001

Figure 13. Students and parents survey LD group (students n = 11; parents n = 5)

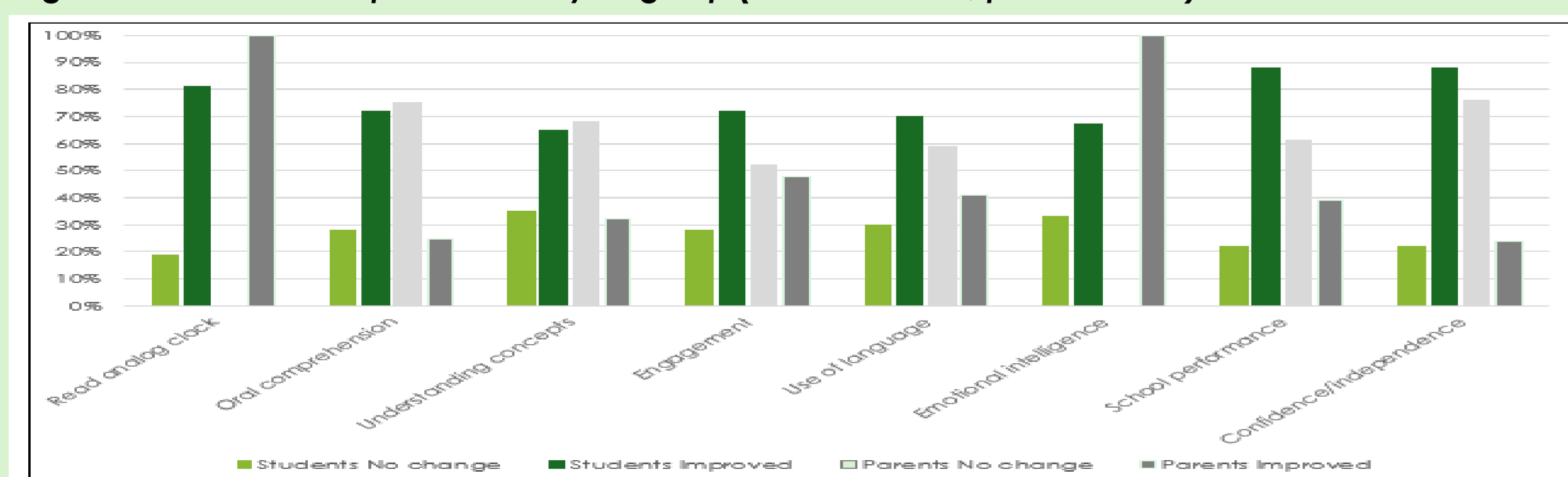
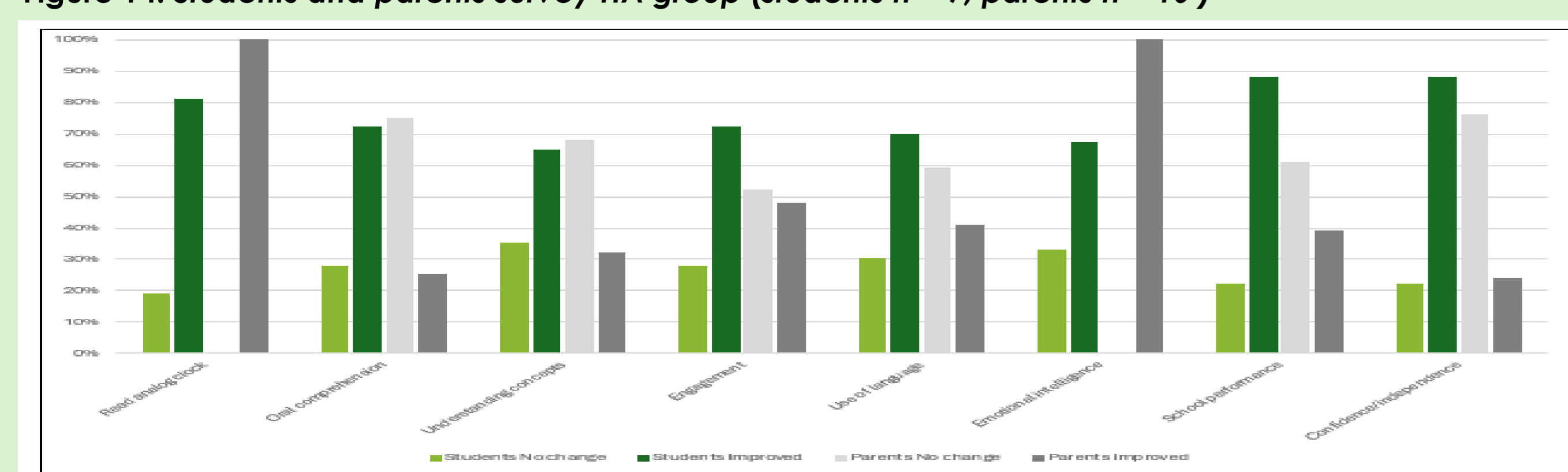


Figure 14. Students and parents survey HA group (students n = 7; parents n = 10)



DISCUSSION AND CONCLUSIONS

- Regardless of planning, students significantly differ in their cognitive abilities at the initial level. With similar training time, high achievers reached higher level of performance in Symbol Relations task. However, cognitive improvements were found in both groups.
- Results are in line with previous evidence using Symbol Relations task, in which significant improvements in attention and visuospatial memory were found in typically developing children of similar ages (Herrero et al., 2023) as well as with those found improvements in processing speed in children with learning difficulties (Rose & Jagger-Rickels, 2019).
- The specific improvements in planning within each group and the significant relationship between duration of training and general improvements in planning could reflect different levels of engagement as a function of cognitive abilities, which in fact may impact on school achievement (Martins et al., 2021).
- Interestingly, parents of children with learning difficulties were the least willing to answer the survey and parents of both groups tended to perceive less improvements than their children. It is possible that parents exceeded expectations and that children's perceptions were related to feelings of self-efficacy and increased motivation. Perception of teachers could be a key point to contrast the differences.