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Tablet-based visuo-spatial training tool for preschoolers

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INTRODUCTION

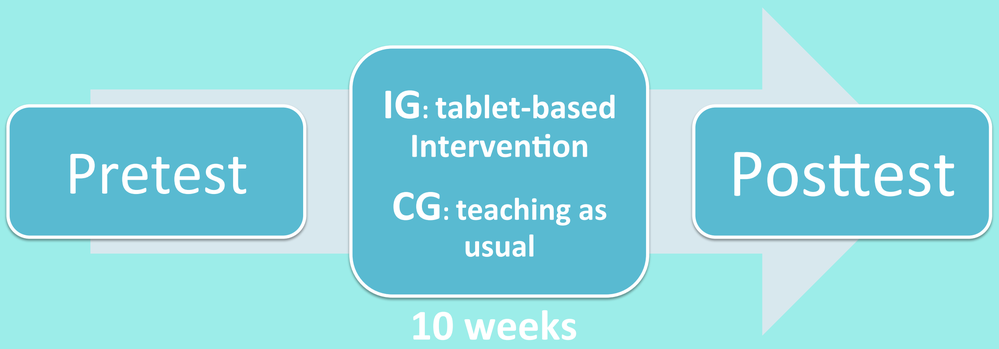
In the context of numerical development, visuo-spatial skills are assumed to provide an early foundation for mathematics learning [1,2,3]. Recently, the importance of these abilities in preschool years has been stressed out [e.g. 7].
Nevertheless, rarely any specific visuo-spatial training tools are available for the preschool setting.
We have developed a tablet-based visuo-spatial intervention tool for preschoolers and implemented it in 5 Luxembourgish kindergarten classrooms.

METHOD

- **Participants & Design**

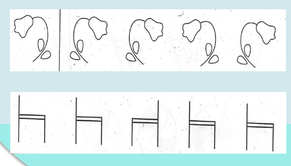
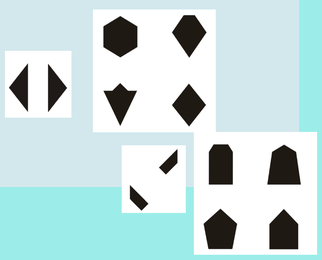
10 kindergarten classrooms from two schools in Luxembourg were recruited. Half of the classrooms were assigned to a "teaching as usual" control condition, whereas the other five classrooms received 20 sessions (two sessions per week) of visuo-spatial training (20 minutes per session). A total of ***N*=125** children (61 girls) participated in the study with a mean age of *M* = 5.49 years (*SD* = .63).

Intervention group (IG): *n* = 68
Control group (CG): *n* = 57



- **Assessment**

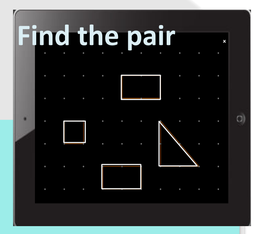
A specific assessment battery targeting visuo-spatial, symbolic and non-symbolic early numerical abilities has been compiled. All tests, besides the non-symbolic magnitude comparison task, were administered in paper-pencil version. Tests were administered during the three weeks before and after the intervention.

Tests assessing "**near transfer**"	Test assessing "**Intermediate transfer** "	Tests assessing "**Far transfer**"
• Spatial relations [4]  • Position in space [4] 	• Children's mental transformation task (CMTT) – shortened 12 item version [6] 	• Counting tasks • Number naming • Magnitude comparison (symbolic & non-symbolic) • Arithmetic [5] • Number line estimation [0-20]

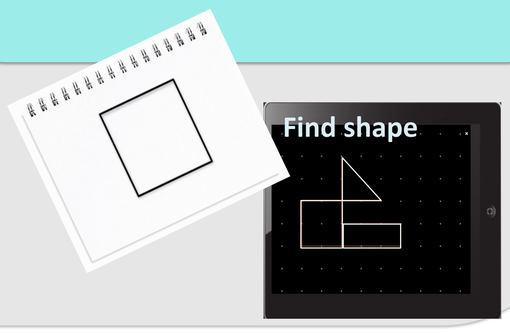
TRAINING TOOL

Training tasks:

- Find shape in a complex figure
- Tangram
- Complete the figure
- Copying tasks
- Find the pair / Odd one out
- Row completion
- Close the shape
- Symmetry
- Line and figure bisection
- Dot connection
- Rotation



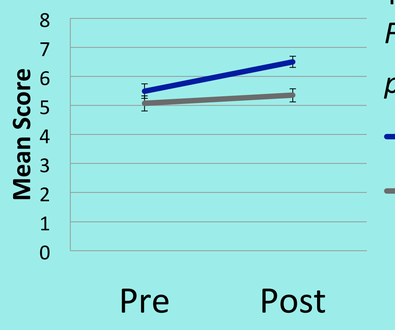
Tablet workspace is conceptualized as an electronic blackboard that can be used in combination with external material such as booklets.



RESULTS

Significant **near transfer** effects could be observed in the intervention group compared to the control group.
Measures of verbal and non-verbal intelligence were entered as covariates into the model.

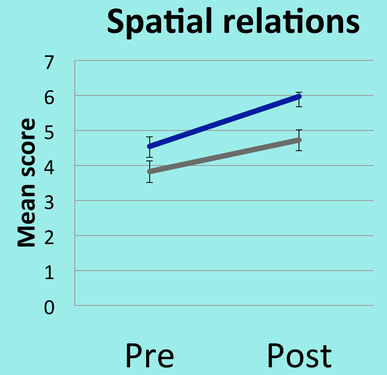
Position in space



Time x group:
$F(1,121) = 5.45$,
$p = .02^{*}$, $\eta_p^2 = .04$

IG
CG

Spatial relations

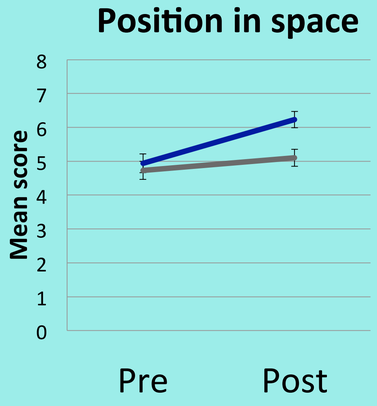


Time x group:
$F(1,121) = 2.34$,
$p = .13$ (n.s.), $\eta_p^2 = .02$

IG
CG

If we remove children scoring very high on tests of visuo-spatial abilities at pretest (> 4th quartile) from our sample, time x group interaction reaches statistical significance for both measures (*N* = 101; $n_{IG} = 52$, $n_{CG} = 49$).

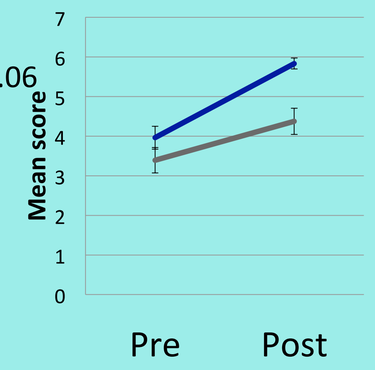
Position in space



Time x group:
$F(1,97) = 6.67$,
$p = .011^{**}$, $\eta_p^2 = .06$

IG
CG

Spatial relations



Time x group:
$F(1,97) = 5.0$
$p = .028^{*}$, $\eta_p^2 = .05$

IG
CG

No **intermediate** and no **far transfer** effects could be observed at this stage..

DISCUSSION

Near transfer effects on trained visuo-spatial abilities could be observed, but no gains on measures of mental transformation skills and early mathematical abilities could be observed.

Possible explanation: transfer to mathematical skills might only occur when formal math instruction has begun as visuo-spatial abilities are thought to provide an **early** foundation for **later** mathematics performance.

BIBLIOGRAPHY

1. Ansari, D., Donlan, C., Thomas, M. S., Ewing, S. A., Peen, T., & Karmiloff-Smith, A. (2003). What makes counting count? Verbal and visuo-spatial contributions to typical and atypical number development. *Journal of Experimental Child Psychology*, *85*(1), 50-62. doi: 10.1016/S0022-0965(03)00026-2
2. Assel, M., Landry, S., Swank, P., Smith, K., & Steelman, L. (2003). Precursors to mathematical skills: examining the roles of visual-spatial skills, executive processes, and parenting factors. *Applied Developmental Science*, *7*(1), 27-38. doi: 10.1207/S1532480XADS0701_3
3. Cheng, Y.-L., & Mix, K.S. (2014). Spatial training improves children's mathematics ability. *Journal of Cognition and Development, 15*(1), 2-11. doi: 10.1080/15248372.2012.725186
4. Frostig, M. (1973). *Test de développement de la perception visuelle [Developmental test of visual perception]*. Paris: Les éditions du centre de psychologie appliquée.
5. Grégoire, J., Noël, M., & Van Nieuwenhoven, C. (2004). *Tedi-Math*. Antwerpen: Harcourt.
6. Levine, S. C., Huttenlocher, J., Taylor, A., & Langrock, A. (1999). Early sex differences in spatial skill. Developmental Psychology, 35(4), 940–949. http://doi.org/10.1037/0012-1649.35.4.940
7. Verdine, B. N., Irwin, C. M., Golinkoff, R. M., & Hirsh-Pasek, K. (2014). Contributions of executive function and spatial skills to preschool mathematics achievement. Journal of Experimental Child Psychology, 126(0), 37–51. http://doi.org/10.1016/j.jecp.2014.02.012