Modifying Executive Function and Self-Regulatory Behaviours in Developmental Dyslexia: Cognitive and Neural Bases of Response Inhibition

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Background

Dyslexia is characterised by impaired reading, but socio-emotional problems typically co-occur (1). It is also associated with response inhibition (RI) impairments at the behavioural (2,3) and neural levels as indexed by reduced response-inhibition related P3 amplitude (4). Studies have shown that variability in RI is predictive of the severity of reading and socio-emotional problems in dyslexia (2,5), suggesting that RI may underpin these issues.

RI appears modifiable at the behavioural and neural levels with training (6,7). Therefore, RI training may improve RI (behavioural & neural), and reduce reading and socio-emotional problems in dyslexia. No study to date has explored whether RI is modifiable in dyslexia and whether training transfers to reduced symptoms.

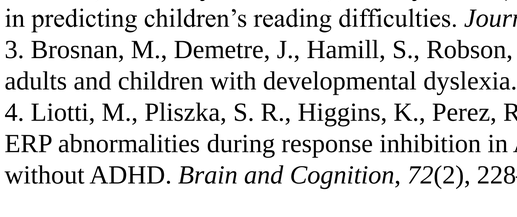
Method

Thirty children with dyslexia aged 10-12 years were randomly allocated to low non-adaptive (14) and high adaptive (16) arms of Go No-Go RI training (8). All participants trained 3 times per week for 6 weeks. The low dose group trained 6 mins per day at a stable No-Go frequency of 40%. The high dose group trained 20 mins per day and No-Go frequency adapted based on player performance.

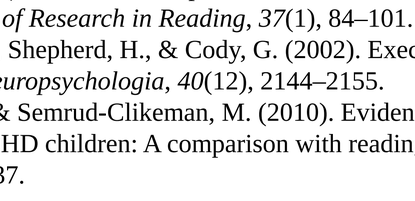
Pre-Post Assessments

1. Picture Go No-Go Task- 32 Channel EEG recording
2. Word Reading Subtest of WRAT-IV
3. Child Behaviour Checklist
4. Early Adolescent Temperament Scale

Training Game- Screen Play and Procedure



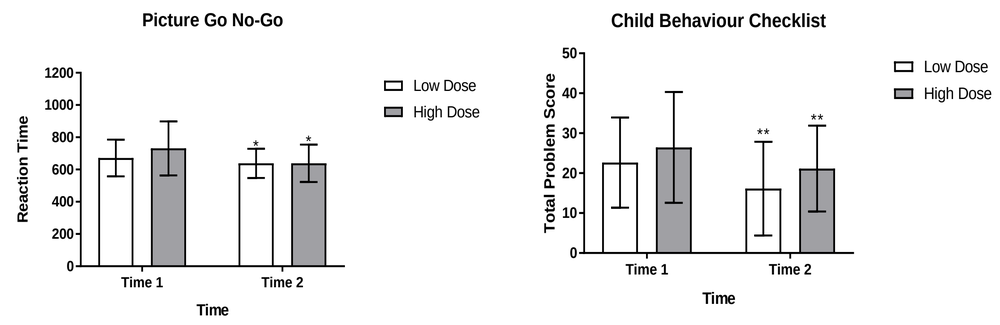
Panel A

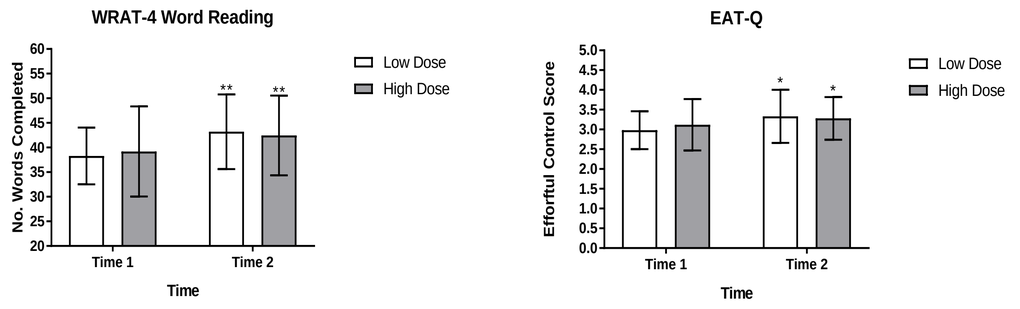


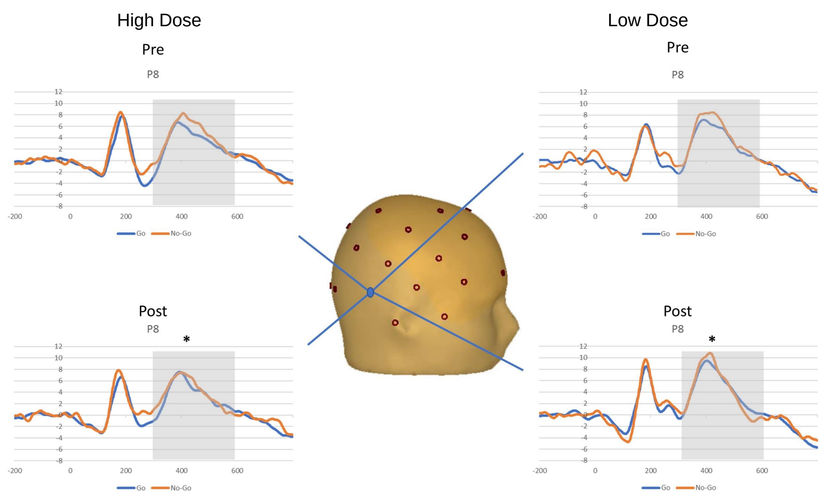
Panel B

Results

Training effects were explored with 2 (dose: high, low) x 2 (Time: pre, post) mixed design ANOVAs. There were no significant dose or dose*time interaction effects. There were significant main effects of time (*p<.05; **p<.01) for reduced RI reaction time, increased P3 amplitude, improved reading ability, reduced socio-emotional problems and improved self regulation. Reduced RI RT: ($F(1,27)=6.54$, $p=.011$, $\eta_p^2=.218$); Increased P3 Amp at P8: ($F(1,23)=6.33$, $p=.019$, $\eta_p^2=.21$); Improved Reading ability: ($F(1,28)=25.90$, $p=.000$, $\eta_p^2=.481$); Reduced Socio-Emotional problems: ($F(1,28)=9.16$, $p=.005$, $\eta_p^2=.246$); and Increased Effortful-Control: ($F(1,28)=7.01$, $p=.013$, $\eta_p^2=.200$)







Conclusions

- Both low non-adaptive and high adaptive doses of RI training significantly reduced RI RT, increased P3 amplitude, improved reading ability, reduced socio-emotional problems and increased effortful-control in children with dyslexia.
- This suggests that RI training can be a useful intervention for improving RI and symptom expression in children with dyslexia
- Future research should explore RI training in dyslexia with passive and active control groups to account for possible placebo effects

References

1. Mugnaini, D., Lassi, S., La Malfa, G., & Albertini, G. (2009). Internalizing correlates of dyslexia. *World Journal of Pediatrics*, *5*(4), 255–264.
2. Booth, J. N., Boyle, J. M. E., & Kelly, S. W. (2014). The relationship between inhibition and working memory in predicting children's reading difficulties. *Journal of Research in Reading*, *37*(1), 84–101.
3. Brosnan, M., Demetre, J., Hamill, S., Robson, K., Shepherd, H., & Cody, G. (2002). Executive functioning in adults and children with developmental dyslexia. *Neuropsychologia*, *40*(12), 2144–2155.
4. Liotti, M., Pliszka, S. R., Higgins, K., Perez, R., & Semrud-Clikeman, M. (2010). Evidence for specificity of ERP abnormalities during response inhibition in ADHD children: A comparison with reading disorder children without ADHD. *Brain and Cognition*, *72*(2), 228–237.
5. Wang, L.-C., & Yang, H.-M. (2014). Diverse Inhibition and Working Memory of Word Recognition for Dyslexic and Typically Developing Children. *Dyslexia*.
6. Benikos, N., Johnstone, S. J., & Roodenrys, S. J. (2013). Short-term training in the Go/Nogo task: Behavioural and neural changes depend on task demands. *International Journal of Psychophysiology*, *87*(3), 301–312.
7. Johnstone, S. J., Roodenrys, S., Blackman, R., Johnston, E., Loveday, K., Mantz, S., & Barratt, M. F. (2012). Neurocognitive training for children with and without AD/HD. *ADHD Attention Deficit and Hyperactivity Disorders*, *4*(1), 11–23.
8. Delany, D. (2015). *Complex Sustained Attention Trainer (CSAT)*. Waterford, Ireland: Waterford Institute of Technology.