Visual specialization for words in dyslectic and typically reading children

Fraga González, G. 1, Žarić, G. 4, Bonte, M. 4, Blomert, L. 4, Tijms, J. 1, 3, Van der Molen, M. W. 1, 2

1 Department of Psychology, University of Amsterdam, The Netherlands
2 Cognitive Science Center Amsterdam, The Netherlands
3 IWAL Institute, Amsterdam, The Netherlands
4 Department of Cognitive Neuroscience, University of Maastricht, The Netherlands

Introduction

Fluent readers develop expertise to decode visual information to access a series of speech sounds, and word meanings during reading. Dyslexia is a disorder in the neural network for reading, with dysfluent reading as its most persistent symptom (Gabrieli, 2009).

Alongside a core phonological deficit, impairment in fast visual word processing might contribute to the persistent lack of fluency in dyslexia (Helenius, Tarkkainen, Correllissen, Hansen, & Salmelin, 1999).

Functional neuroimaging studies suggest a Visual Word Form Area (VWFA) in left occipito-temporal regions specialized for print reading (McCandliss, Cohen, & Dehaene, 2003).

Electrophysiological data suggest that early N1 responses at around 200 ms are sensitive to word-likeness of stimuli and reading expertise (Maurer et al., 2003). Further, longitudinal studies suggest an inverted ‘U’ development in early word-specific activations after the first years of reading and atypical activation patterns in dyslectics (Maurer et al., 2011).

Goals

• Compare early visual responses in normal readers and dyslectics in school grade 3.

• Explore the sensitivity of visual ERPs using letter-like symbols as contrast stimuli to known words.

• Find correlations between word specific ERP responses and reading fluency measurements.

Methods

Participants

40 dyslectics: (age 9 ± 0.41), Grade 3
20 normal readers: (age 8.7 ± 0.35), Grade 3.

ERP experiment

Block design: 8 blocks
(3 x 2 string types x 2 length) 40 trials per block
Thal length: 700 ms
Inter-trial interval (ITI): 1350 ms
Stimuli:

• Words (CELEX database) and symbol strings (letter-like).

• Either short (4-5 characters) or long (6-7 characters).

Task:

• Button press when stimuli are read or immediate repetitions are detected (4 per block).

ERP analysis

Biosemi ActiveTwo system 64 scalp electrodes Epochs (-500 to 1550 ms) Artifact rejection: Manual and ICA Reference: average. Filter: 1-30 Hz

Statistics:

• Repeated Measures ANOVA

• Electrodes in analysis: P9, P7, P5, P10, P6, P6P7, PO3, PO8, PO4, PO1, PO2, O1, O2

Behavioral measurements

3DM:

• Letter-Gap sounds discrimination/identification

• Word Reading (HF,FP,Paladino)

• Spelling

• One Minute Test

• Test reading

Discussion

In line with previous studies N1 is found to be sensitive to string type. That is, N1 amplitude is enhanced to words relative to symbols. The enhancement of N1 amplitude is found for both groups.

The N1 word vs. symbol difference is larger for dyslectics compared to typical readers. In contrast to previous findings reported by Maurer (2011), the apparent discrepancy might be due to the type of symbol string; word-like in the current study vs. icon-like in the Maurer et al. study.

The current N1 data suggest a stronger reliance on visual encoding in dyslectics compared to typical readers. These data might be suggestive of a developmental delay in dyslectic children.

Finally, the positive correlations, albeit moderate, between N1 amplitudes and speed reading measures contribute to the validity of N1 vis-a-vis visual word processing.

References


